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PSO

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ORIGINAL ARTICLE

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The impact of armed conflicts on health-care utilization in Northern Nigeria: A difference-in-differences analysis

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Abstract

Women and children suffer worse health outcomes during armed conflicts. For more than a decade, Northern Nigeria has been facing one of the most violent armed conflicts in sub-Saharan Africa. Studies on the conflict's impact on healthcare utilization in the area are few. The aim of this study is to explore the effect of the protracted armed conflicts on healthcare utilization, measured by maternal care and child immunization, in Northern Nigeria. Data from the Armed Conflict Location and Events Data set are spatially merged to birth records from the Nigerian Demographic and Health Survey. An area is classified to be a conflict cluster if it is within a 5–10 km radius of conflict event(s) with at least one fatality. The difference-in-differences method is applied to estimate the effect of the armed conflicts on healthcare utilization in the area. We find that residing within a conflict cluster significantly reduces the probability of utilization of healthcare services. We conclude that robust policies and strategies to mitigate the adverse effects of the armed conflicts on healthcare delivery are necessary for the short run. In the long run, systematic efforts to identify and address the root causes of the conflict with a view to finding a lasting solution are necessary to improve health-care utilization in conflict-affected areas.

KEYWORDS
armed conflict, Boko Haram, immunization, insurgency, maternal healthcare, Nigeria

Highlights

- Armed conflict has an adverse effect on healthcare utilization in Northern Nigeria.
- Living in a rural area reduces the possibility of utilization of healthcare services in Northern Nigeria.
- Compared to their Muslim counterparts, Christian mothers are more likely to give birth in a health unit in Northern Nigeria.
- Armed conflict reduces the chances of child immunization in Northern Nigeria.
- Armed conflict hinders expectant mothers from attaining the minimum antenatal care visits.

INTRODUCTION

The protracted armed conflicts in Northern Nigeria, exacerbated by the Boko Haram Insurgence (BHI), have led to the breakdown of a health system already experiencing years of neglect and underfunding (Howell et al., 2020; IPI, 2019). Evidence shows that underfunding and insecurity are two major barriers to the provision and utilization of healthcare in conflict contexts (Ojeleke et al., 2022). Bertone et al. (2018) find that armed conflict affects the provision of healthcare by worsening pre-existing health system's weaknesses (Bertone et al., 2016, 2018). While the health status of the entire population deteriorates during armed conflicts and complex emergencies, women and children are particularly vulnerable and suffer worse health outcomes due to both biological and sociocultural factors (Algasseer et al., 2004; Howell et al., 2020; Kim et al., 2007; Moss et al., 2006). Specifically, the burden of conflict on maternal and child health (MCH) outcomes is frequently substantial and higher than available estimates suggest (Okiro & Ayieko, 2018).

The literature reports mixed findings on the impact of conflict on the provision and utilization of healthcare. Casey (2015) note that security concerns and disruption in essential medical supplies result in an inconsistent quality of reproductive healthcare services. In separate studies, Muyinda and Mugisha (2015) and Chi et al. (2015) observe that the destruction of physical infrastructure and health facilities during the war in Northern Uganda has a significant negative impact on the availability of health-care services. The weaponization of healthcare is another factor that can have severe consequences on the utilization of healthcare during armed conflict. Health workers may sometimes become collateral damages or even be deliberately targeted during armed conflict (Pannu, 2020). This can limit the availability of health workers due to the threat to their lives and have devastating consequences on the supply side of healthcare service.

In Northern Nigeria, like in most complex emergencies, the strategy of weaponization of healthcare is rife. This is a situation in which health facilities are attacked, health workers detained, kidnapped, or even killed, and international humanitarian laws deliberately violated to prevent access to healthcare (ACF, 2021). This has been linked to a shortage of health workers during armed conflict (Elamein et al., 2017; Fouad et al., 2017; Heisler et al., 2015; Mahase, 2019; Patel et al., 2017; Roucka, 2011).

In the context of the BHI, there have been studies on its effect on child nutrition, childhood wasting and stunting (Dunn, 2018; Ekhator-Mobayode & Abebe Asfaw, 2019; Iacoella &

Tirivayi, 2020), and on maternal healthcare (Chukwuma & Ekhator-Mobayode, 2019; Solanke, 2018). However, studies documenting the inherent difficulties plaguing healthcare delivery and utilization in Northern Nigeria as a result of the conflict are few. Therefore, the aim of this paper is to explore the impact of the protracted armed conflict on healthcare utilization in Northern Nigeria. More specifically, the study looks at how conflicts affect the use of maternal care (i.e., childbirth at health facilities and antenatal care visits during pregnancy) and child immunization (i.e., vaccination) by comparing it to the counterfactual, that is, whether these types of healthcare services would have had a higher likelihood of being used if the service users had not been exposed to the conflict.

This study adds to the existing literature by capturing the effect of conflict exposure on maternal healthcare utilization over a longer time horizon. It differs from other studies by measuring conflict in a way that captures the intensity of exposure rather than measuring the effect of being resident in a conflict region or not (Dunn, 2018). Unlike Chukwuma and Ekhator-Mobayode (2019), this study also looks at child immunization as an important indicator of health-care utilization.

To analyze the effect of armed conflict on healthcare use (HCU) in Northern Nigeria, we spatially merge geographical data on armed conflicts provided in the Armed Conflict Location and Events Data set (ACLED) with data from the nationally representative Nigerian Demographic and Health Survey (NDHS). A detailed description of the merging procedure is described in the section "Materials and methods." We apply the difference-in-differences (DID) technique to estimate the impact of conflict exposure on the utilization of health care. However, unlike previous studies (Chukwuma & Ekhator-Mobayode, 2019; Dunn, 2018), we use three waves of the NDHS. By using multiple waves of data, we are able to capture the effects of conflict on healthcare utilization over time.

CONTEXT

Boko Haram in Northern Nigeria

With a population of over 200 million at the end of 2019 (World Bank, 2020), Nigeria is the most populous nation in Africa and, with over 400 different ethnic nationalities and about 250 different languages, it is one of the most diverse countries in the world (Dunn, 2018; Heerten & Moses, 2014; Solanke, 2018). The country comprises 36 states and the Federal Capital Territory (i.e., Abuja). It is divided into six geopolitical zones: Northeast, Northwest, North-central, Southeast, Southwest, and South–South. The three zones in the Northern part of the country are inhabited by a predominantly Muslim population, while the inhabitants of the southern zones are predominantly Christian. Since the country's independence from Britain in 1960, the country has witnessed a civil war and many other conflicts as a result of overlapping cultural, ethnic, religious, political, and regional differences (Fjelde & Østby, 2014; Heerten & Moses, 2014; Onwuzuruigbo, 2010).

Since July of 2009, the Northern part of the country, especially the Northeast, has been engulfed in the most brutal conflict since its civil war and one of the most violent insurgencies in Africa. The insurgency campaign is waged by *Jama'atu Ahlis Sunnah Lidda'awati w'al Jihad* (popularly referred to as Boko Haram [BH]) with the objective to Islamize Nigeria, create an Islamic caliphate, and oppose Western ideologies (Comolli, 2015; Onapajo & Uzodike, 2012; Pannu, 2020).

Although BH has carried out sporadic attacks in parts of the Northwest and Northcentral, the insurgency has impacted more on the inhabitants of the Northeast, claiming more than 40,000 lives, and displaced over two million people in the six states of Borno, Bauchi, Yobe, Adamawa, Gombe, and Jigawa, and neighboring countries of Cameroon, Chad, and Niger

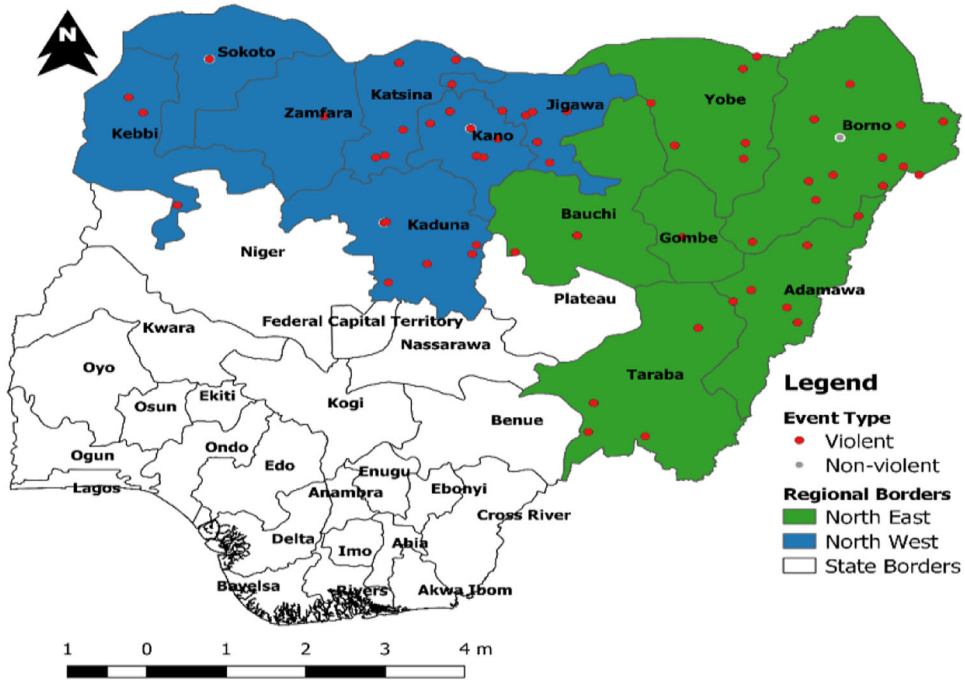

FIGURE 1 Northeast and Northwest Nigeria with respective violent incidents from 2004 to 2008

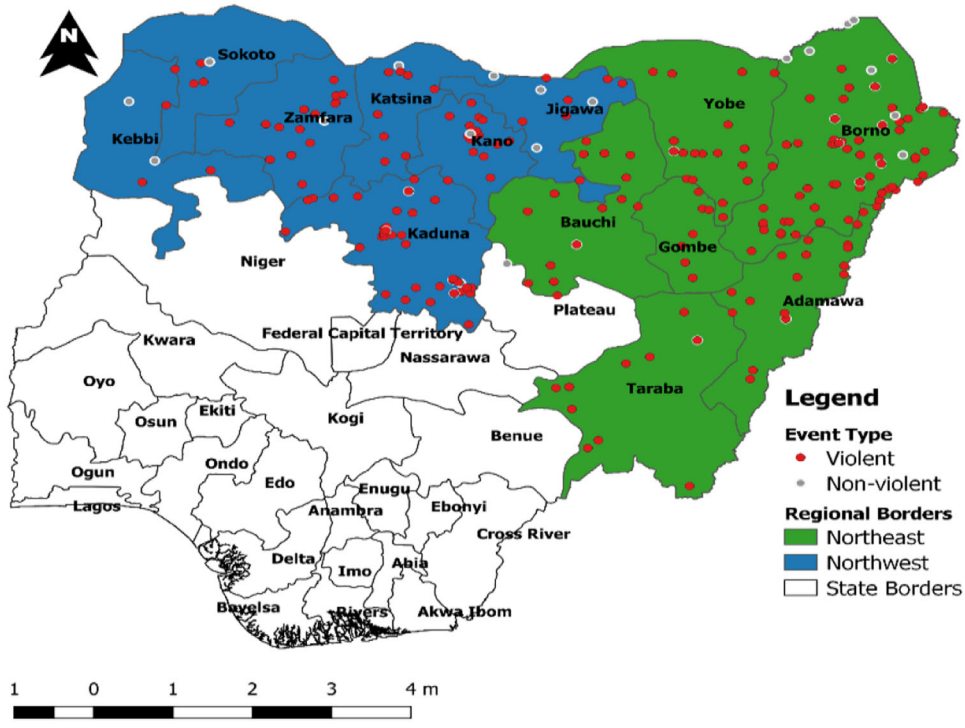

FIGURE 2 Northeast and Northwest Nigeria with respective violent incidents from 2009 to 2013

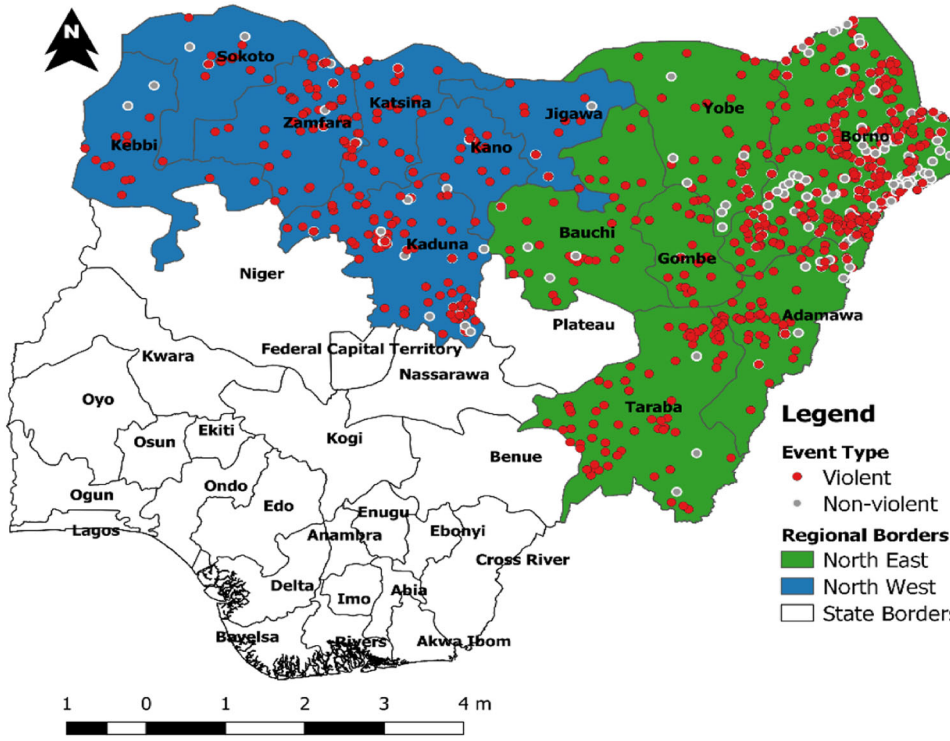

FIGURE 3 Northeast and Northwest Nigeria with respective violent incidents from 2014 to 2018

(Abdullahi et al., 2020; Grundy & Biggs, 2018; Okiro & Ayieko, 2018). Figures 1, 2, and 3 show the mapping of armed conflict incidents in Northern Nigeria between 2004 and 2008, 2009 and 2013, and 2014 and 2018, respectively. Evidence shows that the conflict is having devastating effects on the health of the people in the region. Care seekers find it overly challenging to use healthcare due to insecurity, disruption of healthcare services, emigration of healthcare providers, or outright destruction of health infrastructures (Abdullahi et al., 2020; ACF, 2021; Bertoni et al., 2019; Iyekekpolo, 2016; WHO, 2017).

The Nigerian health system

Nigeria runs a three-tiered public health system. Healthcare service delivery is decentralized between the Federal Ministry of Health (FMoH), the State Ministries of Health (SMoH), and the Local Government Area Health Departments (LGAHDs) (IPI, 2019). The FMoH is responsible for developing policies and guidelines, providing tertiary healthcare, and coordinating with other healthcare service providers. The SMoH provides secondary healthcare and gives technical support to LGAHDs. Primary healthcare delivery is the responsibility of the LGAHDs (Federal Ministry of Health, 2016; PharmAccess Foundation, 2015).

However, poor integration of the private and public health sectors, hard-to-reach locations, cost of service, and recurring industrial actions by health workers have impeded care service delivery in Nigeria (Federal Ministry of Health, 2016). Public health in Nigeria is also grossly underfunded. In 2016, only 4% of the national budget was allocated to health (Pannu, 2020). The result is extremely poor healthcare delivery in many parts of the country, especially in remote communities.

In addition to the inherent problems facing the country's healthcare system is the unabating conflicts, fueled by the BHI. Against this backdrop, considering the adverse effects these may have on healthcare delivery, coupled with the vulnerability of women and children in the region, it is important to investigate the impact of the armed conflicts on MCH outcomes in the region. Understanding these interactions will enable policymakers and other stakeholders to fashion out measures to mitigate the consequences of the conflict on the health system in the region in general and MCH outcomes in particular.

MATERIAL AND METHODS

Data sources

Two main sources of secondary data are utilized for this study. First, we use individual-level birth records data from three waves of the NDHS data sets collected by the ICF International in 2008, 2013, and 2018. The NDHS data sets are large, nationally representative, cross-sectional household data collected using a two-stage sampling technique. This method stratifies the country by administrative geography (i.e., region, states, and local government). In the first stage, a questionnaire is used to collect key characteristics of all the members and visitors in the selected households to identify the household member eligible for individual interview in the second stage. In the second stage, data are collected for children under the age of five, who are weighed, measured, and tested for anemia. In that second stage, data for men and data for women of reproductive age (i.e., 15–59 and 15–49, respectively) (DHS, 2018) are collected as well. Data from the three NDHS waves provide 92,036 birth records on MCH use, including antenatal care, birth experiences, and immunization in the 5 years preceding the survey.

Second, data on conflict events are drawn from the ACLED. The ACLED is a disaggregated data collection, analysis, and crisis mapping repository containing dates, actors, locations, and fatalities that occur during public disobedience, civil wars, and other forms of armed conflict across the globe ACLED (2020). While the ACLED collects real-time data on these variables, the NDHS data are available on a 5-year interval, namely, 2008, 2013, and 2018. In this study, fatal attacks are used to signify the severity of conflict incidents. For our analysis, all fatal incidents during the 5-year periods, 2004–2008, 2009–2013, and 2014–2018, respectively, are mapped to the 2008, 2013, and 2018 NDHS clusters.

Conceptual framework

To understand how armed conflict impacts healthcare utilization in Northern Nigeria, we applied the World Health Organization's social determinants approach (SDA) to healthcare during armed conflict (WHO, 2008). The SDA emphasizes health as a human right and makes it a legal obligation for states to ensure timely, acceptable, and affordable healthcare of appropriate quality to the citizenry (World Bank, 2020). However, the loss of human rights is a major characteristic of armed conflict contexts. The framework can be used to identify pathways through which conflict events can impact the health of the population either directly or indirectly. This approach identifies two prominent structural determinants typical of armed conflicts viz the loss of human rights and the breach of medical neutrality.

During armed conflicts, the loss of human rights can manifest itself in the form of a lack of dignified and secured living, loss of livelihood, lack of essential health and social services, and food insecurity. In addition, conflicts may also result in outright violation of medical neutrality when combatants deliberately create barriers and obstruct physical access to healthcare services by targeting health facilities, health workers, caregivers, and patients,

and they may also result in the mounting of roadblocks and checkpoints. In this context, the frequent and incessant assaults by the insurgency in Northern Nigeria are clear signs of the withdrawal of the rights of residents of the region (Matfess, 2017; Sato, 2019; Ukiwo, 2005; Yerima & Ranjit-Singh, 2017).

Conflict exposure

To capture all armed conflict incidents which may affect the provision and utilization of healthcare services, we follow d'Errico et al. (2021) and include all conflict incidents with at least one fatality irrespective of whether BH claimed responsibility or not. Using geocoordinates, we spatially match fatal incidents obtained from the ACLED data set to the clusters of the NDHS households based on the distance between each cluster and event locations over the survey years 2008, 2013, and 2018. In view of the absence of a standard definition for conflict exposure (Chukwuma & Ekhator-Mobayode, 2019), we classify a cluster to be within a conflict catchment area (and the household exposed to conflict) if it is located within a 5-km radius of conflict event (s) with at least one fatality. A similar measure of conflict exposure has been used in recent literature (Chukwuma & Ekhator-Mobayode, 2019; d'Errico et al., 2021).

On the assumption that the further away a cluster is from a conflict event, the lesser the consequence on the cluster, we vary the catchment area to a 10-km radius. This enables the testing of the sensitivity of our results to variation in distance. Higher distance thresholds are not considered because exposure to and impact of these attacks decay with distance. As shown in Chukwuma and Ekhator-Mobayode (2019), the farther away a cluster is from an attack location, the less directly and significantly affected they will be.

The study area encompasses two Northern regions of Nigeria, namely the Northeast and Northwest. Though similar in many respects, they differ in terms of conflict exposure, with households in the Northeast being more exposed to fatal attacks than the Northwestern part. In both regions, the ACLED data set identifies a total of 3129 fatal incidents resulting in 40,368 deaths between 2008 and 2018. More than 80% of the fatal attacks and about 81% of related fatalities over this period occur in the Northeast.

To investigate the effects of armed conflict on utilization of healthcare services in the two regions before and after the outset of the insurgency in 2009, we look at the short-term (using the 2008 and 2013 waves) and the long-term (using the 2008, 2013, and 2018 waves) effects of the conflict by comparing healthcare utilization pre-insurgency in 2008 and at the end of 2018.

To check the robustness of the results, the intensity of conflict exposure is also constructed by summing the number of fatalities in the location of an NDHS cluster (within 5 or 10 km radius, respectively) for each 5-year period, with higher levels of casualties signifying higher degrees of exposure.

Measurement of variables

Outcome variables

We use three outcome variables to capture the effects of armed conflict on the utilization of healthcare services in the two Northern Nigeria's regions:

1) Mothers' antenatal care visits: A dummy variable that takes the value of 1 if the mother reported having 4 and above antenatal care visits during pregnancy.
2) Vaccination: A dummy variable taking the value of 1 if the child has ever been immunized.

3) Place of childbirth: A dummy variable that takes the value of 1 if the childbirth is at a health facility.

All three variables are based on self-reported records.

Control variables

In addition to conflict exposure (i.e., living in a conflict area) and period, which are the main explanatory variables, other explanatory variables are grouped into three categories:

1) Household characteristics consist of the place of residence classified as either rural or urban, gender of household head classified as male or female, and religion is either Islam, Christianity, or other. Others are the number of people in the household, the number of under-fives in the household, and household wealth. They also include water source and toilet type, which are dummy variables taking the value of 1 if "improved." Distance of the household to a health facility is also a dummy variable taking the value of 1 if the distance is seen as a problem to getting medical help.
2) Mother's characteristics consist of mother's age, which may affect care-seeking habits, educational attainment, taking the value of 1 if a mother has some formal education (primary, secondary, or tertiary), and mother's employment status measured as currently working, which is a dummy variable taking the value of 1 if the mother works.

Those variables are included because they have been found to influence HCU as outlined above in previous sections.

Model specification and estimation strategy

To estimate the causal effects of exposure to conflict-related attacks on HCU, in the face of nonrandom assignment of dwelling places to conflict and nonconflict zones, we apply the DID estimator. DID is a quasi-experimental approach that accounts for changes in the outcome variable before and after the intervention (conflict exposure) as well as between treated (affected) and nontreated (placebo) groups. In this study, the outcome variables are indicators of HCU.

The utilization of healthcare is determined by many demographic, socioeconomic, political, and policy and institutional factors (as presented above). In this study, HCU is modeled as a function of conflict exposure, and other determinants, as expressed in Equation (1):

$$HCA_{ict} = \beta_0 + \beta_1 Confperiod_{it} + \beta_2 ConfExpo_{ct} + \beta_3 Confperiod_{it} \times ConfExp_{ct} + \beta_4 X_{ict} + \varepsilon_{ict}, \quad (1)$$

where HCU_{ict} is an indicator of HCU for mother/child i dwelling in cluster c at time t. Three binary outcome variables are considered as measures of HCU, antenatal care visits, childbirth at the health facility, and vaccination. $Confperiod_{it}$ stands for survey periods after 2009 when the first BHI incident was reported. It is a binary variable and is coded as 1 for post-2009 years (i.e., 2013 and 2018) and 0 for 2008. $ConfExpo_{ct}$ is a measure of conflict exposure, assuming the value 1 if the household is exposed to the conflict (within 5–10 km of the attack) and 0 otherwise. The interaction between *ConfExpo* and *Confperiod* captures respondents living within a conflict cluster/area after the BHI started. X_{ict} is a vector of control variables. It includes several environmental, household, caregiver, and child factors

that may influence healthcare utilization. Seasonal differences are accounted for by the month of the interview. Similarly, we control for the number of under-fives in a household as it may negatively affect the attention a particular child receives. Wealth is controlled by an index that accounts for assets and resources available to a household. The distance of a household to a health facility is controlled by a covariant, which measures if the distance to a health facility is a problem to getting medical help. Details of these control variables are presented in Table 1; ε_{ict} is the random error term.

To check the robustness of the result, conflict exposure is also measured as a continuous variable, that is, the number of conflict-related fatalities occurring within 5 or 10 km of the cluster, respectively. Regarding the rest of the model, the same specification is used as the one explained above.

Two sources of variation are exploited to identify the impact of conflict exposure by means of the DID estimator. The first source is the spatial distribution of attacks across the two Northern Nigeria. There are remarkable spatial variations in the incidence of attacks, the majority of which are targeted at households in the Northeast region (see Figures 1–3). In addition, the geographic distance between the place of residence (clusters) and attack locations varies across space. The second one is that the incidence of these events also varies over time. These sources of variation, along with the repeated cross-sectional data, enable us to estimate Equation (1) through the DID approach, with the interaction coefficient, β_3, being the parameter of interest. Under the assumption that, in the absence of conflict exposure, there are parallel trends in the outcome variables, the DID estimates are consistent. However, even in the absence of conflicts, government policies, social interventions, expansion in health infrastructure and other health reforms aimed at improving health outcomes in the study areas can cause some changes in the use of healthcare over time. This could violate the parallel trends assumption and thereby threaten the identification of the impact of conflict exposure on the outcome variables. While there is no direct test for this assumption, we control for time trend to capture some of these policy changes and developments across the regions over time.

RESULTS

Descriptive results

Table 1 presents the descriptions of outcome and explanatory variables, summary statistics by area/cluster of residence and for each survey year, and the results of *t* tests for difference-in-means. In general, the descriptive results show significant differences in the characteristics of households/individuals in the conflict and nonconflict clusters, where conflict cluster is defined as living 5 or 10 km from conflict, respectively. These significant differences persist over time. Before the insurgency, the proportion of mothers reporting at least 4 antenatal care visits in 2008 are 52.8% and 77.3% in nonconflict and conflict areas, respectively. The rate of antenatal care visits increases over time, reaching 85.6% (nonconflict area) and 90.5% (conflict area) in 2018. In 2008, only 43% and 42.1% of children in nonconflict and conflict-affected clusters, respectively, have ever received vaccination. However, significant differences emerge post-2008 era as the proportion of children ever vaccinated drops significantly to 8.4% and 7.5% in nonconflict and conflict-affected clusters, respectively. Only 1% (nonconflict area) and 35.1% (conflict area) of childbirths occurred at a health facility in 2008. Though significantly higher (and declining) in conflict areas, the proportion of births in health facilities improved slightly in nonconflict areas over time. These low levels of vaccination and childbirth at a health facility are reflective of the precarious state of healthcare utilization in Northern Nigeria due to the conflicts. Overall, the strongly

TABLE 1 Description of variables and summary statistics

(1)	(2)	2008 (3)	(4)	(5)	2013 (6)	(7)	(8)	2018 (9)	(10)	(11)
Variable	**Description**	**Nonconflict cluster**	**Conflict cluster**	**Diff**	**Nonconflict cluster**	**Conflict cluster**	**Diff**	**Nonconflict cluster**	**Conflict cluster**	**Diff**
Outcome variable										
Antenatal	Dummy = 1 if antenatal visits >4 during pregnancy, 0 otherwise	0.528 (0.499)	0.773 (0.419)	−0.245***	0.776 (0.417)	0.845 (0.361)	−0.070***	0.859 (0.348)	0.905 (0.293)	−0.0461***
Vaccination	Dummy = 1 if child is ever vaccinated, 0 otherwise	0.430 (0.495)	0.421 (0.494)	−0.009	0.281 (0.449)	0.235 (0.424)	0.045***	0.084 (0.277)	0.075 (0.263)	0.009***
Place of childbirth	Dummy = 1 if childbirth is at health facility, 0 otherwise	0.100 (0.300)	0.351 (0.478)	−0.251***	0.115 (0.320)	0.311 (0.463)	−0.196***	0.152 (0.359)	0.348 (0.476)	−0.197***
Household characteristics										
Urban	Residence in urban area	0.132 (0.339)	0.775 (0.418)	−0.642***	0.101 (0.301)	0.724 (0.447)	−0.623***	0.129 (0.335)	0.684 (0.465)	−0.555***
Male	Household head is male	0.956 (0.206)	0.950 (0.219)	0.006	0.958 (0.200)	0.926 (0.262)	0.032***	0.962 (0.192)	0.936 (0.245)	0.026***
Islam	Practices Islamic religion	0.876 (0.329)	0.940 (0.237)	−0.064***	0.901 (0.299)	0.901 (0.299)	−0.000	0.921 (0.270)	0.865 (0.342)	0.056***
Christian	Practices Christianity	0.108 (0.310)	0.057 (0.231)	0.0515***	0.0891 (0.285)	0.0966 (0.295)	−0.00757*	0.074 (0.262)	0.135 (0.342)	−0.061***
Other	Practices other religion	0.016 (0.124)	0.003 (0.056)	0.0124***	0.010 (0.099)	0.002 (0.049)	0.008***	0.005 (0.072)	0.001 (0.021)	0.005***

(Continues)

TABLE 1 (Continued)

(1)	(2)	2008 (3)	2008 (4)	2008 (5)	2013 (6)	2013 (7)	2013 (8)	2018 (9)	2018 (10)	2018 (11)
Variable	**Description**	**Nonconflict cluster**	**Conflict cluster**	**Diff**	**Nonconflict cluster**	**Conflict cluster**	**Diff**	**Nonconflict cluster**	**Conflict cluster**	**Diff**
No. in household	No. in household is between 1 and 5	0.344 (0.475)	0.301 (0.459)	0.043***	0.261 (0.439)	0.281 (0.449)	−0.020***	0.217 (0.412)	0.241 (0.428)	−0.024***
	No. in household is between 6 and 10	0.475 (0.499)	0.437 (0.496)	0.038***	0.505 (0.500)	0.450 (0.498)	0.055***	0.487 (0.500)	0.476 (0.499)	0.011*
	No. in household is >10	0.181 (0.385)	0.262 (0.440)	−0.081***	0.234 (0.423)	0.269 (0.444)	−0.035***	0.296 (0.456)	0.283 (0.450)	0.013**
Period of interview	Period of interview was Feb–Apr	-	-		0.580 (0.494)	0.624 (0.484)	−0.044***	-	-	
	Period of interview was May–Jul	0.383 (0.486)	0.562 (0.496)	−0.179***	0.420 (0.494)	0.376 (0.484)	0.044***	-	-	
	Period of interview was Aug–Oct	0.617 (0.486)	0.438 (0.496)	0.179***	-	-		-	-	
Children under-five	Children under-five in household is 1	0.247 (0.431)	0.201 (0.401)	0.046***	0.263 (0.440)	0.295 (0.456)	−0.032***	0.302 (0.459)	0.380 (0.486)	−0.079***
	Children under-five in household is 2–4	0.687 (0.464)	0.679 (0.467)	0.008	0.659 (0.474)	0.627 (0.484)	0.033***	0.608 (0.488)	0.572 (0.495)	0.036***
	Children under-five in household >4	0.065 (0.247)	0.119 (0.324)	−0.054***	0.0781 (0.268)	0.0787 (0.269)	−0.001	0.0897 (0.286)	0.0472 (0.212)	0.043***
Household wealth	Dummy = 1 if household is wealthy, 0 otherwise	0.245 (0.430)	0.858 (0.349)	−0.613***	0.202 (0.402)	0.732 (0.443)	−0.530***	0.240 (0.427)	0.703 (0.457)	−0.463***

TABLE 1 (Continued)

(1)	(2)	2008 (3)	2008 (4)	2008 (5)	2013 (6)	2013 (7)	2013 (8)	2018 (9)	2018 (10)	2018 (11)
Variable	**Description**	**Nonconflict cluster**	**Conflict cluster**	**Diff**	**Nonconflict cluster**	**Conflict cluster**	**Diff**	**Nonconflict cluster**	**Conflict cluster**	**Diff**
Type of water source	Dummy = 1 if water source is improved, 0 otherwise	0.369 (0.483)	0.660 (0.474)	0.291***	0.459 (0.498)	0.738 (0.440)	0.279***	0.417 (0.493)	0.518 (0.500)	0.101***
Type of toilet	Dummy = 1 if toilet type is improved, 0 otherwise	0.456 (0.498)	0.817 (0.387)	−0.361***	0.442 (0.497)	0.794 (0.405)	−0.352***	0.364 (0.481)	0.773 (0.419)	−0.408***
Mother's characteristics										
Current age	Mother's age in years	28.68 (7.434)	29.00 (6.930)	−0.321	30.63 (7.438)	30.91 (7.224)	−0.280**	32.32 (7.493)	33.19 (7.218)	−0.878***
Education attainment	Dummy = 1 if mother has some formal education, 0 otherwise	0.074 (0.261)	0.205 (0.404)	−0.131***	0.075 (0.263)	0.261 (0.439)	−0.186***	0.087 (0.281)	0.329 (0.470)	−0.242***
Currently working	Dummy = 1 if mother is working, 0 otherwise	0.535 (0.499)	0.503 (0.500)	0.032**	0.620 (0.485)	0.608 (0.488)	0.012	0.607 (0.488)	0.655 (0.475)	−0.047***
Child characteristics										
Male	Child is male	0.507 (0.500)	0.510 (0.500)	−0.003	0.508 (0.500)	0.515 (0.500)	−0.008	0.514 (0.500)	0.500 (0.500)	0.0140**
Age	Child's age in months	2.915 (4.931)	2.701 (4.243)	0.214	5.223 (6.042)	4.742 (4.836)	0.481***	7.449 (7.091)	6.974 (6.021)	0.475***
Age sq	Child's age squared	32.81 (150.0)	25.28 (127.3)	7.526*	63.78 (202.9)	45.87 (152.6)	17.91***	105.8 (248.7)	84.88 (194.8)	20.89***

(Continues)

TABLE 1 (Continued)

(1)	(2)	2008 (3)	2008 (4)	2008 (5)	2013 (6)	2013 (7)	2013 (8)	2018 (9)	2018 (10)	2018 (11)
Variable	**Description**	**Nonconflict cluster**	**Conflict cluster**	**Diff**	**Nonconflict cluster**	**Conflict cluster**	**Diff**	**Nonconflict cluster**	**Conflict cluster**	**Diff**
Health insurance	Dummy = 1 if birth is covered by health insurance, 0 otherwise	0.002 (0.040)	0.013 (0.115)	−0.012***	0.006 (0.075)	0.018 (0.131)	−0.012***	0.014 (0.116)	0.046 (0.208)	−0.032***
Distance	Dummy = 1 if distance to health facility is problem to getting medical help, 0 otherwise	0.440 (0.496)	0.208 (0.406)	0.232***	0.398 (0.490)	0.176 (0.381)	0.223***	0.337 (0.473)	0.154 (0.361)	0.183***
N	Total observations	6294 (45%)	7734 (55%)		12,122 (39%)	18,921 (61%)		18,927 (40%)	28,038 (60%)	

Note: Data *N* (%), mean coefficients, and SD within parentheses. In this analysis, exposure is measured as having at least one fatality within 5 km of Demographic and Health Survey cluster of residence. The *z* values are for the two-sample *z* test with equal variances (Ho: difference in means = 0 and Ha: difference in means ≠ 0).

*$p < 0.10$.
**$p < 0.05$.
***$p < 0.01$.

significant *t* statistics point to the presence of significant differences in health utilization outcomes in both areas over time.

Most conflict-affected households reside in the Northeast region. As typical of most patriarchal societies, most households are male-headed, with Islam being the predominant religion in the region. Interestingly, the proportion of households practicing Islamic religion declined in conflict-affected areas from 94% in 2008% to 86.5% in 2018, whilst those practicing Christianity in conflict-hit areas more than doubled from 5.7% in 2008% to 13.5% in 2018.

In terms of size, most households in the study areas have 6–10 members, followed by 1–5 members. Compared to 43.7% (conflict area) and 47.5% (nonconflict area) in 2008, the proportion of households with 6–10 members increased to 47.6% (conflict area) and 48.7% (nonconflict area) in 2018. In all waves, more than two-thirds of the sampled households have two to four under-five children irrespective of conflict exposure. Whilst this proportion declined over time, households with one under-five child rather increased from 24.7% (conflict) and 20.1% (nonconflict) in 2008% to 30.2% (conflict) and 38% (nonconflict) respectively in 2018. The proportion of wealthy households declined in both conflict and nonconflict areas between 2008 and 2018. Overall, the *t* tests show that there are statistically significant differences in household wealth status, with those in conflict-hit areas doing relatively better than those in nonconflict clusters. This also reflects in the significant differences in access to improved water sources and improved toilet facilities.

Furthermore, formal education among women is generally low in both regions, with only a marginal improvement over time. The proportion of mothers with some formal education is significantly higher in conflict areas than in nonconflict areas across the three waves, rising from 20.5% (conflict) and 7.4% (nonconflict) in 2008% to 32.9% (conflict) and 8.7% (nonconflict) in 2018. The statistics also show an increase in the percentage of working mothers over time, up from 53.5% (nonconflict) and 50.3%% (conflict) in 2008% to 60.7% (nonconflict) and 65.5% (conflict) in 2018.

These differences are statistically significant in 2018, with a higher proportion of working mothers in conflict areas than in nonconflict areas (in contrast with pre-BHI period). Health insurance coverage remains disturbingly low in both regions and has only improved marginally between 2008 and 2018. In 2008, the proportion of women reporting distance as a hindrance to getting medical help stood at 44% and 20.8% in nonconflict and conflict areas, respectively. These proportions decline, however, over time to 33.7% (nonconflict) and 15.4% (conflict) in 2018, possibly reflecting general infrastructural improvements in the health sector and the economy at large. However, there are persistent significant differences across the regions, with those in nonconflict areas being significantly more constrained by distance.

The impact of armed conflict on antenatal visits

Table 2 reports the results of the impact of armed conflict on antenatal care visits. To aid the understanding of the results, the following must be noted. The estimated coefficients are odds ratios from logistic regressions of the DID model in Equation (1). There are two groups of results distinguished by the distance used in constructing conflict exposure. Models 1–3 refer to the results when conflict exposure is based on a 5 km distance between cluster and the location of conflict/attack; Models 4–6 are the results when the 10 km distance threshold is applied. Lastly, for each distance threshold, the results are differentiated by the sample used for the estimation.

For the 5 km specifications (Models 1–3), the positive coefficients of conflict exposure show that, on average, mothers residing in conflict clusters have significantly higher odds

TABLE 2 Effect of armed conflict on antenatal visits (healthcare utilization)

	Dependent variable: Antenatal visits (=1 if at least four visits, 0 otherwise)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Conflict exposure	1.51*** (4.64)	1.54*** (4.81)	1.65*** (5.69)	1.81*** (7.73)	1.85*** (7.97)	1.93*** (8.64)
Period	2.72*** (27.41)	5.22*** (51.31)	3.88*** (56.15)	2.75*** (27.40)	5.26*** (49.19)	3.89*** (54.66)
Conflict exposure # period	0.57*** (−5.86)	0.59*** (−5.27)	0.58*** (−5.90)	0.53*** (−7.60)	0.54*** (−7.25)	0.55*** (−7.62)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported in parenthesis, are *z* statistics based on robust standard errors. Other variables relating to household, mother, and child characteristics are controlled for (see Table 1 for full list). # indicate model numbers.

***$p < 0.01$.

(1.51–1.65 times) of making the minimum four antenatal care visits than those in nonconflict clusters. As shown in Models 4–6, this relationship remains positive and statistically significant even at 10 km radius of the conflict catchment area. Similarly, the coefficients of period (or the common time trend) suggest that the odds of undertaking 4 or more antenatal care visits increase significantly over time by 2.72–5.26 times, regardless of being within a conflict zone or not. This reflects the general improvement in healthcare utilization over time, possibly because of health-related policy change and interventions by government and nongovernmental organizations.

The coefficients of interest are those of the interaction term. The results show that conflict exposure exerts a significantly negative impact on antenatal visits as a marker of healthcare utilization. That is, all other things being equal, living in the conflict area significantly lowers the odds of expectant mothers making the minimal antenatal care visits to a healthcare unit. Women in a conflict area are 0.6 as likely to attain the minimum number of antenatal visits (Models 1–3) as women located in a nonconflict area. As demonstrated in Models 4–6, the results remain robust at 10 km.

The impact of armed conflict on childbirth at a health facility

Childbirth at a health facility is another important indicator of healthcare utilization that can be impacted by armed conflicts, as shown in Table 3. On average, mothers residing in conflict clusters have significantly higher odds (1.44–1.57 times for 5 km cut-off distance) of giving birth in a health facility than those in nonconflict clusters. However, relative to residing in a nonconflict cluster, the estimates suggest that exposure to conflict significantly reduces the odds of a woman giving birth at a health facility. For a woman dwelling within the 5 km catchment area of attacks, the odds of childbirth at a health facility are 0.72–0.82 of those not residing in a conflict area. But at the 10 km cut-off distance, the relative odds of health center childbirth are reduced by a multiple of 0.2. These adverse effects of conflicts on women's likelihood of giving birth at a health unit are statistically significant at 1% or 5% levels.

The impact of armed conflict on child immunization

Estimates of the impact of the conflict-related fatal attacks on child immunization are presented in Table 4. On average, child immunization in conflict clusters has significantly lower odds (0.81–0.86 times for 5 km cut-off distance) than nonconflict clusters, which is different from the results for visits and childbirth at a health facility. Like antenatal visits and childbirth at a health facility, the results show that exposure to conflict events impedes child immunization as well. In particular, the odds of a child being immunized are 0.74–0.98 if the conflict incident occurs within 5 km, and 0.62–0.82 when the attacks are located within 10 km to mother's place of residence, relative to children in nonconflict areas. Except for Model 2, the estimated coefficients are statistically significant. This implies that exposure to conflict events significantly hinders child immunization.

The impact of control variables

Although the impact of conflict exposure is the main explanatory variable of interest, other covariates have been controlled for to account for their influence on the utilization of healthcare. While the effects of some control variables are consistent across all specifications, others have mixed

TABLE 3 Effect of armed conflict on childbirth at a health facility (hospital utilization)

	Dependent variable: childbirth at a health facility (=1 if birth is at a health facility, 0 otherwise)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Conflict region	1.44*** (4.07)	1.54*** (4.81)	1.57*** (5.09)	1.40*** (4.30)	1.42*** (4.46)	1.47*** (5.00)
Period	1.20*** (3.37)	1.97*** (15.80)	1.64*** (14.50)	1.18*** (3.02)	1.96*** (14.97)	1.60*** (13.39)
Conflict region # period	0.72*** (−3.46)	0.82** (−2.03)	0.79*** (−2.63)	0.80*** (−2.71)	0.84** (−2.15)	0.83** (−2.36)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. Other variables relating to household, mother, and child characteristics are controlled for (see Table 1 for full list). # indicate model numbers.

**$p < 0.05$.

***$p < 0.01$.

TABLE 4 Effect of armed conflict on child immunization (healthcare utilization)

	Dependent variable: vaccination (=1 if child has ever been vaccinated, 0 otherwise)					
	Model1	Model 2	Model 3	Model 4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Conflict region	0.81**	0.87	0.86*	0.96	1.01	1.02
	(−2.42)	(−1.63)	(−1.73)	(−0.60)	(0.16)	(0.22)
Period	1.78***	0.21***	0.56***	1.87***	0.22***	0.60***
	(14.06)	(−40.94)	(−21.56)	(15.00)	(−37.46)	(−18.38)
Conflict region # period	0.74***	0.98	0.76***	0.63***	0.82**	0.62***
	(−3.23)	(−0.22)	(−3.04)	(−5.70)	(−2.31)	(−6.17)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. Other variables relating to household, mother, and child characteristics are controlled for (see Table 1 for full list). # indicate model numbers.

*$p < 0.10$.
**$p < 0.05$.
***$p < 0.01$.

effects. The results show that, compared to Islam, being a Christian is significantly associated with a higher probability that a woman has at least four antenatal care visits, that a child is delivered at a health facility, and that the child is vaccinated.

Household wealth is also found to play an important role in health-care utilization by significantly increasing the odds of having the minimum antenatal care visits, giving birth in a facility as well as a child being immunized. That is, the wealthier the household, the more likely they are to utilize healthcare services. Households with access to improved sanitation and good hygiene practices are also found to have significantly higher odds of achieving the minimum antenatal visits, giving birth at a health unit, and getting their child vaccinated. Maternal education and employment are also estimated to exert positive and statistically significant effects on the utilization of healthcare services. Specifically, the results indicate that, compared to uneducated and nonworking mothers, women who have (some) formal education and mothers who are working are significantly more likely to achieve the recommended number of antenatal care visits, deliver at a health facility and have their child immunized.

On the other hand, residing in rural areas is associated with significant reductions in the odds of attaining these healthcare outcomes. Similarly, distance to a health facility is found to act as a limiting factor to achieving any of the three measures of health-care utilization. The results show that mothers who identify the distance to a health facility as a major challenge are also less likely to go for antenatal visits, give birth at a health unit, and have their children immunized. Having health insurance, mother's age, improved toilet facility, and the number of household members are found to have no robust or any discernible effects on our measures of utilization of healthcare.

Robustness checks

A key finding from the foregoing results is that armed conflict significantly impedes the utilization of healthcare. In this section, we assess the robustness of these results to an alternative measure of conflict exposure. We also explore heterogeneity in the results based on the place of residence and the religion of the household head.

Instead of being measured as a dummy variable, conflict exposure can also be measured in continuous terms, showing the number of conflict-related fatalities that occur within 5 or 10 km of household's cluster. Unlike the binary indicator, the number of conflict-induced fatalities captures the intensity of the conflict or conflict-related events to which people are exposed. The ensuing abridged DID estimates of the effects of the conflicts on our measures of healthcare utilization are presented in Tables 5 and 6 (see Appendices A, B and C for the full results). The results show that an additional conflict-related death reduces the odds of achieving the minimum antenatal care visits by 0.1 units if the fatal incident occurs within 5 km or by 1 unit if the attack happens within 10 km. Similarly, one more life lost to armed conflicts results in a unit reduction in the odds that childbirth is at a health facility, all other things being equal. These results are largely consistent with those obtained from using a dummy variable to capture conflict. Hence, in terms of the direction of effect and statistical significance, the results are robust to the alternative ways of measuring conflict exposure.

While the results have resoundingly shown that conflict exposure significantly hinders healthcare utilization, it is also possible that the impacts of armed conflicts on these outcomes differ across different categories of individuals/households. To explore this, we analyze the differential impacts of the conflict on urban and rural areas as well as religious groups. The results are reported in Appendices D and E. Relative to residents in urban areas, the results show significant reductions in the odds of women in rural areas attaining the minimum number of antenatal care visits, and giving birth in a health facility, following conflict incidents within 5 and 10 km of their cluster.

TABLE 5 Effect of armed conflict on antenatal visits with conflict as a continuous variable

	Dependent variable: antenatal (=1 if at least four visits, 0 otherwise)					
	Model1	Model2	Model3	Model4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Total death in cluster	1.01***	1.01***	1.01***	1.00***	1.00***	1.00***
	(5.08)	(5.12)	(4.80)	(–4.58)	(–4.82)	(–4.47)
Period	2.64***	5.20***	23.83***	2.65***	5.29***	3.87***
Total death in cluster # period	0.99***	0.99***	0.99***	1.00***	1.00***	1.00***
	(–5.19)	(–5.33)	(–4.93)	(–4.58)	(–4.82)	(–4.47)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. Other variables relating to household, mother, and child characteristics are controlled for (see Table 1 for full list). # indicate model numbers.

***$p < 0.01$.

TABLE 6 Effect of armed conflict on childbirth at health facility (hospital utilization) with conflict as a continuous variable

	Dependent variable: childbirth at a health facility (=1 if birth of child is at a health facility, 0 otherwise)					
	Model1	Model2	Model3	Model4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Total death in cluster	1.00*** (4.26)	1.00*** (4.24)	1.00*** (3.66)	1.00*** (3.87)	1.00*** (3.43)	1.00*** (2.86)
Period	1.16*** (2.79)	2.07*** (17.42)	1.65*** (15.70)	1.16*** (2.75)	2.07*** (17.45)	1.65*** (15.61)
Total death in cluster # period	1.00*** (−3.92)	1.00*** (−4.24)	1.00*** (−3.58)	1.00*** (−3.43)	1.00*** (−3.78)	1.00*** (−2.90)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported in parenthesis, are *z* statistics based on robust standard errors. Other variables relating to household, mother and child characteristics are controlled for (see Table 1 for full list). # indicate model numbers.

***$p < 0.01$.

Another source of heterogeneity relates to religion. With the BHI and its related attacks being motivated by the religious beliefs of a radical Islamic sect, it is likely that these acts of violence will have differential impacts on different religious groups in the area. However, the results in Appendices F and G show the attacks having no significant impact on the odds of antenatal visits and childbirth at a health facility among women from Islamic households relative to those from other religions.

DISCUSSION

This study examines the effect of armed conflicts on health-care utilization in Northern Nigeria. To the best of our knowledge, this study is the first to analyze the impact of armed conflicts on health-care utilization in Northern Nigeria using three waves of the NDHS. Although we observe some improvements in healthcare utilization over time, most probably because of community mobilization and patient education activities of aid organizations (Muyinda & Mugisha, 2015), the impact of conflict incidents is negative. Irrespective of whether a conflict is measured as a binary or a continuous variable, the DID estimates of the effects of the conflict on healthcare utilization are largely consistent and robust.

The findings of this study indicate that armed conflict adversely affects healthcare utilization in Northern Nigeria. We find that expectant mothers residing within the areas of conflict-related attacks are 0.6 as likely to meet the minimum number of antenatal care visits as women located in nonconflict areas. The finding is not surprising and can be explained by the fact that fatal attacks limit physical movement in the region and consequently prevent the use of health facilities (Chukwuma & Ekhator-Mobayode, 2019). This underscores the need to get care services closer to the population by revitalizing primary healthcare and encouraging the training of local community health workers who could be remotely monitored through telemedicine from safer locations. Remote monitoring of medical activities has been found to be a highly effective strategy in conflict contexts where care service delivery proves to be difficult due to movement restrictions and attacks on health facilities (Liddle et al., 2013).

The finding that exposure to conflict significantly reduces the odds of a woman giving birth at a health facility and that conflict events also hinder child immunization in the conflict cluster are not farfetched. Armed conflict has been found to worsen health systems by disrupting medical activities, exacerbating the shortage of skilled health workers and destroying health facilities (Bertone et al., 2018). Furthermore, a significant number of women mention distance as a problem to getting medical help. The inability to afford the cost of transport can be a serious barrier to seeking necessary care in resource-poor areas (Muzyamba et al., 2017; Patel et al., 2017). This is consistent with prior expectations because rural areas are largely underserved with health facilities, thereby limiting households in rural areas from utilizing health-care services (Muyinda & Mugisha, 2015; Roucka, 2011).

More importantly, having to travel long distances to a health facility increases the chances of being attacked, abducted, or even killed by the BHI rebels. Incessant conflict-induced attacks and the resulting insecurity call for innovative approaches to care delivery. One approach is to engage and train traditional birth attendants and other auxiliary health workers to provide basic MCH services in the affected communities. While this may not be a lasting solution, it can act as a short-term strategy to get care services to those who need them most. Although international aid organizations are complementing government's efforts by providing health-care assistance to the conflict-affected population (ACF, 2021; MSF, 2021), such assistance is often basic, sometimes such aid does not get to the most vulnerable populations and is mostly not context-specific (Ganle, 2015; Howell et al., 2020; Kotsadam et al., 2018; Muzyamba et al., 2017).

At a time when the World Health Organization is increasingly advocating traditional and alternative medicine (TAM) as a complement to the orthodox approach to health-care

delivery, especially in resource austere environment like Northern Nigeria (Oyabode et al., 2016; WHO, 2013), another approach, albeit radical, would be for policymakers and other stakeholders to encourage alternative care and incorporate TAM into the formal health system. This may be a useful strategy because traditional care providers operate closer to the people and are less susceptible to attacks because of their proximity. They can be part of the "on-the-ground-team" that carries on health-care delivery during armed conflicts when physical access to health facilities is difficult.

We observe that child vaccination is also affected by the conflict. This is consistent with previous studies, which indicate that movement restrictions occasioned by tense security situations do damage to or lead to outright destruction of health infrastructure and shortage of health workers, which hinder mass vaccination campaigns. Evidence shows that irrespective of the availability of resources, deliberate targeting of vaccinators results in a substantial reduction in vaccination activities (Grundy & Biggs, 2018; Mahase, 2019; Sato, 2019).

In addition, compared to Islam, being a Christian is significantly associated with better outcomes regarding antenatal care visits, childbirth at a health facility, and child immunization. This result is consistent with the findings in Ganle (2015) that religious obligations inhibit Muslim women from using skilled healthcare services in Northern Ghana. Moreover, an increasing proportion of households are converting to Christianity, which belief system favors antenatal care visits, childbirth at a health facility, and child immunization. This increased swing in favor of a "Western religion" among other factors has been cited as one of the underlying drivers of the BHI in Northern Nigeria (Bertoni et al., 2019; Iyekekpolo, 2016).

The differential impact of conflict is also worthy of note. We analyze the differential impacts of the conflicts on urban and rural areas as well as on religious groups. As expected, relative to residents in urban areas, there exist significant reductions in the odds of women in rural areas attaining the recommended minimum antenatal care visits and giving birth at a health facility following fatal attacks within 5 and 10 km of their residential cluster. Because most of the attacks are motivated by the religious beliefs of a radical Islamic sect (i.e., BH), it is expected that the attacks will have more severe impacts on communities practicing religions other than Islam, especially in the Northeast where BHI is predominant. Counterintuitively, findings show that the conflict has no significant impact on the odds of antenatal visits as well as childbirth at a health facility among women from Islamic households relative to those from other religions. This finding contradicts prior expectation that the BH, being an Islamic sect, would disrupt the provision of health-care services more in areas with a high concentration of non-Muslim households (Silvestri et al., 2015). However, this may be because BH's ideology opposes "Western" education and general ways of life (Mahase, 2019; Yerima & Ranjit-Singh, 2017), and so, anyone with a contrary opinion to this ideology, irrespective of religion, is termed an *infidel* and is subject to attacks (Gurses and Ozturk, 2020). This finding is very instructive and vital for the planning and deployment of MCH resources. Decision makers should note that BHI attacks are indiscriminate, irrespective of religious affiliation of the population, and therefore, equal priority should be given to every community in the area with respect to mobilization and provision of health-care resources.

LIMITATIONS

This study is not without some limitations. First, the inclusion of all fatal incidents, irrespective of whether BH claimed responsibility or not, may have influenced the outcome of the analysis. Although not many fatal incidents are reported in Northern Nigeria other than the BHI for the period under study, the magnitude and/or the direction of such few fatal incidents are not separately analyzed in this study and may have biased the results. Second, the study does not account for the difference between households in host communities, where problems of proximity to and austerity of healthcare resources might be more pronounced due to the conflict and in internally

displaced persons' camps, where healthcare resources are more readily available due to the activities of several aid organizations. Finally, there is the likelihood of unidentified confounding created by some extraneous factors which may influence both the exposure (i.e., conflict) and outcome (i.e., health outcomes) variables.

CONCLUSIONS AND POLICY IMPLICATIONS

Armed conflict can have devastating consequences on health-care delivery and utilization. As shown by our results, the armed conflicts in Northern Nigeria further exacerbate the challenges facing the health in a country with an already weak health system by further hindering health-care service delivery and utilization. Although based on our findings, the negative impact of the conflict on healthcare utilization is substantial and extends farther than the conflict area; it would be myopic to conclude that the conflict is the sole driver of healthcare delivery challenges in Northern Nigeria, though it establishes the fact that exposing the population to the conflict significantly lowers the likelihood of using healthcare services.

The results of this study highlight the need for creative approaches to and a paradigm shift in the way healthcare is provided to the conflict-affected population of Northern Nigeria, and particularly, the Northeastern part of the country. In the short term, there is a need for robust policies and strategies to mitigate the adverse effects of the BHI and other conflict incidents on healthcare utilization. Constituting an "on-the-ground-team" of health workers from members of the community to be remotely controlled from safer locations, can also prove effective. Considering the increasing popularity of alternative medicines as a complement to "regular" healthcare delivery, traditional care providers can be incorporated into the formal health system as a part of the "on-the-ground-team" of health workers.

Ultimately, a systematic effort to identify and address the root causes of the conflict with a view to finding a lasting solution is necessary to improve healthcare delivery and utilization in the region.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

ETHICS STATEMENT

Ethical approval for this type of study is not required by our institution. All authors have reviewed the final manuscript and have approved its submission for publication.

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APPENDIX A:

Table A1

TABLE A1 Effect of armed conflicts on antenatal care visits (healthcare utilization)

	Dependent variable: antenatal visits (=1 if at least four visits, 0 otherwise)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Conflict exposure	0.51*** (4.64)	1.54*** (4.81)	1.65*** (5.69)	1.81*** (7.73)	1.85*** (7.79)	1.93*** (8.64)
Period	2.72*** (27.41)	5.22*** (51.31)	3.88*** (56.15	2.75*** (27.40)	5.26*** (49.19)	3.89*** (54.66)
Conflict exposure # period	0.57*** (−5.86)	0.59*** (−5.27)	0.58*** (−5.90)	0.53*** (−7.60)	0.54*** (−7.25)	0.55*** (−7.62)
Place of residence (ref: urban)						
Rural	0.73*** (−7.80)	0.71*** (−7.77)	0.79*** (−7.08)	0.76*** (−7.00)	0.74*** (−7.16)	0.81*** (−6.30)
Household gender (ref: male)						
Female	1.15 (2.55)	1.05 (0.72)	1.12** (2.33)	1.15** (2.43)	1.04 (0.60)	1.12** (2.25)
Religion (ref: Islam)						
Christian	1.44*** (8.20)	1.43*** (6.78)	1.48*** (9.83)	1.45*** (8.25)	1.42*** (6.73)	1.48*** (9.74)
Other	0.86 (−1.51)	0.74** (−2.08)	0.88 (−1.19)	0.86 (−1.49)	0.74** (−2.06)	0.89 (−1.18)
Household members (ref: 1–5)						
6–10						

(Continues)

TABLE A1 (Continued)

	Dependent variable: antenatal visits (=1 if at least four visits, 0 otherwise)					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
	5 km to conflict location			**10 km to conflict location**		
	2008/2013	**2013/2018**	**All years**	**2008/2013**	**2013/2018**	**All years**
	OR (z value)	**OR (z value)**	**OR (z value)**	**OR (z value)**	**OR (z value)**	**OR (z value)**
	1.0 4	1.08**	1.11***	1.04	1.08**	1.11***
	(1.44)	(2.27)	(4.19)	(1.53)	(2.36)	(−2.28)
>10	0.96	0.99	1.05	0.96	1.00***	1.05
	(−1.02)	(−0.15)	(1.35)	(−0.95)	(−0.09)	(1.40)
Period of interview (ref: Aug–Oct)						
Feb-Apr	1.24***	-	0.71***	1.24***	-	0.72***
	(4.64)		(−13.58)	(4.62)		(−11.40)
May-Jul	1.12***	1.13***	0.75***	1.12***	1.13***	0.76***
	(3.08)	(3.30)	(−12.36)	(3.19)	(3.44)	(−11.94)
Under five in household						
(ref: 1)						
2-4	1.48***	1.39***	1.33***	1.48***	1.39***	1.33***
	(14.59)	(10.83)	(12.32)	(14.58)	(10.80)	(12.33)
>4	1.73***	1.65***	1.54***	1.73**	1.65***	1.55***
	(9.88)	(7.89)	(9.20)	(9.90)	(7.92)	(9.26)
Wealth index						
Wealthy	1.55***	1.52***	1.48***	1.53***	1.50***	1.46***
	(13.15)	(11.30)	(13.77)	(12.71)	(10.92)	(13.33)
Source of water supply						
Improved	1.05*	1.07**	1.06***	1.04*	1.06**	1.06***
	(1.93)	(2.55)	(3.02)	(1.74)	(2.34)	(2.78)
Toilet type						
Improved						

TABLE A1 (Continued)

	Dependent variable: antenatal visits (=1 if at least four visits, 0 otherwise)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
	1.00	1.03	1.05**	1.04*	1.02	1.04**
	(0.10)	(1.17)	(2.45)	(1.66)	(0.73)	(2.03)
Mother's age	1.03***	1.03***	1.04***	1.03***	1.03***	1.04***
	(15.16)	(−16.05)	(−24.69)	(15.09)	(15.97)	(24.64)
Mother's education						
Mother has some formal education	1.85***	1.61***	1.63***	1.84***	1.60***	1.63***
	(11.58)	(8.45)	(11.40)	(11.52)	(8.35)	(11.31)
Mother currently working						
Yes	1.11***	1.16***	1.13***	1.11***	1.16***	1.13***
	(4.64)	(5.73)	(6.16)	(4.68)	(5.72)	(1.48)
Health insurance						
Yes	2.14***	1.23	1.47***	2.19***	1.23	1.48***
	(2.87)	(1.58)	(3.28)	(2.96)	(1.61)	(3.29)
Distance	0.78***	0.84***	0.78***	0.78***	0.84***	0.78***
	(−10.97)	(−6.45)	(−12.70)	(−10.90)	(−6.45)	(−12.67)
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. # indicate model numbers.

*$p < 0.10$.
**$p < 0.05$.
***$p < 0.01$.

APPENDIX B:

Table B1

TABLE B1 Effect of armed conflicts on childbirth at a health facility (Hospital utilization)

	Dependent variable: childbirth at a health facility(=1 if birth of child is at a health facility, 0 otherwise)					
	Model1	Model2	Model3	Model4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Conflict exposure	1.44*** (4.07)	1.54*** (4.81)	1.57*** (5.09)	1.40*** (4.30)	1.42*** (4.46)	1.47*** (5.00)
Period	1.20*** (3.37)	1.97*** (15.80)	1.64*** (14.50)	1.18*** (3.02)	1.96*** (14.97)	1.60*** (13.39)
Conflict exposure # period	0.72*** (−3.46)	0.82** (−2.03)	0.79*** (−2.63)	0.80*** (−2.71)	0.84** (−2.15)	0.83** (−2.36)
Place of residence (ref: urban)						
Rural	0.55*** (−14.24)	0.64*** (−11.32)	0.64*** (−14.26)	0.56*** (−13.77)	0.63*** (−13.04)	0.63*** (−15.33)
Household gender (ref: male)						
Female	0.97 (−0.39)	0.90* (−1.38)	0.94 (−1.19)	0.97 (−0.45)	0.91* (−1.32)	0.94 (−1.10)
Religion (ref: Islam)						
Christian	2.94*** (22.31)1.	2.01*** (13.78)	2.46*** (23.95)	2.93*** (22.25)	2.00*** (13.58)	2.43*** (23.50)
Other	22 (1.11)	1.00 (−0.13)	1.26 (1.40)	1.22 (1.08)	1.00 (0.01)	1.26 (1.39)
Household members (ref: 1–5)						

TABLE B1 (Continued)

	Dependent variable: childbirth at a health facility(=1 if birth of child is at a health facility, 0 otherwise)					
	Model1	Model2	Model3	Model4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
6–10	0.88*** (–3.41)	0.93* (–1.87)	0.94** (–2.23)	0.88*** (–3.40)	0.93* (–1.89)	0.94** (–2.28)
>10	0.90** (–1.98)	0.88*** (–2.66)	0.90*** (–2.93)	0.90** (–1.98)	0.88*** (–2.71)	0.89*** (–2.99)
Period of interview (ref: Aug–Oct)						
Feb–Apr	1.16** (2.13)	-	0.71*** (–12.09)	1.16** (2.14)	-	0.72*** (–11.40)
May–Jul	0.98 (–0.45)	0.99 (–0.19)	0.67*** (–14.30)	0.98 (–0.46)	0.99 (–0.16)	0.67*** (–13.97)
Under five in household (ref: 1)						
2–4	1.18*** (4.29)	1.47*** (10.52)	1.39*** (11.55)	1.18*** (4.34)	1.48*** (10.60)	1.40*** (11.68)
>4	1.20** (2.50)	1.50*** (6.12)	1.45*** (7.09)	1.21** (2.56)	1.51*** (6.22)	1.46*** (7.26)
Wealth index						
Wealthy	2.96*** (27.34)	2.54*** (24.70)	2.60*** (32.53)	2.94*** (27.13)	2.53*** (24.70)	2.59*** (32.44)
Source of water supply						
Improved	1.05 (1.33)	1.18*** (5.68)	1.12*** (4.64)	1.04 (1.11)	1.18*** (5.60)	1.11*** (4.40)
Toilet type						

(Continues)

TABLE B1 (Continued)

	Dependent variable: childbirth at a health facility(=1 if birth of child is at a health facility, 0 otherwise)					
	Model1	Model2	Model3	Model4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Improved	1.00 (0.10)	1.10*** (2.85)	1.07*** (2.72)	0.99 (−0.18)	1.11*** (3.08)	1.07*** (2.58)
Mother's age	0.98*** (−8.72)	0.97*** (−13.91)	0.97*** (−16.63)	0.98*** (−8.76)	0.97*** (−13.83)	0.97*** (−16.59)
Mother's education						
Mother has some formal education	2.97*** (26.29)	3.20*** (29.16)	3.01*** (36.06)	2.95*** (26.14)	3.20*** (29.33)	3.01*** (36.04)
Mother currently working						
Yes	1.02 (0.54)	1.18*** (5.51)	1.11*** (4.66)	1.02 (0.60)	1.18*** (5.48)	1.12*** (4.69)
Health insurance						
Yes	1.19 (1.24)	0.99 (−0.06)	1.06 (0.73)	1.18 (1.18)	1.00 (0.01)	1.05 (0.63
Distance	0.65*** (−11.89)	0.79*** (−6.44)	0.69*** (−13.36)	0.65*** (−11.87)	0.79*** (−6.39)	0.69*** (−13.35)
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. # indicate model numbers.

*$p < 0.10$.
**$p < 0.05$.
***$p < 0.01$.

APPENDIX C:

Table C1

TABLE C1 Effect of armed conflicts on child immunization

	Dependent variable: vaccination (=1 if child has ever been vaccinated, 0 otherwise)					
	Model1	Model 2	Model3	Model 4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Conflict exposure	0.81**	0.87	0.86*	0.96	1.01	1.02
	(−2.42)	(−1.63)	(−1.73)	(−0.60)	(0.16)	(0.22)
Period	1.78***	0.21***	0.56***	1.87***	0.22***	0.60***
	(14.06)	(−40.94)	(−21.56)	(15.00)	(−37.46)	(−18.38)
Conflict exposure # period	0.74***	0.98	0.76***	0.63***	0.82**	0.62***
	(−3.23)	(−0.22)	(−3.04)	(−5.70	(−2.31)	(−6.17)
Place of residence (ref: urban)						
Rural	0.96	1.04	0.93**	0.98	1.07	0.94*
	(−0.91)	(0.92)	(−2.11)	(−0.44)	(1.46)	(−1.78)
Household gender (ref: male)						
Female	1.17***	1.18**	1.18***	1.17***	1.18**	1.18***
	(2.79)	(2.28)	(3.25)	(2.78)	(2.21)	(3.12)
Religion (ref: Islam)						
Christian	1.11**	1.54***	1.05	1.13***	1.55***	1.07*
	(2.42)	(8.11)	(1.16)	(2.70)	(8.27)	(1.68)
Other	0.67***	0.56***	0.55***	0.67***	0.56***	0.55***
	(−3.39)	(−3.39)	(−4.94)	(−3.37)	(−3.36)	(−4.91)
Household members (ref: 1–5)						

(Continues)

TABLE C1 (Continued)

	Dependent variable: vaccination (=1 if child has ever been vaccinated, 0 otherwise)					
	Model1	Model 2	Model3	Model 4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
6–10	1.06* (1.83)	1.02 (0.64)	1.03 (1.20)	1.06* (1.82)	1.03 (0.66)	1.03 (1.22)
>10	0.98 (−0.41)	0.98 (−0.44)	0.91** (−2.45)	0.98 (−0.49)	0.98 (−0.40)	0.91** (−2.42)
Period of interview (ref: Aug–Oct)						
Feb–Apr	0.53*** (−12.56)	-	2.68*** (34.82)	0.52*** (−12.71)	-	2.59*** (33.44)
May–Jul	0.53*** (−16.02)	0.52*** (−16.50)	1.65** (−19.18)	0.53*** (−16.04)	0.52*** (−16.51)	1.62*** (18.28)
Under five in household (ref: 1)						
2–4	1.44*** (11.32)	1.39*** (8.33)	1.39*** (11.81)	1.43*** (11.30)	1.38*** (8.23)	1.39*** (11.66)
>4	1.36*** (5.15)	1.21** (2.57)	1.26*** (4.46)	1.35*** (5.12)	1.20** (2.45)	1.25*** (4.27)
Wealth index						
Wealthy	1.23*** (5.85)	1.23*** (4.99)	1.14*** (4.35)	1.23*** (5.82)	1.22*** (4.88)	1.15*** (4.44)
Source of water supply						
Improved	1.05* (1.73)	1.04 (1.14)	1.07*** (3.09)	1.05** (1.98)	1.03 (0.99)	1.08*** (3.32)
Toilet type						

TABLE C1 (Continued)

	Dependent variable: vaccination (=1 if child has ever been vaccinated, 0 otherwise)					
	Model1	Model 2	Model3	Model 4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)	OR (z value)
Improved	0.82*** (−7.15)	0.84*** (−5.29)	0.82*** (−8.18)	0.84*** (−6.61)	0.84*** (−5.26)	0.83*** (−7.65)
Mother's age	1.00 (1.19)	1.00 (1.22)	1.00 (−0.05)	1.00 (1.27)	1.00 (1.18)	1.00 (−0.06)
Mother's education						
Mother has some formal education	1.04 (0.96)	1.08 (1.45)	1.00 (0.02)	1.06 (1.26)	1.08 (1.50)	1.01 (0.23)
Mother currently working						
Yes	1.40*** (13.23)	1.28*** (8.02)	1.40*** (14.97)	1.39*** (13.10)	1.28*** (8.08)	1.40*** (14.88)
Child's gender (ref: male)						
Female	1.07*** (2.60)	1.04 (1.31)	1.06*** (2.60)	1.07*** (2.67)	1.04 (1.30)	1.06*** (2.64)
Child's age	4.43*** (66.67)	3.26*** (37.68)	3.96*** (68.35)	4.43*** (66.71)	3.27*** (37.70)	3.97*** (68.44)
Child's age squared	0.71*** (−78.76)	0.74*** (−42.14)	0.72*** (−82.74)	0.71*** (−78.80)	0.74*** (−42.16)	0.72*** (−82.81)
Health insurance						
Yes	0.73* (−1.92)	0.76* (−1.84)	0.68*** (−3.37)	0.78 (−1.48)	0.76* (−1.82)	0.71*** (−3.09)

(Continues)

TABLE C1 (Continued)

	Dependent variable: vaccination (=1 if child has ever been vaccinated, 0 otherwise)					
	Model1	**Model 2**	**Model3**	**Model 4**	**Model5**	**Model6**
	5 km to conflict location			**10 km to conflict location**		
	2008/2013	**2013/2018**	**All years**	**2008/2013**	**2013/2018**	**All years**
	OR (*z* value)	**OR (*z* value)**	**OR (*z* value)**	**OR (*z* value)**	**OR (*z* value)**	**OR (*z* value)**
Distance	1.05*	0.90***	1.08***	1.05**	0.90***	1.08***
	(1.93)	(−3.24)	(3.41)	(1.97)	(−3.25)	(3.45)
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. # indicate model numbers.

*$p < 0.10$.
**$p < 0.05$.
***$p < 0.01$.

APPENDIX D:

Table D1

TABLE D1 Differential effect of living in a rural area on antenatal care visits in conflict areas

	Dependent variable: Antenatal visits (=1 if at least four visits, 0 otherwise)					
	Model1	Model2	Model3	Model4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR	OR	OR	OR	OR	OR
Conflict exposure	1.08 (0.74)	1.07 (0.64)	1.08 (0.72)	1.22** (1.99)	1.22* (1.93)	1.23** (2.03)
Period	1.62*** (6.13)	2.71*** (12.24)	2.15*** (11.29)	1.61*** (5.72)	2.70*** (11.32)	2.13*** (10.63)
Conflict exposure # period	0.94 (−0.45)	1.09 (0.63)	1.02 (0.15)	0.91 (−0.78)	1.01 (0.06)	0.96 (−0.36)
Rural	0.52*** (−10.81)	0.49*** (−11.64)	0.49*** (−11.72)	0.53*** (−10.34)	0.50*** (−11.13)	0.50*** (−11.14)
Conflict exposure # rural	1.82*** (2.59)	1.94*** (2.85)	1.79** (2.46)	1.85*** (3.70)	1.95*** (3.98)	1.80*** (3.45)
Period # rural	1.79*** (7.44)	2.10*** (8.79)	1.96*** (9.48)	1.82*** (7.29)	2.13*** (8.29)	1.97*** (9.13)
Conflict exposure # period # rural	0.51*** (−2.59)	0.45*** (−3.04)	0.53** (−2.54)	0.50*** (−3.70)	0.43*** (−4.31)	0.52*** (−3.64)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. Other variables relating to household, mother, and child characteristics are controlled for (see Appendix A for full list). # indicate model numbers.

*$p < 0.10$.
**$p < 0.05$.
***$p < 0.01$.

APPENDIX E:
Table E1

TABLE E1 Differential effect of living in a rural area on hospital utilization in conflict areas

	Dependent variable: childbirth at a health facility(=1 if birth of child is at a health facility, 0 otherwise)					
	Model1	Model2	Model3	Model4	Model5	Model6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR	OR	OR	OR	OR	OR
Conflict exposure	0.98 (−0.21)	0.93 (−0.72)	0.96 (−0.39)	0.99 (−0.09)	0.93 (−0.75)	0.98 (−0.26)
Period	0.73*** (−3.92)	1.05 (0.64)	0.94 (−0.99)	0.70*** (−4.11)	1.08 (0.96)	0.93 (−1.16)
Conflict exposure # period	1.34** (2.54)	1.71*** (4.65)	1.51*** (3.83)	1.37*** (2.77)	1.52*** (3.77)	1.84*** (3.52)
Rural	0.36*** (−15.03)	0.35*** (−16.00)	0.36*** (−15.64)	0.36*** (−14.71)	0.35*** (−15.48)	0.36*** (−15.15)
Conflict exposure # rural	4.22*** (5.69)	4.42*** (5.91)	3.88*** (5.28)	1.94*** (3.55)	2.05*** (3.83)	1.84*** (3.28)
Period # rural	1.96*** (8.26)	2.44*** (11.10)	2.16*** (10.56)	2.01*** (7.93)	2.30*** (9.63)	2.12*** (9.70)
Conflict exposure # period # rural	0.14*** (−7.01)	0.17*** (−6.47)	0.19*** (−6.21)	0.42*** (−4.10)	0.40*** (−4.48)	0.46*** (−4.02)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. Other variables relating to household, mother, and child characteristics are controlled for (see Appendix A for full list). # indicate model numbers.

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**$p < 0.05$.

***$p < 0.01$.

APPENDIX F:

Table F1

TABLE F1 Differential effect of Islam on antenatal care visits in conflict areas

	Dependent variable: Antenatal visits (=1 if at least four visits, 0 otherwise)					
	Model1	Model2	Model3	Model4	Model5	Model 6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR	OR	OR	OR	OR	OR
Conflict exposure	1.96 (1.20)	2.04 (1.27)	1.82 (1.05)	2.50*** (2.59)	2.52*** (2.59)	2.65*** (2.69)
Period	2.78*** (12.88)	4.89*** (14.47)	3.63*** (18.00)	2.83*** (12.80)	5.02*** (12.31)	3.67*** (17.42)
Conflict exposure # period	0.80 (−0.37)	0.56 (−0.98)	0.73 (−0.53)	0.49* (−1.81)	0.43** (−2.19)	0.46** (−2.08)
Islam	1.19 (1.62)	1.36** (2.09)	1.10 (0.85)	1.20 (1.64)	1.36** (2.09)	1.10 (0.88)
Conflict exposure # Islam	0.76 (−0.48)	0.75 (−0.51)	0.90 (−0.18)	0.71 (−0.94)	0.73 (−0.88)	0.72 (−0.89)
Period # Islam	0.97 (−0.36)	1.07 (0.62)	1.07 (0.94)	0.96 (−0.45)	1.05 (0.37)	1.06 (0.78)
Conflict exposure # period # Islam	0.71 (−0.55)	1.04 (0.07)	0.78 (−0.43)	1.09 (0.22)	1.28 (0.62)	1.20 (0.48)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. Other variables relating to household, mother, and child characteristics are controlled for (see Appendix A for full list). # indicate model numbers.

*$p < 0.10$.
**$p < 0.05$.
***$p < 0.01$.

APPENDIX G:

Table G1

TABLE G1 Differential effect of Islam on hospital utilization in conflict areas

	Dependent variable: childbirth at a health facility(=1 if birth of child is at a health facility, 0 otherwise)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	5 km to conflict location			10 km to conflict location		
	2008/2013	2013/2018	All years	2008/2013	2013/2018	All years
	OR	OR	OR	OR	OR	OR
Conflict exposure	1.94	2.19	1.89	1.61	1.73*	1.75*
	(1.36)	(1.59)	(1.29)	(1.61)	(1.84)	(1.81)
Period	1.19*	1.27**	1.35***	1.24**	1.23*	1.40***
	(1.92)	(2.34)	(3.90)	(2.34)	(1.76)	(4.18)
Conflict exposure # period	0.48	0.50	0.50	0.52**	0.64	0.51**
	(−1.46)	(−1.38)	(−1.37)	(−2.05)	(−1.40)	(−2.10)
Islam	0.81	0.81	0.65**	0.82	0.89	0.66**
	(−1.16)	(−0.46)	(−2.49)	(−1.07)	(−0.48)	(−2.37)
Conflict exposure # Islam	0.74	0.74	0.85	0.86	0.86	0.87
	(−0.62)	(−0.60)	(−0.31)	(−0.48)	(−0.48)	(−0.44)
Period # Islam	1.02	1.69***	1.27***	0.95	1.73***	1.19**
	(0.16)	(5.01)	(2.83)	(−0.56)	(4.58)	(2.00)
Conflict exposure # period # Islam	1.53	1.61	1.56	1.59	1.27	1.63
	(0.83)	(0.92)	(0.87)	(1.42)	(0.73)	(1.50)
Control	Yes	Yes	Yes	Yes	Yes	Yes
N	45,071	40,517	71,560	45,071	40,517	71,560

Note: The results are based on logistic regression. The coefficients are odds ratios (ORs). Reported within parenthesis are *z* statistics based on robust standard errors. Other variables relating to household, mother, and child characteristics are controlled for (see Appendix A for full list). # indicate model numbers.

*$p < 0.10$.
**$p < 0.05$.
***$p < 0.01$.

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The effect of price on cigarette consumption among youth in Indonesia: Implications for tobacco tax policy

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Abstract

The study aimed to estimate cigarette price elasticity among youth in Indonesia. We used a two-part model to estimate the impact of price on smoking participation and smoking intensity on smokers. Data were obtained from National Socioeconomic Survey or *Survei Sosial Ekonomi Nasional* 2015, 2016, 2017, 2019, and 2020. This study included males and females aged 15–24 years from all districts. We controlled for socio-economic variables such as age, sex, education, working status, marital status, wealth quintile, place of residence, geographical region, and year of the survey. Price was negatively associated with cigarette consumption. The estimated total cigarette price elasticity was approximately −0.6740, meaning a 10% increase in price would reduce cigarette consumption by 6.74%. We also found that females were more sensitive to price change than males. This result indicated that the percentage change in demand for cigarettes among youth is less than the percentage change in price or inelastic. Therefore, a higher tariff and simpler tobacco tax structure is necessary to make cigarettes less affordable in Indonesia.

KEYWORDS

cigarette, demand, Indonesia, price, tax, tobacco, youth

Key points

- Price was negatively and significantly associated with youth smoking behavior, indicating that pricing policy through taxation would reduce smoking behavior among youth in Indonesia.
- The demand for cigarettes among youth in Indonesia was inelastic to price change. Thus, a substantial

increase in tobacco tax is necessary to make the cigarette price less affordable.
- A simpler tobacco tax structure is also needed to create less variability in cigarette prices. Hence, the smokers would not switch to a lowered price brand when the tobacco tax was increased.

INTRODUCTION

Indonesia is an upper-middle-income country considered the tobacco industry's "Disneyland" (Webster, 2013). The country is the world's third-largest tobacco market, with almost 60 million smokers or 33.8% of the adult population (Kemenkes-Ministry of Health, 2019; Lian & Dorotheo, 2018). Most current adult smokers (77.7%) start smoking before 19 years old (Kemenkes-Ministry of Health, 2019). In the last two previous surveys conducted by the Ministry of Health, the smoking prevalence among children aged 10–14 years had elevated from 3.7% in 2013% to 4.9% in 2018, while in aged 15–19 years, the prevalence was 20.5% and 20.8%, respectively (Soerojo et al., 2020). In addition, the average age of smoking initiation was getting younger, from 17.2 in 2013 to 16.8 years in 2018 (Soerojo et al., 2020).

Price is a crucial determinant of cigarettes demand (NCI WHO, 2016). Empirical evidence has shown that an increase in cigarette price would reduce people's decision to smoke and the amount or number of cigarettes smoked by remaining smokers (NCI WHO, 2016). From an economic perspective, price elasticity is a measure of the change in the quantity of products consumed in response to the change in price, assuming other variables are constant. A prior study using aggregate consumption data suggested that cigarette price elasticity ranged from –0.037 to –1.304 in low- and middle-income countries (LMICs) of the Asia Pacific Region, meaning a 10% increase in price would reduce the number of cigarette consumption between 0.37% to 13.04% (Ho et al., 2018). Furthermore, the pricing intervention has a more noticeable impact on youth than adults (NCI WHO, 2016). A previous study using the Global Youth Tobacco Survey (GYTS) from 17 LMICs revealed that youth's total cigarette price elasticity was approximately –2.11, which was more elastic than those found in adults (Kostova et al., 2011; NCI WHO, 2016).

There is no single optimal taxation system that is suitable for all countries (Yurekli, 2013). However, a simpler tax structure (unitary or single tax) is easier to administer (WHO, 2015). It prevents smokers from shifting the higher-taxed and higher-priced brands to lower-taxed and lower-priced brands (Ahsan et al., 2016). Moreover, the tax rates should be adjusted annually, taking into account inflation and income growth (WHO, 2015). Without regular adjustment, the real value of cigarettes price will fall over time (Chaloupka et al., 2012). Ultimately, WHO recommended that tobacco excise taxes account for at least 70% of the retail price (WHO, 2015).

Indonesia has one of the most complicated tobacco tax structures globally (Ahsan et al., 2016). It uses multitiers with different tariffs based on cigarette type, production scale, and retail price (Ahsan et al., 2016). Currently, there are eight specific tax tariffs, with the lowest of 115 Rupiah and the highest of 1065 Rupiah per stick (Kemenkeu-Ministry of Finance, 2021). In addition, the Indonesian government has increased the cigarette excise tax tariff every year since 2010, but in 2014 and 2019 (Soerojo et al., 2020). Recently, the Ministry of Finance announced on average a 12.5% increase in the cigarette excise tax tariff from January 1, 2022, onward (Kemenkeu-Ministry of Finance, 2021). However, the policy may have a limited impact on cigarette price and consumption, which could be reflected by a growing domestic cigarette production in the past decade (Soerojo et al., 2020). The Ministry of Finance recorded that cigarette production had increased from 317.8 billion in 2011 to

356.5 billion sticks in 2019 (Soerojo et al., 2020). Moreover, the complex excise taxes structure may create an opportunity for the tobacco industry to sell cigarettes at a wide range of prices (Ahsan et al., 2016). A study from the World Bank shows that the cigarette price in Indonesia was relatively more affordable in 2016 than in 2005 (Zheng et al., 2018). The government is planning to reform the excise tax system in Indonesia, but the implementation process is likely to be delayed due to political lobbying from tobacco industry (Bigwanto, 2019).

Although the burden of tobacco use is considerably high and smoking prevalence among youth is increasing in Indonesia, the literature examining the demand for cigarettes is limited, and no literature exists on youth. Ahsan et al. (2013) and Adioetomo and Djutaharta (2005) rely on the household as the unit of analysis to examine the effect of price on the demand for cigarettes in Indonesia. Household data, however, lack information on individual-level data. In fact, smoking is an individual-level decision rather than a household. Moreover, those studies may not be appropriate to estimate the current cigarette price elasticity as the tobacco tax system has changed in recent years, which inevitably impacts the market price of cigarettes (Ahsan et al., 2016; NCI WHO, 2016).

The paper estimates the cigarettes price elasticity among youth aged 15–24 years in Indonesia by using *Survey Sosial Ekonomi Nasional* (SUSENAS) or National Socio-economic Survey. The SUSENAS provides individual-level cigarettes consumption data as well as social determinants, which may affect the demand for consumption. This study addressed the need for evidence examining the impact of the price on cigarettes consumption among youth in Indonesia. The finding can be used to support tobacco excise tax reform advocacy and help the policymakers to improve tobacco control regulation in Indonesia.

MATERIALS AND METHODS

Data

The national socioeconomic survey is a major annual household survey organized by the Central Agency of Statistics Indonesia. The SUSENAS captures broad social and economic issues, including demographic, education, health, employment, housing, and information and technology (BPS-Statistics Indonesia, 2020). Although the SUSENAS is not panel data, it provides sufficient information on the time series of cross-sections. Since 2015, the SUSENAS has collected information on smoking behavior at the individual level. However, the SUSENAS 2018 did not gather smoking information because the data collection schedule was in the same year as Basic Health Research or Riset Kesehatan Dasar (RISKESDAS) 2018 conducted by the ministry of health. In addition, there is no change in tobacco control regulation as well as tobacco excise tax structure during the period of 2015–2015. Thus, this study used the pooled cross-sectional design derived from the SUSENAS 2015, 2016, 2017, 2019, and 2020.

The SUSENAS used a multistage sampling method. First, a total of 25%–40% of census blocks were systematically selected by probability proportional to the size depending on the type of residence and economic status of the households. Second, 10 households were systematically picked from each selected census block stratified by household head education level. The total participant was around one million individuals from 300,000 households in all districts in Indonesia (Adji & Asmanto, 2019). This study included all individuals aged 15–24 years who had complete smoking information. We excluded those who had ever attended special needs schools. The final participants were 886,521 male and female youth from the SUSENAS 2015, 2016, 2017, 2019, and 2020. The Research Ethics

Review Committee of Chulalongkorn University had granted an ethical review exemption for this study (COA number 040/2021).

Dependent variables

The outcome variables were smoking participation and smoking intensity. The smoking participation was in binary format. The youth who smoked at least one day in the past 30 days had coded as 1 and 0 otherwise. The smoking intensity was the number of cigarettes smoked during the past week conditional on being a smoker. These variables were derived from the SUSENAS. The empirical model of this study consists of the following equations:

$$P(\text{current smoking} = 1) = \Lambda(\beta' X), \tag{1}$$

$$\mu = \text{Exp}(\beta' X) \text{ if current smoking} > 0, \tag{2}$$

where $\Lambda$is the logistic distribution function, X is the explanatory variable, including price, age, sex, education, health problem, economic status, working status, marital status, place of residence, geographical region, year, and interaction term between price variable and year dummy variables, β is the coefficient corresponding to the explanatory variables, and μ is the predicted mean of the number of cigarettes consumed per week.

Explanatory variables

All explanatory variables were obtained from the SUSENAS. The economic variables were household expenditure per capita and cigarette price. Those variables were measured in Rupiah, adjusted with the Consumer Price Index (CPI) 2020 (BPS-Statistics Indonesia, 2021). The household expenditure per capita was calculated from the estimated monthly expenditure household divided by the total of household members (Equation 3). The household expenditure per capita was then classified into five quintiles: lowest, low, middle, high, and highest. Household expenditure is preferable to measure the living standard of developing countries (O'Donnell et al., 2007):

$$\text{HEP}_{x,t} = \frac{\text{MHE}_{x,t}^{*} \quad \text{CPI}_{2020}}{\text{HM}_{x,t}^{*} \quad \text{CPI}_{t}}, \tag{3}$$

where HEP is the household expenditure per capita of the household x in year t, MHWE is the total monthly expenditure of household, HM is the number of a household member, and CPI is the consumer price index.

Cigarette price data were calculated from the average consumption price for cigarettes per stick among all households with cigarette expenditure in different locations. The location-specific price was assigned based on districts, type of residence, and the survey year in this study. Given that the market price data is unavailable, this approach is recommended to avoid the endogeneity problem (WHO, 2011).

We controlled sociodemographic variables including age, sex, working status, education (years of schooling), health problems, marital status, place of residence, and geographical region. In addition, female, urban, and not working were assigned as a reference category in the sex, place of residence, and working status variable, respectively. The participants were asked about their general health condition. The value of 1 was assigned to those who reported having health problems affecting their daily activities during the past month. The marital status variable was categorized into never married, married, and divorced/widowed.

We also created a dummy variable for the region, including Sumatera (omitted variable), Java & Bali, central (NTB, Central Kalimantan and Sulawesi), and eastern region (NTT, Maluku and Papua.)

The general procedure to model pooled cross-sectional data includes time dummy variables in the analysis. This study employed the dummy variable for the survey year to control the unobservable time factor. The year 2015 was assigned as a reference variable. In addition, the government regularly increases the excise tax tariff during 2015–2020. This policy may impact the price of cigarettes each year. Therefore, we included the interaction term between the price variable and year dummy variables in the models.

Statistical analysis

A two-part econometric model was employed to estimate the demand for cigarettes. The first part estimated smoking participation using the logit specification, while the second part estimated smoking intensity using the generalized linear model (GLMs). The Box–Cox and modified-park tests were performed to determine an appropriate link function and family distribution of the GLMs model. The results showed that log was an appropriate link function ($\lambda = 0.3543$), while the suitable family distribution was Poisson. The model specification was then evaluated using Pregibon's link test. Ultimately, the total elasticity is the sum of smoking participation elasticity and smoking intensity elasticity. We also conducted the incremental analysis to approximate differential price elasticity by sex. The estimate of the coefficient was presented with a 95% confidence interval. All data analyses were performed using STATA v.16 software.

The total cigarettes price elasticity was obtained as follows:

$$\eta = \eta_p + \eta_i, \tag{4}$$

where η is the total cigarette price elasticity, η_p is the smoking participation elasticity, and η_i is the smoking intensity elasticity.

RESULTS

Table 1 contains descriptive statistics of the characteristics of participants. Of the 886,521 participants, the proportion of males and females in the smoking participation model was nearly the same (48.47% vs. 51.43%). About 154,514 participants (17.43%) were categorized as current smokers. The estimated cigarette consumption per week was 75 sticks (52.93). Of the 154,514 current smokers, the majority (98.36%) were male. Almost three-quarters (74.87%) of smokers were currently working. The proportion of smokers from the poorest households was slightly higher (19.22%) than those from the richest (15.71%).

Table 2 shows a multivariate analysis of smoking participation specifications. Cigarette price, education, and living in urban had a negative effect on the chance of being smokers ($p < 0.001$). Males were more likely to smoke cigarettes than females ($p < 0.001$). Marital status, economic status, and geographical region were associated with current smoking status. Afterward, age and working status were positively associated with smoking participation.

Price and education were also negatively associated with the smoking intensity among smokers, while age had a positive association. Working status, health problems, geographical region, and type of residence were also associated with the number of cigarettes smoked in a week among smokers. Male smokers smoked more quantity of

TABLE 1 Characteristics of participants

Variables	Smoking participation	Smoking intensity
Observation	886,521	154,514
Cigarette prices (Indonesian rupiah), mean (SD)	1043.94 (266.56)	1028 (248.45)
Age in years, mean (SD)	19.08 (2.91)	20.74 (2.43)
Sex, *n* (%)		
Female	429,703 (48.47)	2534 (1.64)
Male	45,653 (51.43)	886,980 (98.36)
Education in years, mean (SD)	10.45 (3.01)	9.75 (3.28)
Health problem, *n* (%)		
No	727,682 (82.08)	128,834 (83.38)
Yes	158,839 (17.92)	25,680 (16.62)
Economic status, *n* (%)		
Poorest	200,830 (22.65)	29,699 (19.22)
Poorer	193,111 (21.78)	33,734 (21.83)
Middle	181,698 (20.50)	34,657 (22.43)
Richer	166,519 (18.78)	32,144 (20.80)
Richest	144,363 (16.28)	24,280 (15.71)
Working status, *n* (%)		
No	564,625 (64.39)	38,828 (25.13)
Yes	321,896 (36.31)	115,686 (74.87)
Marital status		
Never married	740,722 (83.55)	126,164 (81.65)
Married	139,313 (15.71)	27,264 (17.65)
Divorced/widowed	6486 (0.73)	1086 (0.70)
Smoking status, *n* (%)		
No	732,007 (82.57)	N/A
Yes	154,514 (17.43)	N/A
Cigarette consumption per week, mean (SD)	N/A	75.19 (52.93)
Place of residence, *n* (%)		
Rural	493,832 (55.70)	92,128 (59.62)
Urban	392,689 (44.30)	62,386 (40.38)
Cigarette price per stick, mean (SD)	1043.94 (266.56)	1028.33 (246.45)
Region, *n* (%)		
Sumatera	261,048 (29.45)	45,265 (29.30)
Java and Bali	264,611 (29.85)	49,640 (32.13)

TABLE 1 (Continued)

Variables	Smoking participation	Smoking intensity
Central	236,571 (26.69)	40,763 (26.38)
Eastern	124,291 (14.02)	18,846 (12.20)
Year of survey, *n* (%)		
2015	166,778 (18.81)	29,314 (18.97)
2016	169,721 (19.14)	28,100 (18.19)
2017	174,157 (19.64)	31,122 (20.14)
2019	184,088 (20.77)	32,660 (21.14)
2020	191,777 (21.63)	33,318 (21.56)

cigarettes than their counterparts. Those who had married were more likely to smoke more cigarettes than those who never married, but no association was found among those who had divorced or widowed. Higher-income smokers consumed more cigarettes per week than lower-income smokers (Table 3).

As shown in Table 4, the cigarette price elasticity was approximately −0.6740, indicating that a 10% increase in price was associated with a 6.74% reduction in overall cigarette consumption. Furthermore, the results revealed that the demand for cigarettes among females was more sensitive to price change than males (−0.7703 vs. −0.6204).

DISCUSSION

We estimated that a 10% increase in price would reduce 6.74% of cigarette consumption among youth aged 15–24 years in Indonesia. In this study, the smoking participation elasticity is slightly lower than in the previous study among the general public, ranging from −0.42 to −0.51 (Sahadewo et al., 2018). These results are not surprising because youth usually spend a higher share of disposable income buying cigarettes than adults (NCI WHO, 2016). Thus, they are more responsive to the price change than adult smokers. In addition, the duration of smoking is associated with the severity of nicotine tolerance (USDHSS, 2014). The majority of current adult smokers start smoking before the age of 19 years, meaning youth have a relatively shorter duration of smoking than adult smokers (Soerojo et al., 2020). Therefore, youth are less addicted to cigarettes, suggesting they may be more sensitive to the price change than adults (NCI WHO, 2016).

Our analysis measured the price variable in single sticks/loose cigarettes rather than in a pack. Unlike in other countries, a majority (71.3%) of youth smokers in Indonesia purchased the cigarettes as individual sticks (Kemenkes WHO CDC, 2020). Single stick cigarettes make the product more affordable for youth. The prices varied between 1000 to 2500 Rupiah or less than US$0.1 per stick (Kemenkes WHO CDC, 2020). Although the government regulation number 109, the year 2012, has banned the sale of single stick cigarettes, most (60%) of the youth smokers were never refused to purchase cigarettes because of their age (Kemenkes WHO CDC, 2020; Soerojo et al., 2020). In addition, selling loose cigarettes may increase the availability of cigarettes. A study in Denpasar City found that a total of 67% of retailers within a 250-m radius of a school reported selling cigarettes as single sticks (Astuti et al., 2019). Therefore, the loose cigarette selling is one of the most crucial issues that hinder the reduction of tobacco consumption among youth in Indonesia.

TABLE 2 Smoking participation model, coefficient, and 95% confidence interval

Explanatory variables	Coefficient	95% Confidence interval
Price	−0.0004	−0.0005; −0.0003
Sex		
Female	Ref.	
Male	4.8049	4.7609; 4.8488
Age	0.2602	0.2571; 0.2633
Health problem		
No	Ref.	
Yes	0.0846	0.0652; 0.1040
Education	−0.1245	−0.1271; −0.1219
Working status		
No	Ref.	
Yes	1.1787	1.1623; 1.1951
Marital status		
Never married	Ref.	
Married	0.4043	0.3778; 0.4308
Divorced/widowed	0.6977	0.5868; 0.8087
Economic status		
Poorest	Ref.	
Poorer	0.3078	0.2855; 0.3301
Middle	0.4883	0.4657; 0.5108
Richer	0.5740	0.5507; 0.5973
Richest	0.5156	0.4908; 0.5425
Type of residence		
Rural	Ref.	
Urban	−0.1361	−0.1523; −0.1198
Region		
Sumatera	Ref.	
Java and Bali	0.2640	0.2452; 0.2828
Central	−0.0704	−0.0894; −0.0514
Eastern	−0.1330	−0.1613; −0.1046
Year of survey		
2015	Ref.	
2016	−0.0990	−0.2078; 0.0098
2017	0.1196	0.0108; 0.2285

TABLE 2 (Continued)

Explanatory variables	Coefficient	95% Confidence interval
2019	0.0788	−0.0248; 0.1825
2020	0.0792	−0.0176; 0.1760
Year × price[a]		
2015	Ref.	
2016	0.0001	−0.00003; 0.0002
2017	0.00001	−0.0001; 0.0001
2019	0.0001	−0.00003; 0.0002
2020	0.0001	−0.00002; 0.0002
Constant	−9.9755	−10.0799; −9.8712

[a]Interaction term between price variable and year dummy variables.

Another important finding is that higher economic status increased the likelihood of smoking participation and the number of cigarettes smoked among smokers. The result is not surprising because cigarettes are legal, and smoking is normal and socially acceptable in Indonesia (Astuti et al., 2020). The economic theory suggests that as the income increases, the demand for normal products increases as well (IARC, 2011). In addition, the youth from wealthier families may have more disposable income to buy cigarettes than their counterparts. Some studies use pocket money as a proxy to measure the economic status of youth (Cui et al., 2019; Kostova et al., 2011). A previous study in Canada found that the amount of pocket money was positively associated with smoking initiation and smoking intensity among students in Grades 7–12 (Cui et al., 2019).

The current study revealed that females were more responsive to price change than males (−0.7703 vs. −0.6204). There are two possible explanations for this result. First, smoking behavior in females may relate to traditional cultural values in Indonesia. Social approval is a significant predictor of smoking continuation/cessation among youth (Vallata et al., 2021). Smoking is viewed as unacceptable behavior for females in Indonesia (Barraclough, 1999). Thus, females might have less incentive to stick up smoking behavior than males if the cigarette price increases. Females also have minor bargaining power in household spending decision-making (Pangaribowo & Sukamdi, 2019). This situation may render it more difficult for females to continue smoking. Second, females may consider smoking a luxury, making them more likely to smoke premium brands. A study in Surabaya City showed that white machine-rolled cigarettes were the most commonly smoked cigarette among females, followed by kreteks (Hardesty et al., 2019). According to the current cigarette tax structure, white cigarettes are subjected to the highest tax tariff (Kemenkeu-Ministry of Finance, 2020). Hence, white cigarettes are the most expensive type of cigarettes. In addition, white cigarette tax evasion usually increases at a higher rate than kreteks and hand-rolled cigarettes, making the white cigarette less affordable over the years (Kemenkeu-Ministry of Finance, 2020).

This is the first study to estimate price elasticity among youth in Indonesia. However, it is subject to some limitations. First, the smoking behavior was obtained from the self-report, which is prone to reporting and recall bias. However, the sensitivity and specificity of self-report are still considerably high in assessing the smoking behavior in youth (Dolcini et al., 2003). Second, in the model, we do not include the following variables, which may affect smoking participation and intensity, such as tobacco advertising/promotion exposure,

TABLE 3 Smoking intensity model, coefficient, and 95% confidence interval

Explanatory variables	Coefficient	95% Confidence interval
Price	−0.0003	−0.0004; −0.0003
Sex		
Female	Ref.	
Male	0.0342	0.0033; 0.0652
Age	0.0275	0.0260; 0.0290
Health problem		
No	Ref.	
Yes	−0.0636	−0.0728; −0.0545
Education	−0.0152	−0.0162; −0.0141
Working status		
No	Ref.	
Yes	0.2453	0.2362; 0.2545
Marital status		
Never married	Ref.	
Married	0.0601	0.0515; 0.0688
Divorced/widowed	0.0333	−0.0008; 0.0674
Economic status		
Poorest	Ref.	
Poorer	0.2187	0.2077; 0.2297
Middle	0.3185	0.3076; 0.3294
Richer	0.4075	0.3964; 0.4185
Richest	0.5106	0.4982; 0.5230
Type of residence		
Rural	Ref.	
Urban	−0.0890	−0.0967; −0.0814
Region		
Sumatera	Ref.	
Java and Bali	−0.2176	−0.2260; −0.2092
Central	−0.0247	−0.0328; −0.0165
Eastern	−0.3321	−0.3482; −0.3160
Year of survey		
2015	Ref.	
2016	−0.0024	−0.0705; 0.0657
2017	0.1087	0.0498; 0.1677

TABLE 3 (Continued)

Explanatory variables	Coefficient	95% Confidence interval
2019	0.2333	0.1733; 0.2933
2020	0.1644	0.1058; 0.2231
Year × price[a]		
2015	Ref.	
2016	0.0001	0.00003; 0.0002
2017	−0.00004	−0.0001; 0.00003
2019	−0.0001	−0.0002; −0.0001
2020	−0.0001	−0.0001; 0.000001
Constant	3.7452	3.6981; 3.8249

[a]Interaction term between price variable and year dummy variables.

TABLE 4 Cigarette price elasticity sex and coefficient (95% confidence interval)

	Cigarette price elasticity		
	Smoking participation	Smoking intensity	Total
Overall	−0.3130 (−0.3473; −0.2788)	−0.3610 (−0.3850; −0.3369)	−0.6740
Sex			
Female	−0.3756 (−0.4166; −0.3346)	−0.3947 (−0.4209; −0.3685)	−0.7703
Male	−0.2600 (−0.2885; −0.2315)	−0.3604 (−0.3844; −0.3364)	−0.6204

antismoking sentiment, antitobacco media exposure, peer influence, and access to buy cigarettes. Those variables are not available in the SUSENAS data sets. Third, the SUSENAS may not be appropriate to describe the overall tobacco prevalence in Indonesia. Unlike RISKESDAS, the SUSENAS do not take into account the consumption of other tobacco products such as rolled my own cigarettes, electronic cigarettes, and shisha. However, it is still valid to measure cigarettes consumption in Indonesia.

CONCLUSIONS

The present study was designed to determine the role of price in cigarette consumption among youth in Indonesia. We found that price had a negative impact on cigarette consumption among youth. This result indicates that pricing policy through taxation would be effective in reducing smoking behavior among youth. We also estimated that cigarette price elasticity was approximately −0.68, which means demand for cigarettes is inelastic to the price change. An increase in cigarette price would not change cigarette consumption as much as its change in price. Thus, we first recommend that the Ministry of Finance simplify the tobacco taxation structure. A simpler taxation structure would create less variability in cigarette prices across brands. This could make smokers more difficult to switch brands when the tax is increased. A study by Prasetyo and Adrison (2020) using transactional data of cigarettes brands produced in Indonesia from 2005 to 2017 found that tax tiers were negatively associated with cigarette prices in Indonesia (Prasetyo & Adrison, 2020). Second,

the annual cigarette tax rate increase should be higher than the income growth. An optimal tax increase would make cigarettes less affordable as well as generate additional revenue for the government. Third, we recommended the local government strengthen the enforcement of single/loose cigarettes selling banned regulation. Banning the selling of cigarettes as single sticks could significantly reduce the affordability and availability of cigarettes. Moreover, further studies would be interesting to assess the impact of combination pricing and other tobacco control policy such as advertisement ban, smoke-free area regulations, and pictorial health warnings on cigarette packs.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data were obtained from the Central Agency of Statistics Indonesia (BPS) and cannot be shared with third parties according to an agreement signed by BPS and the author (Ridhwan Fauzi). The data (described in this article) can be obtained by request to BPS.

ETHICS STATEMENT

The study was exempted from ethical review according to The Research Ethics Review Committee of Chulalongkorn University (COA number 040/2021).

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Cardiovascular diseases preventive policy-making process in Iran: A framework-based policy analysis

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Abstract

Strengthening countries' policies to prevent cardiovascular diseases (CVDs) relies on their policymaking processes. This study aimed to create a deep understanding of these processes through evaluating preventive and control policies of CVD in Iran, using Walt and Gilson's policy analysis triangle framework to analyze the policymaking process qualitatively. Data were collected using various methods such as reviewing international and national documents and interviewing experts; the framework analysis method was used to analyze the data. Findings were reported in four dimensions of the policy analysis triangle, including content, context, process, and actors. Various social, economic, environmental, and political factors affect the policy's development. Prevention plans emphasize inter- and intrasectorial collaborations and require community-based interventions. Achieving universal health coverage and global attention to the prevention of noncommunicable diseases (NCDs) has put CVD prevention on the agenda in Iran. In addition, the National Action Plan for Prevention and Control of NCDs has been compiled with the participation of all ministries. An Iranian Non-Communicable Diseases Committee has also been established, reflecting the national effort to control CVD. Although Iran has taken important steps to control and prevent CVD, the incidence of CVD is still increasing. Comprehensive action plans should be implemented with extensive intrasectorial cooperation and a clear framework to achieve the desired goals.

KEYWORDS

cardiovascular disease, policy analysis, policy process, policy triangle framework, prevention

BACKGROUND

The incidence of noncommunicable diseases (NCDs) has dramatically increased worldwide (Ernita & Wibowo, 2018). According to the World Health Organization (WHO) reports in 2016, NCDs are the most common cause of death, and four diseases account for 80% of the global premature deaths, including cardiovascular disease (CVD), cancer, diabetes, and respiratory diseases (World Health Organization, 2016). Most NCDs are caused by a number of risk factors (Khuwaja et al., 2011). For instance, obesity, hypertension, inactivity, and smoking, which can be prevented, account for 68% of the risk factors and 11% of the total disease burden (Goli et al., 2018). The first National Burden of Disease study in Iran showed that 58% of disability-adjusted life years (DALYs) were owing to NCDs in 2003 (Naghavi et al., 2009). The results of the modeling study show that the burden of CVD will increase steeply in Iran from 2005 to 2025 (Sadeghi et al., 2017). Such factors have led to disorders such as CVD (48% of deaths), cancer (21%), chronic lung disease (12%), and diabetes (3%). In addition, 80% of deaths from NCDs (equivalent to 29 million people) occur in low- and middle-income countries (World Health Organization, 2014). Due to the preventable incidence of CVD, different countries develop and implement various policies to prevent these diseases.

Currently, some developing countries (e.g., Iran) are adopting policies to prevent CVD. Major policies for preventing such diseases in Iran are planned at the secondary and primary prevention level (Mollarahimi et al., 2017), and primordial prevention has received less attention. This type of prevention deals with the creation and maintenance of conditions minimizing the emergence of risk factors for diseases (Ebrahimpour & Esmaeili, 2018). A systematic review aimed at evaluating the effectiveness of community-based plans for preventing CVD showed that media, screening programs, and counseling activities are effective in preventing these diseases (Pennant et al., 2010). Based on experiences, emphasizing health promotion and preventive policies for reducing the burden of these diseases is extremely necessary (Arokiasamy, 2018; Srivastava & Bachani, 2011).

Each year, the American Heart Association, in collaboration with the Centers for Disease Control and Prevention, the National Institutes of Health, and other government agencies, provide the latest statistics on heart disease, stroke, and so on. Updated statistics provide valuable resources for researchers, physicians, health policymakers to increase service quality while reducing costs, mortality, and risks (Benjamin et al., 2019). Health policies play a very important role in controlling and preventing NCDs. It is noteworthy that developing countries, due to inappropriate allocation of financial resources, are more prone to the effects of NCDs such as poverty and the lack of economic development because affected people are more at the age of production. On the other hand, health policy in these countries faces problems such as the lack of effective intersectoral cooperation between different sectors. In addition, in such countries there are problems such as the lack of full implementation of the referral system within health systems. Given the above-mentioned issues, policy analysis for evidence-based policymaking is necessary for developing countries (Biswas et al., 2017; Thakur et al., 2011).

Thus, fundamental steps can be taken in evidence-informed policymaking, and appropriate plans and actions can be formulated for the future by clarifying the nature of the issue and analyzing the country's approach. The purpose of this study is to analyze the policymaking process by identifying the actors and their role in policymaking, as well as analyzing the content of policies and the context in which policies are formulated in Iran. In this regard, the triangle framework has been used for analysis.

MATERIALS AND METHODS

Research team and reflexivity

Two members of the research team conducted interviews: one lead investigator with prior experience conducting research based on qualitative interviews and one Ph.D. graduate student. Student researchers received training on skills, attributes, practices, and specific project tools for coordinating and conducting interviews.

Study design

The present qualitative, descriptive-exploratory study was conducted retrospectively using a combination of deductive–inductive approaches in the form of policy analysis. In this study, the Walt and Gilson policy triangle was applied as a conceptual framework, which is outlined in Figure 1.

The policy analysis triangle has process, content, and context dimensions, and the actors are at the center of this framework. The health policy triangle (HPT) framework is a means to help organize and think about the descriptive analysis of key variable types (O'Brien et al., 2020). This framework shows how these four dimensions interact with each other in shaping and implementing a policy. Furthermore, actors are a set of individuals, groups, and organizations involved in or influenced by the implementation process. Content refers to a set of goals and planned actions that bring the policy to fruition. Moreover, background points to a set of national and international systemic political, economic, and social factors that may influence health policy. Similarly, process refers to the need for all actions and activities that are performed during policy implementation (Buse et al., 2012). The policy analysis triangle is one of the most widely used tools in health research and has been the subject of various analyses, especially in the field of infectious diseases such as acquired immunodeficiency syndrome, coronavirus disease-19, and NCDs such as diabetes (Khodayari-Zarnaq et al., 2019; Raoofi et al., 2020; Shiroya et al., 2019).

Study setting

The study population included experts and stakeholders related to CVD prevention plans. No sampling was conducted and all key documents were analyzed. Additionally, policy documents related to CVD prevention programs including plans and reports (Table 1) were identified using the review of sources, studies, and reports published locally and internationally and the interview with experts. Finally, experts were

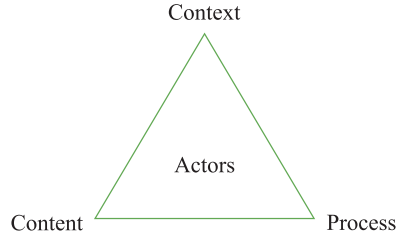

FIGURE 1 Walt and Gilson policy triangle

TABLE 1 Policy documentation related to cardiovascular disease (CVD) prevention plans

National documents	International documents
✓ Principles of diseases prevention and care: Noncommunicable diseases care system	✓ Action plan for the global strategy for the prevention and control of noncommunicable diseases 2013–2008
✓ Care system for risk factors for noncommunicable diseases	✓ Package of essential noncommunicable disease interventions for primary healthcare in low-resource settings
✓ CVD prevention and control programs	✓ Global Atlas on CVD prevention and control
✓ Ways to prevent and control CVD	✓ National Heart Disease and Stroke Prevention Program
✓ Noncommunicable diseases	✓ A prioritized research agenda for the prevention and control of noncommunicable diseases
✓ National action plan for prevention and control of noncommunicable diseases and related risk factors in the Republic of Iran 2015–2025	✓ Global Hearts Initiative Working together to beat CVD
✓ Iran's package of essential interventions for noncommunicable diseases in the primary health care system (IraPEN)	✓ Global Action Plan for the prevention and control of noncommunicable diseases 2013–2020
	✓ HEART: Technical package for CVD management in primary healthcare

purposefully sampled and those with the most information and experience in the field of study were selected. Selection criteria were at least two related articles or 5 years of work experience.

Data collection

The study was initiated with a review of the most prominent CVD documents to identify both the core key informants and other important documents.

Policy documents

Some international and national databases were searched, including the WHO and the World Heart Federation, as well as the Ministry of Health and Medical Education (MoH) and the Health Policy Research Center, along with committees related to NCDs and CVD in Iran. The websites of Iran's universities of medical sciences were searched as well. Google was also searched to find related contents. The study inclusion criteria were all national and international documents related to NCDs that directly refer to CVD prevention and published in Persian and/or English. Nonapproved drafts and noncitable documents were excluded. Further, several keywords were searched in English databases and websites, including "heart disease," "cardiovasculardisease," "Control," "Program," "Policy," "Document," "Prevention," and "Non-communicable Diseases," followed by searching Persian language websites and databases using equivalent Persian keywords. In this study, 35 documents were found in the initial search (20 international and 15 national documents). Then, 20 out of 20 international and 7 out of 15 national documents were selected and the remaining documents were omitted due to noncompliance with the inclusion criteria, and finally, 16 documents were included in the study. A self-developed checklist was used as the data collection tool (Appendix 1).

Key informants

Fifteen experts in various fields, including experts in health policy, health services management, social medicine, and cardiologists were interviewed. Table 2 presents the individual characteristics of study participants. The purposeful sampling method was used and continued until saturation, and experts with the most knowledge and experience in the prevention of CVD were selected. An interview guide was developed using document analysis and a semi-structured interview was conducted (Appendix 2). Furthermore, written consent to record the interview was obtained from the participants. To increase the consistency of the study, interviews were returned to the participants for review and approval at the end of each interview. Moreover, interviews were transcribed immediately and the findings were analyzed using the framework analysis. Eventually, the transcribed texts were reviewed several times and the relevant codes were extracted accordingly.

Quality of research

The criteria of credibility, dependability, and transferability of data were examined to achieve the accuracy and validity of the study. Credibility, conformability, dependency, and transferability were considered as the criteria for data trustworthiness (Barnett-Page & Thomas, 2009; Ward et al., 2013). Interview contents were returned to participants to check for accuracy and resonance. Experts were purposefully selected who have good knowledge in this field. Document review and interview have been used to methods triangulation. Criteria for transparent entry, a comprehensive search of documents, and the extraction of information were examined by two people independently, and a third person was included in

TABLE 2 Individual characteristics of research participants

Expert	Gender	Field
1	M	Food and nutrition policy
2	F	Health service management
3	F	Health policy
4	M	Health economy
5	M	General practice (GP)
6	F	General practice (GP)
7	F	Social medicine
8	F	Cardiology
9	M	Health economy
10	M	Health policy
11	M	Social medicine
12	F	Health service management
13	F	General practice (GP)
14	M	Cardiology
15	M	NGO activity in CVD prevention

Abbreviations: CVD, cardiovascular disease; F, female; M, male; NGO, nongovernmental organization.

cases of disagreement. The compliance with the themes was also verified and the deduction of identical themes from the texts by the two researchers was also ensured. No changes have been made to the current trends, although some slight adjustments have been made to the terminology. To improve dependence, all comments made by the members of the research team were considered and applied. Some participants were presented with the results of the data analysis and their input was considered during the data analysis process. Relevant participants were also included in the study to increase transferability. Data collection and interpretation were performed at the same time.

Analysis and findings

First, information such as type, year, place and the purpose of publication, the period and the content of documents, including plans and policies for preventing and controlling CVD as national and international strategies and actions were extracted using a checklist and then a time chart was drawn accordingly. Additionally, the document and framework analysis methods were used for data collection and analysis, respectively. The interview findings were analyzed after transcription and coding using the framework analysis and HPT. Next, document analysis findings were analyzed and reported as a policy triangle. Framework analysis was first introduced in the 1980s by researchers at the National Center for Social Research in the United Kingdom as a method for managing and analyzing qualitative data. In addition, it is a hierarchical approach that is used to classify and organize data based on key themes, concepts, and emerging classes. This approach has been highly regarded in health care research due to the clarity and transparency of the analysis, flexibility, and ease of application, especially for novice qualitative researchers (Gale et al., 2013).

RESULTS

The results of this study are presented in accordance with the triangle of policy analysis in the four main dimensions of this framework (i.e., actors, content, context, and process). Content-related, contextual, and process-related factors are classified and presented in three main categories, followed by identifying related actors.

Policy context

The contextual effective factors include political, administrative, economic, financial, social, and cultural factors. Table 3 summarizes and reports the influencing factors.

Political and administrative factors

CVDs impose a significant economic burden on society and affect the production of the country. Meanwhile, catastrophic health expenditures of health are especially problematic for poor people; economic problems increase social inequalities in addition to creating economic stress (Peykari et al., 2015; Richards et al., 2016; Wagner & Brath, 2012). Further, poor people are more prone to economic stress compared to others since they struggle with health and living costs (Woolf, 2015). Meanwhile, the level of people's access to prevention services is highly decisive. Thus, achieving universal health coverage can be effective in reducing the incidence of CVD.

TABLE 3 Contextual factors affecting the CVD prevention policymaking process

Contextual affective factors	Examples
Political and administrative factors	• Increasing social inequalities • Community poverty • Challenges of achieving universal coverage of health services
Economic and financial factors	• Financial burden of NCD • Stress caused by economic problems • Decreased productivity and reduced capital and economic growth • The cost of treating CVD • Economic sanctions
Social and cultural factors	• Excessive consumption (of meat, salt, sugar, fat, smoking) • Compliance with the principles of public health, vaccination, and production of antibiotics and effective drugs for the treatment of infectious diseases • Population aging • Reducing social support • Increasing social isolation • Condition and quality of living space • Childhood development conditions

Abbreviations: CVD, cardiovascular diseases; NCD, noncommunicable diseases.

Economic and financial factors

It should be noted that CVD is costly in the Iranian health care system. Health policymakers can limit the costs and consequences of the disease by using resources efficiently and effectively and expanding self-care and screening programs (Raghfar et al., 2018). The burden of NCDs is associated with poverty and serves as a barrier in achieving sustainable development goals (Nugent et al., 2018). Furthermore, NCDs decrease productivity and reduce capital and economic growth (Engelgau et al., 2011). Moreover, economic sanctions against Iran decrease the revenues of the country and lead to devaluation, inflation, and unemployment. The effects of economic sanctions, including reduced access to essential drugs in public health, are well known. Additionally, CVD-related mortality has increased with reduced access to essential drugs and diagnostic equipment (Aloosh et al., 2019; Kokabisaghi, 2018; Roshan et al., 2015).

Social and cultural factors

In developing countries, the excessive consumption of fats, meat, sugar, salt, and tobacco is common while physical activity is decreasing. In addition, the compliance with the principles of public health, vaccination, and production of antibiotics and effective drugs for the treatment of infections have prevented the incidence of infectious diseases and provided proper treatment for them. Therefore, the number of the elderly in developing countries has raised by the increased average life expectancy. In recent decades, the socioeconomic growth and effective delivery of primary healthcare have improved health and reduced maternal and child mortality in Iran (Khayati & Saberi, 2009). In addition, life expectancy increased from 66 to 78 years between 1990 and 2013. In fact, aging has a remarkable effect on the heart and arterial system, leading to an increase in CVD. Due to the above-mentioned factors, there is a higher prevalence of NCDs and related risks (Azimi et al., 2012; Danaei et al., 2019; Mohammadi et al., 2017). Various social factors such as social support

and isolation affect health and the incidence of CVD (Juma et al., 2018). Social support has a negative effect on social isolation while a positive effect on CVD (Holt-Lunstad & Smith, 2016; Valtorta et al., 2018). It is noteworthy that childhood conditions such as mental, psychological, and nutritional conditions affect the risk of CVD in adulthood (Goldstein & Korczak, 2020; Kelishadi & Poursafa, 2014).

The increasing burden of NCDs and environmental challenges such as air pollution and water crisis, especially in preventive care and weak intersectorial participation to overcome these issues are the challenges faced by Iran health system in preventing NCDs (Lankarani et al., 2013). The quality of living space in terms of access to places for walking and cycling, as well as recreational facilities and green space has been a positive effect on increasing the amount of physical activity (Devarajan et al., 2020).

Policy content

The content of the policy includes a set of goals and actions planned in national and international prevention plans. International documents aim to increase the priority of NCDs in global and national programs, to put the prevention and control of these diseases in government policies, and finally, to create and strengthen policies by increasing participation in such plans. In this regard, global efforts provide assistance to governments to prevent and control CVDs, develop trained and engaged public health professionals for treatment of CVD and stroke, and to monitor NCDs and related risk factors. Furthermore, the emphasis has been placed on promoting research for preventing and controlling NCDs in addition to identifying knowledge gaps and strengthening required research in public health measures, prevention of NCD-related disabilities, and health needs. Finally, the goals of international documents include strengthening international cooperation and support, as well as national capacity, leadership, and governance to accelerate the response of countries in the prevention and control of NCDs.

Figure 2 provides a report on the goals of national documents. Moreover, the national documents generally attempt to present national and training guidelines for caring and controlling NCDs in the country, as well as accurate and up-to-date information sources to provide a tool for evidence-based decision making and capacity building in the health care system to focus on NCDs prevention. Additionally, national documents aim at reducing the incidence of CVD and related complications, disabilities, and death by increasing awareness about CVD-related risk factors and ways to prevent them. These documents also seek to determine the 10-year risk of heart attack and stroke in the target group and reduce the risk with medication interventions and lifestyle changes.

Various strategies and actions have been extracted from national and international documents to achieve national and international goals, the details of which are reported in Table 4.

Strategies are generally divided into individual and social categories. Some strategies refer to individual cases and are related to people (e.g., self-care and lifestyle modifications) and others are related to society and the health system (e.g., how to provide service and policy). The proposed solutions and interventions in national and international documents have emphasized some interventions and actions during several years and in various documents (e.g., improving people's lifestyles).

Actors

Most of the actors in the published documents are the MoH and its subdivisions, however, in the “national action plan for prevention and control of NCDs and related risk factors in Iran

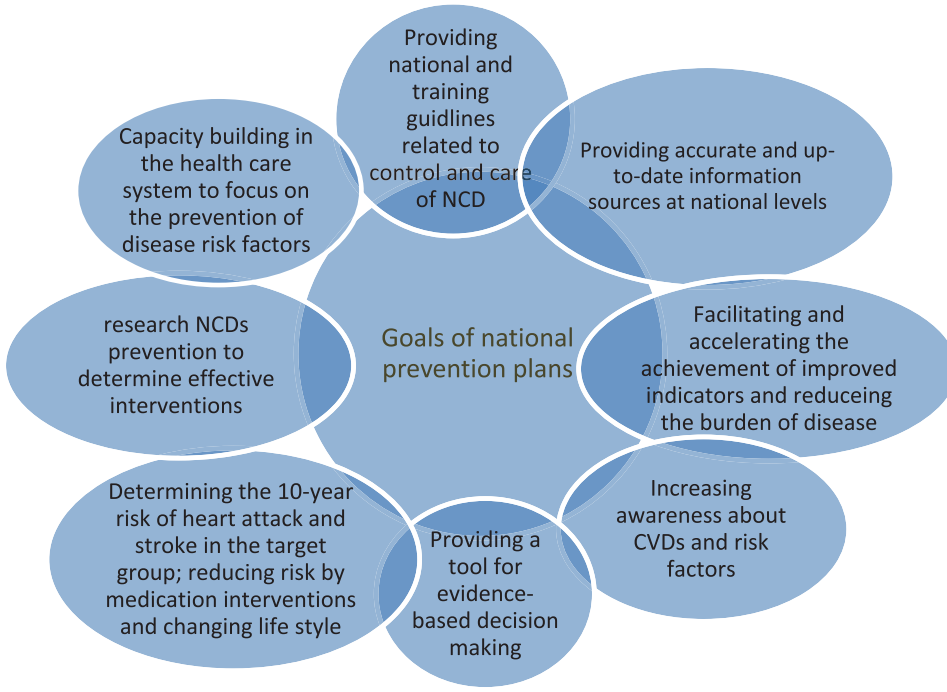

FIGURE 2 Goals of national prevention plans. CVD, cardiovascular diseases; NCD, noncommunicable diseases

2015–2025," all internal and external stakeholders of the MoH are key partners, including various deputies of the MoH and relevant ministries and government organizations. It is noteworthy that this national document was signed by the president, the speaker of the parliament, the president of the WHO, the vice-president, and the main stakeholders in this field, making this document unique. These stakeholders were the Environmental Protection Organization, Ministry of Culture and Islamic Guidance, Ministry of Agriculture Jihad, Ministry of Interior, the Ministry of Economy and Finance, the Ministry of Sports and Youth, the Ministry of Energy, the Ministry of Welfare and Social Security, the Ministry of Education, the Ministry of Industry, Mines and Trade, and the Radio and Television Organization. This is unique among countries in the region and has been accepted by inter- and intrasectorial stakeholders at various levels.

A "National Committee for the Prevention and Control of NCDs and Risk Factors" has been formed to perform the MoH's legal duties aiming at integrating policymaking, planning, and monitoring all activities in the field of NCDs and related risk factors in Iran. The formation of this committee is in accordance with the duties of the MoH. In addition, the National Committee is a policy, regulatory, scientific, and planning committee that has subcommittees required to perform its duties in all areas of controlling NCDs and related risk factors and considered as the decision making authority of the MoH. Considering the importance of this group of diseases and the international commitment of the Iran to take action to control NCDs and related risk factors in the country, this committee has been formed under the chairmanship of the MoH. "It is expected that during this period, the document is available to all administrators and staff of the universities due to a need to respond to the National NCDs Committee and the WHO and there is a commitment to achieve the set goals."

TABLE 4 Strategies and plans extracted from national and international documents

Prevention strategies (theme)	Content of related programs (subtheme)
Early diagnosis and screening	• Identification of people at risk and counseling and treatment based on risk
Lifestyle modification	• Avoiding smoking and alcohol • Insufficient mobility correction • Encouragement to healthy lifestyle changes such as proper diet (low salt, high fiber, low fat) • Stress management
Treatment	• Treatment for lower blood pressure • Medication to prevent hyperlipidaemia • Medication and surgery to control weight
Intrasectorial collaborations	• Strengthening intrasectorial cooperation to integrate the management of NCDs with the approach of controlling the common risk factors
Intersectorial and cross-sectorial cooperation	• Enhancing intersectorial and cross-sectorial collaboration • Emphasis on the role of welfare organization and education organization in forming the correct lifestyle habits • Involvement of private sector representatives in subcommittees of risk factors
Health policy	• Improving skills of health care team in NCDs • Promoting awareness of health policymakers • Strengthening the system of epidemiological examination and care of NCDs • Legislation to strengthen cross-sectorial cooperation between different organizations for the prevention, screening, and control of NCDs • Establish strong national tobacco control programs • Regulatory measures to counter the widespread advertising of beverages and foods with saturated fats, trans-fatty acids, free sugars, and so forth. • Transportation policies • Improving collaboration at all levels between government agencies, intergovernmental organizations, NGOs, civil society, and the private sector • Providing operational evidence and disseminating information on the effectiveness of interventions or policies • Increasing the capacity of health care services to provide prevention and treatment interventions for alcohol-related disorders
Training	• Public and face-to-face training at various levels of public health services, for people at risk and patients
Service delivery	• Changes in the health system to deal with chronic diseases • Design and implementation of comprehensive community-based interventional programs and practical support • Preparing guidelines for determining the risk of CVD • Registering deaths from heart disease and stroke • Providing emergency care for CVD and improve related services • Strengthening and implementing rehabilitation programs in all hospitals with CCU • Introducing policies addressing NCDs determinants
International Cooperation	• Exchange information continuously and effectively and introducing cost-effective interventions

TABLE 4 (Continued)

Prevention strategies (theme)	Content of related programs (subtheme)
	• **Collaboration with the WHO to raise awareness of public health problems** • **Mobilization of resources to promote regional and global monitoring and appraisal of progress**
Assessment of the quality of healthcare	• Strengthening the quality of applied research on diseases and related risk factors • Implementing national studies on CVD and the quality of healthcare for risk factors in a timely manner • Strengthening the reporting system and mechanize it at different levels
Self-care	• Development and promotion of self-care culture in all centers of the health system • Design and implementation of self-care program at different levels of the health system
Development and integration of national guidelines	• Development of guidelines for prevention and control of CVDs • Development of counseling instructions and preparation of self-care training materials
Health economics	• Prevention and regulation regarding communicable diseases directly by poverty reduction initiatives and associated economic and social policies.
Research	• Promotion of the establishment of national reference centers and networks to conduct research • Assisting low-and middle-income countries in capacity building for epidemiological and health system research
Other	• Commitment and desire to implement high-level commitments and documents • Elimination of differences in race, ethnicity, gender, geography, or socioeconomic status • Creating public demand for health services

Abbreviations: CCU, coronary care unit; CVD, cardiovascular disease; NCD, noncommunicable disease; NGO, nongovernmental organization; WHO, World Health Organization.

Using valuable global experiences and the real needs of the country in the field of NCDs and related risk factors, the committee drafted a national document on NCDs, which mainly oversees macropolicies and key strategies for controlling NCDs. Strategies and policies have been formulated inter- and intrasartorially.

> *The National Document for the Prevention and Control of NCDs and Related Risk Factors in Iran has been developed aiming at attracting stakeholders within and outside the health system. It has been also approved by the President and Speaker of the Islamic Parliament of Iran*.

> *In achieving the goals and programs of the National Document for Prevention and Control of NCDs at the province level, the awareness can be transmitted to the community using capacities of the provinces and the cooperation of other relevant agencies, along with using the power and capacity of the media as a bridge between health officials, stakeholders, and people*.

The members of the National Committee are divided into two general categories of deputies, organizations, and subdepartments of the MoH and other ministries, organizations, and institutions (Figure 3). Figure 4 shows the position of each stakeholder relative to each other in Mendelow's power/interest matrix.

Policy process

In this study, policy development was examined in the process section.

Policy development

The National Document for the Prevention and Control of NCDs is a plan that has been approved by the High Council for Health and Food Security since 1995 and communicated by the president to health-related institutions. The main health-related ministries and institutions approved and signed this document. The most important goal of this document is to reduce premature deaths by 25% by 2025; by definition, deaths preceding 70 years are known as premature deaths.

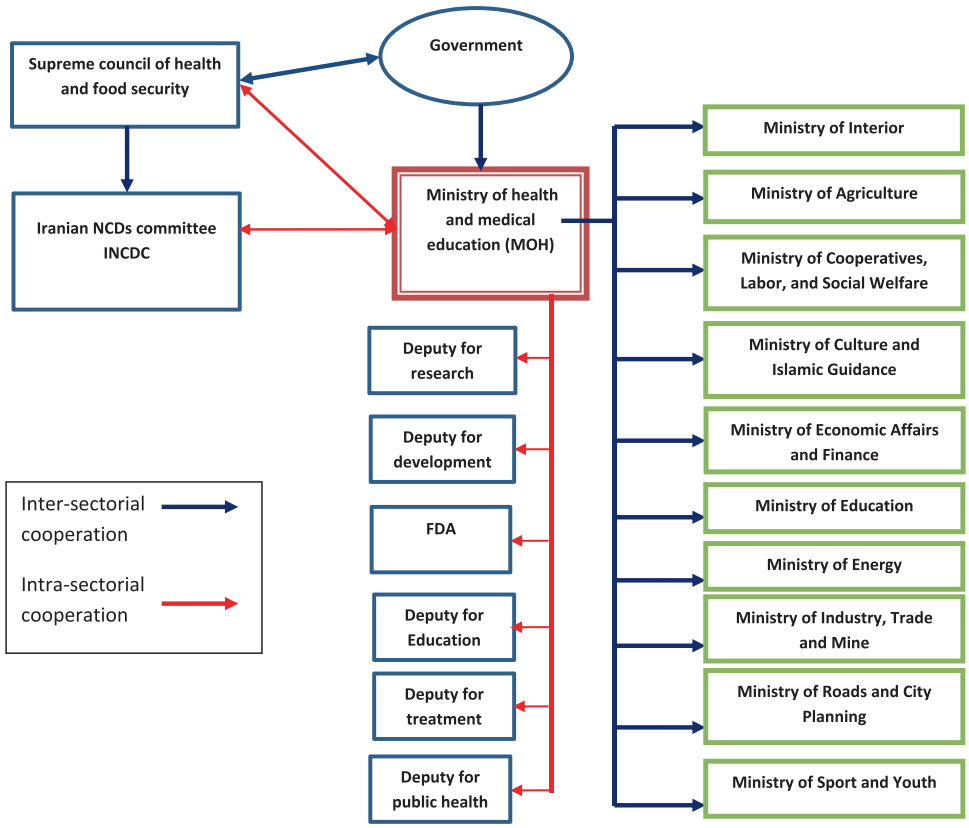

FIGURE 3 National action plan for noncommunicable diseases (NCDs) prevention and control in Iran; a response to emerging epidemic

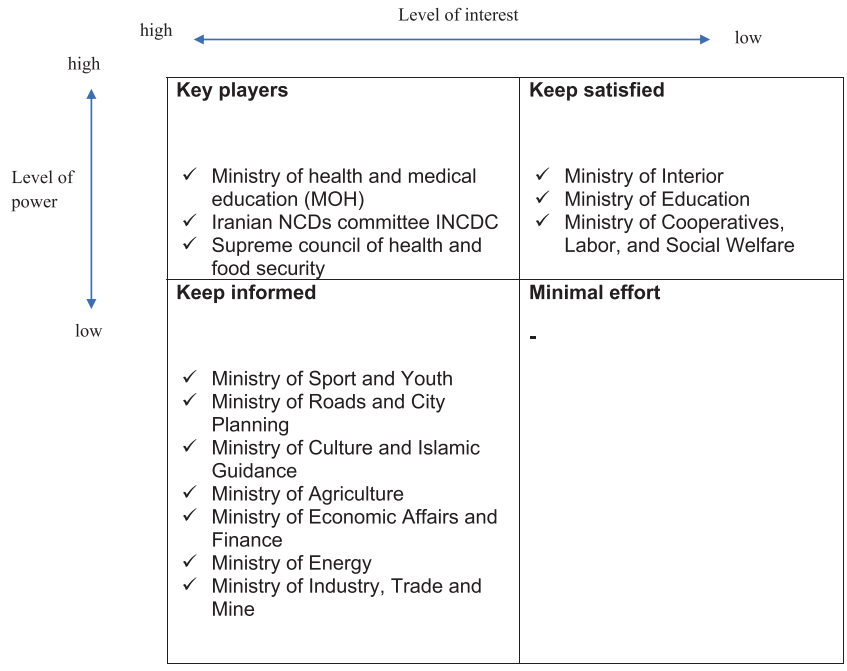

FIGURE 4 Mendelow's power/interest matrix

The main approaches of this document include health system reform, reduction in the risk factors for NCDs, and the strengthening of the care system. It should be noted that the establishment of the National Committee for the Prevention and Control of NCDs is the most important action in this field. The committee is an intersectorial mechanism for overseeing activities designed to control NCDs. Moreover, the MoH is the head of this committee that seeks to establish cross-sectorial coordination between the MoH, the Ministry of Education, the Ministry of Cooperative Labour and Agriculture Jihad, and others.

Efforts to achieve the universal coverage of health services in Iran began by designing the health care network system. To achieve the health coverage goal, measures were adopted within the framework of the Health Transformation Plan (Ahmadnezhad & Abdi, 2018). Additionally, the implementation of this plan was put on the agenda when, based on the available evidence, Iran ranked 96th, 133rd, 100th, and 93rd in terms of "health," "health distribution," and "the level and distribution of response to nonmedical needs," respectively, compared to 191 countries worldwide. Similarly, it ranked 112nd and 114th with respect to the "fair contribution in health financing" and "overall health goals," respectively (Tandon et al., 2000). "People are moving from a healthy to a high-risk lifestyle, and if these risk factors are not controlled, we will see a tsunami of NCDs and disabilities in the future." Regarding health system reforms, one of the most important actions is the IraPEN that has been integrated into the primary health care system. More precisely, IraPEN is a three-dimensional and four-approach service package designed to intervene in the primary care system for CVD, diabetes, cancer, and chronic respiratory diseases. Diagnosis, care, and treatment of patients with chronic respiratory diseases, chronic obstructive pulmonary disease, and the combined care of two diseases, hypertension, and diabetes have been included in the CVD risk assessment program. In addition, this program encompasses four major diseases, along with four behavioral risk factors such as malnutrition, sedentary lifestyle, smoking, and alcohol consumption. "This

document includes all strategies and activities set by the vice-chancellors of the universities and outsourcing organizations." "In this regard, the strategic plan of each university is based on the upstream document of 2025 and the documents of the MoH, and finally, the recommendations of the Supreme Leader concerning health."

The National Committee for the Prevention and Control of NCDs has been formed with a focus on discussing NCDs to prevent and control these diseases and associated risk factors. In the framework of the nine goals proposed by WHO with the aim of reducing NCDs-related mortality by 2025. This document not only emphasizes the nine goals of the WHO but also defines other goals in addressing NCDs in the country. Further, this committee plans for, prioritizes, evaluates, and monitors all measures related to the control and prevention of NCDs and related risk factors. The "High Council for Health and Food Security," aiming at ensuring the health of citizens, has initiated executive policies between the health sectors to ensure, maintain, and promote equitable health, access to and enjoyment of healthy and proper food basket and improve the quality and lifestyle of the people (Damari & Vosoogh Moghaddam, 2014).

DISCUSSION

The present study sought to create a deep understanding of policymaking process through investigating the prevention and control policies of CVD in Iran by the triangle framework of policy analysis. This provides an opportunity for policymakers and health care providers to improve the prevention of CVD in Iran and other countries with similar conditions.

Political, social, economic, and environmental factors affect the incidence of NCDs. Findings of the study by Marmot (2020) showed that lower life expectancy and mortality rates have increased for men and women aged 45–49 in disadvantaged areas possibly due to the so-called "death of despair" (i.e., suicide, drugs, and alcohol). Moreover, living in inappropriate conditions has created various crises and thus predisposed people to various diseases.

The discussion of CVDs is not limited to one region or country and is a challenge that has plagued the health systems of all countries. The WHO and the United Nations are among the bodies that have established programs to prevent and control NCDs, especially CVD in the world (Arthur, 2014). Officials from all over the world are responsible for implementing the WHO Action Plan for the Control and Prevention of NCDs from 2013 to 2025 and the United Nations Declaration on NCDs. To achieve these goals, serious measures are needed to increase services across areas and manage the risk factors (Beaglehole et al., 2014). Strategies to combat NCDs (e.g., CVD) are generally divided into two categories. The first category is related to the public (e.g., legislation, financial, and tax incentives and mobilization to promote public health) and the second one belongs to interventions for specific individuals to change health behaviors through interaction between health care providers and recipients. The WHO Package of Essential NCD is an action-based innovation and a response to existing challenges. It is a set of priority and cost-effective interventions that can provide quality care even with a lack of resources and facilities (Hyon et al., 2017). Such interventions should be performed in infancy, childhood, adolescence, and adulthood. Infant interventions are safe and adequate nutrition and nutritional supplements. In addition, those of childhood and adolescence include life skills training, promotion of physical activity at school and in the community, and healthy eating at school. Similarly, adulthood interventions encompass improving maternal nutrition, encouraging physical activity at work, to name a few (World Health Organization, 2020). In a study conducted in Iran, six community-based strategies were identified for preventing CVD in the country, including utilizing nongovernmental organizations (NGOs) and charities, health marketing methods and strategies, people to provide prevention services, as well as using mobile and other communication devices, modeling social prescriptions, and performing peripheral medicine. Strategies for the use of health

care providers and liaisons, mobile health, and NGOs and charities were prioritized in this regard (Alizadeh et al., 2020). Published documents indicate that national documents have been completed and published after the publication of international documents, especially the documents of the WHO, with the same global goals and only by localizing them and adding some national ones. For instance, the National Document for the Prevention and Control of NCDs and Related Risk Factors in Iran during 2015–2025 was issued after the publication of the Global Action Plan for the Prevention and Control of NCDs 2013–2020. In terms of the proposed solutions and interventions, national and international documents have emphasized some interventions and actions during such a year and in various documents (e.g., improving people's lifestyles).

Given the global trend, the prevention of CVD has become more important on the agenda of policymakers. The mission to implement a national action plan to prevent and control NCDs provided an opportunity for Iran to commit to achieve the goal of 25% reduction until 2025. Within the framework of national action plans, we can arrange scientific, scalable, and cost-effective interventions to reduce mortality and complications from NCDs and achieve an efficient and appropriate health system. In this regard, the sustainable high-level political statement plays a key role in promoting rules and regulations, as well as multisectoral partnerships in the prevention and management of NCDs, taking into account targets for sustainable growth and universal health coverage. As a result, Iran has formed a national authority framework as Iranian NCDs Committee and developed a national action plan for NCDs through multisectoral approaches and collaboration between researchers and policymakers. The translation of Iran's expertize may be useful for mobilizing leadership in other countries to take meaningful steps to save millions of lives (Peykari et al., 2017).

Any intervention to achieve the results requires the cooperation of all factors, especially the highest political commitment of the individual in the organization. Certainly, different departments and ministries have a significant role in ensuring the community health. Furthermore, policymakers and managers of the health system must constantly interact with the managers of other sectors, as well as the representatives of the people and influential people in the community to include health issues in the policies of various government departments and help improving social determinants of health throughout society. The MoH's organizational relationships with other public and private organizations and its advocacy accelerating the achievement of sustainable goals of the health system (Mosadeghrad & Rahimi-Tabar, 2019). Cross-sectorial participation has been well considered in the development of the NCDs national document in such a way that the document has been signed by the president and all the ministers of the time.

Conclusions and policy implications

In general, policy analysis plays a significant role in creating a deeper understanding of policies and the policy process. It also helps identifying key gaps in the policy process so that policymakers can make more effective decisions based on knowing the context, process, and structures for disease control. Nonetheless, diseases continue to grow and the number of patients is increasing day by day despite the implementation of extensive programs on the prevention and control of CVD by the MoH in Iran. CVD is increasing, indicating the great failure of programs in preventing and controlling CVD in the community. During this period, the MoH, could formulate and implement community and strategic programs regarding these diseases, with the participation of various stakeholders in the country, but because these activities and programs have not been fully in line and in coordination between various organizations, they were not successful and efficient as expected. Therefore, the MoH should have appropriate interaction with private sectors,

universities, civil society, and the public using a community-oriented approach and considering the experiences and challenges while exploring community-based models for the prevention and control of CVDs.

LIMITATIONS AND BIAS

Selecting the key informants who participated in this study from members of the CVDs prevention policymaking process can lead to response bias due to their experiences and involvement in the policy process. However, data from informants were comparable to data extracted from the document review. Therefore, this bias cannot have much impact on the results of the study.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

ETHICS STATEMENT

This study has been reviewed and approved by the Research Ethics Committees of Tabriz University of Medical Sciences (Approval ID: IR.TBZMED.REC.1397.908).

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APPENDIX 1: SELF-DEVELOPED CHECKLIST

Title
Year
Publisher organization
Authors
Access date
link
Aim
Policy content (themes)

APPENDIX 2: INTERVIEW GUIDE

Explain the objectives of the study

Get written permission to participate in the study

Get permission to record audio

Name of the interviewee:

Organizational position of the interviewee:

Relevant organization to be interviewed:

Date and time of the interview:

Interview location:

Work experience of the interviewee related to cardiovascular disease:

Questions

1. When do you think cardiovascular disease is discussed? And why? Did it become one of the main priorities in the country's health policy?
2. What is your view on the organizational structure of noncommunicable diseases policy in the country since its inception?
3. How do you see the cardiovascular disease policy process in the country?
4. What factors do you think; Both macro and micro; affect the policy and policies of cardiovascular disease in the country? Explain these factors at the policy level, policy implementation, and implications.
5. A—What are the goals of cardiovascular diseases in the country? B—What was the proportionality of the targeting with the current problems of the country in this regard?
6. How has the realization of the mentioned goals been in the country? Tell your reasons.
7. A—Which organizations, institutions, and individuals are interested in cardiovascular diseases in the country?
8. How do you see the role of a coordinating body with sufficient authority to fully coordinate cardiovascular disease programs and policies at the national level in the country?
9. What is the role of scientific evidence and documents regarding appropriate policies for prevention, treatment, and control of cardiovascular diseases in the country?
10. In your opinion, what should be the main priorities in formulating and implementing cardiovascular disease policies in the country?
11. Have any other points of view regarding the policymaking situation, policies, and programs of cardiovascular diseases in the country?

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ORIGINAL ARTICLE

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Community-based interventions to reduce sugar intake in healthy populations: A systematic review

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Abstract

This study aimed to assess community-based interventions to decrease sugar intake among healthy people. According to PRISMA guidelines, in this systematic review, databases including PubMed/MEDLINE, Scopus, EMBASE, Cochrane Library, Web of Science, ProQuest, and Google Scholar were searched up to August 2021. Randomized clinical trials or quasi-experimental studies reporting the effect of community-based interventions to reduce sugar intake in general population were included. The quality of eligible studies was assessed using The Joanna Briggs Institute Critical Appraisal Checklists. Our search strategy resulted in a total of 1384 articles out of which 59 articles were included in the study. Of 59 included studies, 48 studies reported significant decrease in sugar intake or intention to sugar sweetened beverages (SSBs) intake or purchasing SSBs. Of the 48 effective studies, 45 (93.7%) had a low risk of bias. Based on the results of low risk of bias studies, interventions performed in schools, household, and community were effective in reducing sugar intake. Almost all types of interventions (educational, multiple and changing in law) had the same effectiveness on reducing sugar intake. In addition, interventions which had a duration of 24–48 weeks were less successful than the others. Interventions with the repetition span of more than 1 month were less successful than the others. The application of multiple interventions appears to be the most effective approach to reducing sugar intake in healthy populations. However, long-term and well-designed future studies in different settings are recommended to confirm these results.

KEYWORDS
community-based interventions, refined carbohydrate, sugar, systematic review

Key points

- Educational and multiple interventions are suggested.
- Applying educational and multiple interventions together can be more effective.
- Implementation of the interventions depends on countries' resources.

INTRODUCTION

High intake of sugar (sucrose) is a considerable problem in both developed and developing countries (Abdelmalek & Day, 2015; Adachi-Mejia et al., 2013). A growing body of evidence showed added sugar may result in obesity and metabolic syndrome that increase the probability of type 2 diabetes mellitus, cardiovascular disease, and nonalcoholic fatty liver disease (Eckel et al., 2005). Different studies have shown an increase in the consumption of sweetened foods and drinks over the last decade (Abdelmalek & Day, 2015; Adachi-Mejia et al., 2013; Ahlfeld, 2009; Aller et al., 2011; New Zealand Beverage Guidance Panel, 2014). Different social and environmental factors are related to the increase in purchasing and consumption of sweetened products. These factors vary from the effect of watching television or social media advertisements to higher availability of sweet products and consumption of semi-prepared foods (Battram et al., 2016; Davy et al., 2014; Jou & Techakehakij, 2012). Sugar-sweetened beverages (SSBs) contribute to obesity through their "add-on" caloric load (Basu, Seligman, et al., 2014; Beaglehole, 2014; Beck et al., 2014; Bermudez & Gao, 2010; Blakely et al., 2014; Nikniaz et al., 2018; Van Gaal & Michiel, 2005). In addition, different studies have shown a positive relation between consumption of sweetened beverages and disorders such as diabetes (Baltaci et al., 2012; Basu, Vellakkal, et al., 2014; Belalcazar et al., 2014; Bleich & Wang, 2011; De Koning et al., 2011), high blood triglyceride (Barrio-Lopez et al., 2013; Bray, 2012; Duffey et al., 2010), cardiovascular diseases (Grasser et al., 2014; Johnson et al., 2009; Keller, 2014; Mucci et al., 2012; Sonestedt et al., 2015; Thornley et al., 2012), nonalcoholic fatty liver (Abdelmalek & Day, 2015; Ma et al., 2015; Moore et al., 2014), increase of uric acid in blood (Gao et al., 2007; Hochuli et al., 2014; Nguyen et al., 2009), gout (Dalbeth et al., 2015; Merriman et al., 2014), and tooth decay (Bernabé et al., 2014; Freeman, 2014; Lueangpiansamut et al., 2012; Marshall, 2013). From another perspective, consumption of sweetened beverages is a substitution for consuming healthy drinks like milk; therefore, it can also affect the quality of daily diet (Kohlboeck et al., 2012; Leung et al., 2013, 2012; Libuda et al., 2009).

The consumption rate of sugar and sweet beverages is still high, even though different strategies have been programmed to reduce it. Some of these strategies are as follow: increasing the availability of water and other healthy drinks such as milk, reducing availability of sweet beverages, reducing the price of healthy drinks, and so forth (Veitch et al., 2011; Visscher et al., 2010; Zheng et al., 2015). To identify interventions to reduce consumption of sugar and sweet beverages, it is essential to review some successful community-based strategies and evaluate their effectiveness to help policymakers in choosing best policy options with respect to specific situations of each country. Considering the numerous evidence available and the lack of a systematic review study in this field, this study was conducted to evaluate the community-based interventions performed worldwide to reduce sugar consumption.

MATERIAL AND METHODS

The present study aimed to systematically review the studies which evaluated the effect of community-based interventions in reducing sugar intake in general population. The main outcome of present systematic review was reducing sugar intake in general population. The reporting procedures followed the guidelines presented by Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Moher et al., 2010).

Search strategy

The following electronic databases were searched to identify relevant studies from January 2000 to August 2021: PubMed/MEDLINE, Scopus, EMBASE, Cochrane Library, Web of Science, ProQuest, and Google Scholar. Strategy search was created using a combination of the MeSH (Medical Subject Headings) terms from the PubMed database and free text words. For each electronic database, the search strategy was adopted.

The search strategy for PubMed was as follows: Search ("sugar intake" [Title/Abstract]) OR ("sugar consumption" [Title/Abstract]) OR "refined carbohydrate" [Title/Abstract]) OR "sucrose" [Title/Abstract]) OR "food reformulations" [Title/Abstract]) OR "sugar substitute" [Mesh]) OR "sugar substitute" [Title/Abstract]) OR "sugar-Sweetened Beverages" [Mesh]) OR "sugar-Sweetened Beverages" [Title/Abstract]) OR SSB [Title/Abstract]) OR beverages [Mesh]) OR soda [Title/Abstract]) AND "community based" [Title/Abstract]) OR community-based [Title/Abstract]) OR population-based [Title/Abstract]) OR "population based" [Title/Abstract]) OR evidence-based [Title/Abstract]) OR practice [Title/Abstract]) OR education [Mesh]) OR education [Title/Abstract]) OR "food policy" [Title/Abstract]) OR intervention [Title/Abstract]) OR implementation [Title/Abstract]) OR approach [Title/Abstract]) OR strategy[Title/Abstract]) AND "national program" [Title/Abstract]) OR country [Title/Abstract]) OR community [Title/Abstract]). The reference lists of the retrieved articles were also searched to identify potentially relevant studies. Gray literature was also searched using the guidelines presented by the European Association for Gray Literature Exploitation (EAGLE) and the Healthcare Management Information Consortium (HMIC). All search results were imported into the Endnote software for screening. The entire article-screening procedure was conducted independently by two researchers (ZN and LN). Where disagreement was evident, a final decision was made by discussion and consultation with a third person (MAF).

Inclusion and exclusion criteria

Randomized clinical trials (RCTs) or quasi-experimental studied in English language were included if they: (i) enrolled all age groups of general population; (ii) evaluated the effect of community-based intervention to reduce the intention to consumption of SSBs, or reduce the intake of SSBs or sugar or reduce the purchase of SSBs.

Studies conducted on pregnant or lactating women and subjects with mental illness and chronic diseases such as cardiovascular diseases, diabetes, and hypertension were excluded from the study. Individual interventions, economic evaluations, modeling studies, and clinical and laboratory studies were also excluded. The research question based on Population, Intervention, Comparison, and Outcome (PICO) is available in Table 1.

It is noteworthy to indicate that community-level interventions were defined as group-based health promotion, education, advice, counselling or subsidy interventions, or interventions conducted in a community setting (e.g., a workplace, community center, sports center, and shop) (McLeroy et al., 2003).

TABLE 1 Inclusion and exclusion criteria based on PICO

PICO components	Inclusion criteria	Exclusion criteria
Population	All ages and genders	Patients with chronic illness (such as diabetes and cardiovascular diseases)
Intervention	Community-based interventions to decrease sugar and sugar-sweetened beverages consumption	Clinical or laboratory interventions
Comparison	Control group or pretest	-
Outcome	Decrease in amount or frequencies of sugar and sugar-sweetened beverages consumption	Outcomes like increasing awareness about sugar and sugar-sweetened beverages
Other criteria	Papers in English language	Observational and noninterventional studies, studies with the aim of tool development

Abbreviation: PICO, Population, Intervention, Comparison, and Outcome.

Study selection, data extraction strategy, and quality assessment

Two reviewers extracted data independently and screened the titles and abstracts to identify which potentially relevant records met the inclusion/exclusion criteria. Full-text articles were obtained for these records and were independently assessed for relevance by two reviewers. For any discrepancies between authors, consensus was reached through discussion. The following information was extracted from the studies: author(s), year of publication, target population characteristics, country, methodological characteristics (study design), types and aims of intervention, and main outcomes. The quality of studies was assessed using The Joanna Briggs Institute Critical Appraisal Checklist for RCTs and Quasi-Experimental Studies. The quality assessment of the studies was performed by two independent researchers, and all discrepancies were resolved by discussion. Bias was assessed as a judgment (Yes, No, Unclear, n/a) through 13 questions in RCT checklist and nine questions in Quasi-Experimental checklist that aim to evaluate the study's research design and the validity of its results. A flow chart of literature review is shown in Figure 1.

To calculate the effectiveness rate, the total number of effective interventions was divided by total number of interventions and reported as percentage.

RESULTS

Out of 1384 articles retrieved from different databases, 763 were excluded due to duplicity. In screening the titles and abstracts, 479 articles were excluded and after reviewing the full-texts 83 articles were excluded. Finally, 59 articles were included in the study (Figure 1).

The data and characteristics of the 59 reviewed articles are presented in Tables 2 and 3. Of the 59 articles reviewed, 53 were in high-income countries. Most studies (38 studies) were conducted in the United States. The studies could be divided into four categories based on the context: at the community level (17 studies), schools (31 studies), household (9 studies), and health care and military centers (2 studies). Most studies (51 studies) were randomized controlled trials.

Participants in 17 studies were adults and the elderly people. Children and adolescents were also investigated in 22 and 17 studies, respectively. Totally, the number of subjects in

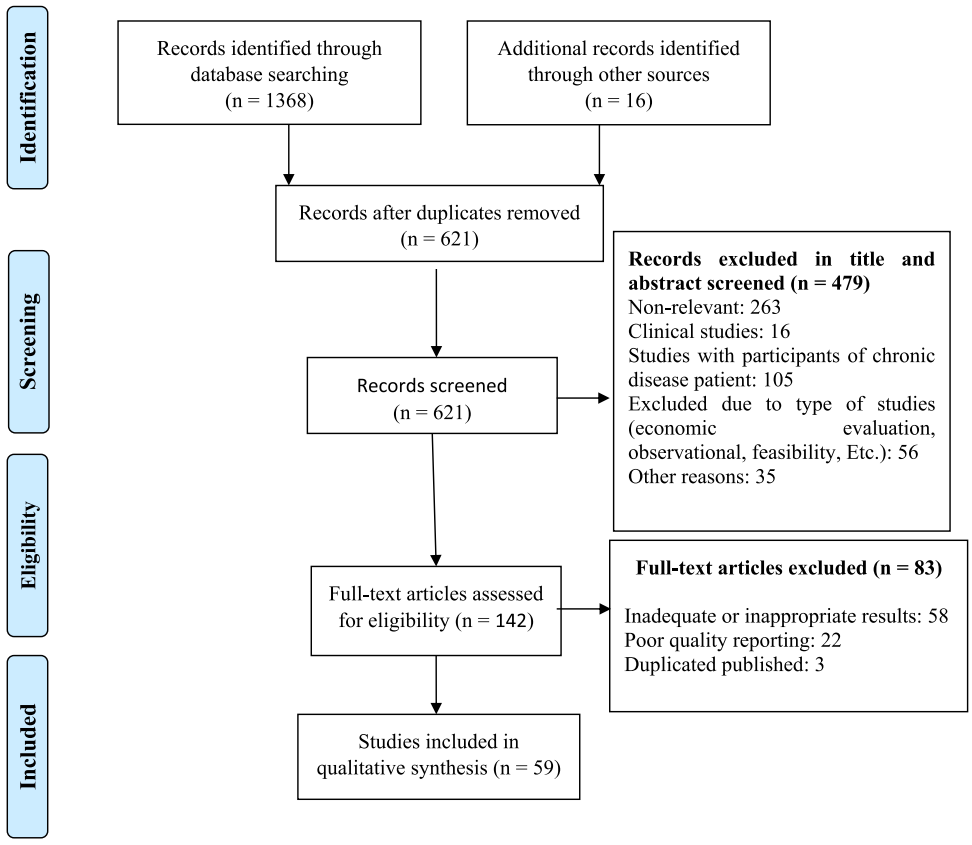

FIGURE 1 Searches and inclusion process flow diagram

the intervention and control groups was 46,831 and 32,336, respectively. In one study, the sample size was not given (Schwendicke et al., 2016).

Results of studies based on interventions

The interventions used in the reviewed studies could be categorized into three groups including education, changing rules and policies, and multiple interventions (Table 3). We identified the reported results as successful if they caused a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs. The three groups of interventions were as follows:

1. Educational interventions were divided based on settings of the intervention: at schools (Bjelland et al., 2011; Bleakley et al., 2015; Bleich et al., 2012; Cunha et al., 2013; Dwyer et al., 2003; Ezendam et al., 2012; Feng et al., 2016; Kattelmann et al., 2014; Kaufman-Shriqui et al., 2016; Kenney et al., 2015; Lane et al., 2018; Lo et al., 2008; Sichieri et al., 2013; Souza et al., 2013, 2018; Nanney et al., 2014; Romo & Abril-Ulloa, 2018; Story et al., 2012), in community (Bergen & Yeh, 2006; Chang et al., 2017; Daivadanam et al., 2018; Davy et al., 2017; Fukuoka et al., 2015; Hernández-Cordero & Popkin, 2015; Kerr et al., 2016; Partridge et al., 2016; Rodríguez-Ramírez et al., 2015; Zoellner et al., 2016),

TABLE 2 Characteristics of included studies

Author: year	Country	Setting	Study design	Participants	
				Intervention group (*n*)	Control group (*n*)
Albala et al. (2008)	Chile	Household	RCT	Children aged 8–10 years (47)	Children aged 8–10 years (46)
Davy et al. (2017)	USA	Community	RCT	Adults aged ≥18 years (151)	Adults aged ≥18 years (145)
Bergen and Yeh (2006)	USA	Community	RCT	Vending machines with beverage selection panels and labels plus motivational posters (6)	Vending machines without labels or posters (2)
Bingham et al. (2012)	USA	Military service	RCT	Conscripts 18–21 years (362)	Conscripts 18–21 years (242)
Bjelland et al. (2011)	USA	School	RCT	Adolescents 11–13 years (498)	Adolescents 11–13 years (898)
Bleakley et al. (2015)	USA	School	RCT	Adolescent ages 13–17 years (805)	Adolescent ages 13–17 years (805)
Bleich et al. (2014)	USA	School	RCT	Adolescents, aged 12–18 years (850)	Adolescents, aged 12–18 years (816)
Blum et al. (2008)	USA	School	Quasi-experimental	Students with the mean age of 15.8 ± 0.8 (235)	Students with the mean age of 15.8 ± 0.8 (221)
Cloutier et al. (2015)	USA	Household	RCT	Maternal-infant dyads (30)	Maternal-infant dyads (27)
Cradock et al. (2011)	USA	School	Quasi-experimental	Adolescents aged 15–19 years (1079)	Adolescents aged 15–19 years (1079)
Cullen et al. (2008)	USA	School	RCT	Middle-School students (1650)	Middle-School students(1650)
Cunha et al. (2013)	Brazil	School	RCT	11 years old students (277)	11 years old students (282)
Delpier et al. (2013)	USA	Healthcare center	Quasi-experimental	Adolescents aged 13–17 years (27)	-
Dwyer et al. (2003)	USA	School	RCT	Intervention schools (56)	Control schools (20)
Ebbeling et al. (2006)	USA	Household	RCT	Adolescents with the mean age of 16.0 ± 1.1 years (53)	Adolescents with the mean age of 15.8 ± 1.1 years (50)
Epstein et al. (2001)	USA	Household	RCT	Families with at least one obese parent and a 6- to 11-year-old nonobese child (30)	Families with at least one obese parent and a 6- to 11-year-old nonobese child (30)
Ezendam et al. (2012)	Nether-lands	School	RCT	Students aged 12–13 years (482)	Students aged 12–13 years (398)

(Continues)

TABLE 2 (Continued)

Author: year	Country	Setting	Study design	Participants	
				Intervention group (*n*)	Control group (*n*)
Feng et al. (2016)	USA	School	Quasi-experimental	Children aged 5–9 years (115)	Children aged 5–9 years (104)
Folta et al. (2013)	USA	Community	RCT	Children aged 6–8 years (68)	Children aged 6–8 years (68)
Fukuoka et al. (2015)	USA	Community	RCT	Adults with a mean age of 55.2 years (30)	Adults with a mean age of 55.2 years (31)
Fung et al. (2013)	Canada	School	RCT	Students Grade 5 in 2003 (5215) and 2011 (5508)	Students Grade 5 in 2003 (5215) and 2011 (5508)
Goldberg et al. (2015)	USA	School	RCT	Children with the mean age of 9.0 (327)	Children with the mean age of 9.1 (177)
Hernández-Cordero and Popkin (2015)	USA	Community	RCT	Women aged 18–45 years (120)	Women aged 18–45 years (120)
Kattelmann et al. (2014)	USA	School	RCT	Students with the mean age of 19.3 ± 1.1 (824)	Students with the mean age of 19.3 ± 1.1 (815)
Kenney et al. (2015)	USA	School	RCT	School (5)	School (5)
Kerr et al. (2016)	Australia	Community	RCT	Men and women aged 18–30 years (82)	Men and women aged 18–30 years (82)
Knowlden and Sharma (2016)	USA	Household	RCT	Mothers (22)	Mothers (22)
Lo et al. (2008)	Canada	School	RCT	Students with an average age of 14 (33)	Students with an average age of 14 (24)
Mendoza et al. (2010)	USA	School	RCT	Adolescents (100)	Adolescents (100)
Mozaffarian et al. (2010)	USA	School	RCT	Children aged 5–14 years (445)	Children aged 5–14 years (445)
Nanney et al. (2014)	USA	School	RCT	Students aged 9–12 (37)	Students age 9–12 (37)
Partridge et al. (2016)	Australia	Community	RCT	Mid-20 young adults (250)	Mid-20 young adults (250)
Rodearmel et al. (2007)	USA	Household	RCT	Children aged 7–14 (100)	Children aged 7–14 (92)

TABLE 2 (Continued)

Author: year	Country	Setting	Study design	Participants	
				Intervention group (*n*)	Control group (*n*)
Rodríguez-Ramírez et al. (2015)	USA	Community	RCT	Women aged 18–45 (120)	Women aged 18–45 (120)
Schwendicke et al. (2016)	German	Community	Quasi-experimental	Population aged 14–79 years	-
Shapiro et al. (2008)	USA	Household	RCT	Children age 5–13 (48)	Children aged 5–13 (48)
Sharma et al. (2014)	Australia	Community	Quasi-experimental	Household aged <40 years (5560)	-
Sichieri et al. (2013)	Brazil	School	RCT	Students aged 10–11 years (1134)	Students aged 10–11 years (1134)
Simon et al. (2013)	USA	Community	RCT	Children aged lower than 17 years (5934)	Children aged lower than 17 years (5934)
Simons et al. (2015)	Nether-lands	Household	RCT	Adolescents aged 12–17 (140)	Adolescents aged 12–17 (130)
Souza et al. (2013)	Brazil	School	RCT	Participate age years adults (47)	Participate age years adults (48)
Story et al. (2012)	USA	School	RCT	Children aged 3–5 years (454)	Children aged 3–5 years (454)
Sturm et al. (2010)	USA	School	Quasi-experimental	Children age 11 ± 4.2 (7414)	-
Taveras et al. (2011)	USA	Household	RCT	Children aged 2–6 years (75)	Children aged 2–6 years (75)
Temme et al. (2011)	Nether-lands	Community	RCT	Young adults aged 19–30 years (750)	Young adults aged 19–30 years (750)
van de Gaar et al. (2014)	Nether-lands	School	RCT	Children aged 6–12 years (651)	Children aged 6–12 years (631)
van Grieken et al. (2014)	Nether-lands	Community	RCT	5 Years old children (349)	5 Years old children (288)
Visscher et al. (2010)	Nether-lands	School	RCT	Children aged 12–18 years (5866)	Children aged 12–18 years (5866)
Waterlander et al. (2014)	Nether-lands	Community	RCT	Participant aged 28 (46)	Participant aged 28 (49)

(Continues)

TABLE 2 (Continued)

Author: year	Country	Setting	Study design	Participants	
				Intervention group (*n*)	Control group (*n*)
Whatley Blum et al. (2007)	USA	School	RCT	High School students (756)	High School students (746)
Zoellner et al. (2016)	USA	Community	RCT	Adults aged 18 to ≥65 (151)	Adults aged 18 to ≥65 (145)
Romo and Abril-Ulloa (2018)	Ecuador	School	Quasi-experimental	Pilot intervention: Preschool children (3–4 years) (155)	-
Daivadanam et al. (2018)	India	Community	RCT	Adults aged 25–45 (239)	Adults aged 25–45 (239)
Chang et al. (2017)	USA	Community	RCT	Low-income mother (410)	Low-income mother (202)
Hawkins et al. (2018)	USA	School	RCT	Elementary school (1195)	Elementary school (431)
Kaufman-Shriqui et al. (2016)	Israel	School	RCT	11 school (276 students) aged 4–7	5 school (104 student) aged 4–7
Lane et al. (2018)	USA	School	Crossover	6th grade ($n = 34$, 3 classrooms)	6th grade ($n = 34$, 3 classrooms)
				7th grade ($n = 43$, 2 classrooms)	7th grade ($n = 43$, 2 classrooms)
Ickovics et al. (2019)	USA	School	RCT	Kindergarten through eighth grade [K-8] 291	Kindergarten through eighth grade [K-8] 304
Liu et al. (2019)	China	School	RCT	6 primary schools (7–11 years old)	6 primary schools (7–11 years old

TABLE 3 Characteristics of interventions and results of included studies

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Albala et al. (2008)	Chile	Children were instructed to drink 3 servings/d (200 g per serving) of the milk delivered to their homes and to not consume SSBs. A nutritionist visited the homes of children in the intervention group weekly to deliver the milk beverages, provide instructions to the family about consuming the delivered beverages, and encourage parents to remove SSBs from their homes.	Education with providing	No	Only SSB	16	Week	FFQ	Yes
Davy et al. (2017)	USA	Participants were randomly assigned to SIPsmartER or MoveMore. SIPsmartER targeted decreasing SSB consumption and MoveMore targeted physical activity promotion.	Education using technology	Yes	Mix	25	Two weeks	Three 24 h recalls	Yes
Bergen and Yeh (2006)	USA	Eight soft drink vending machines were randomly selected and assigned to one of three	Education with providing	No	Mix	5	Week	Totals of each type of	Yes

(Continues)

TABLE 3 (Continued)

Author: year	Country	Dietary intervention: Description in the intervention group	Type of intervention	Use of technology	Only SSB OR Mix	Duration (week)	Frequency-every	Assessment method	Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
		conditions: energy-content labels on nonenergy-containing beverage selection panels (intervention I), labels plus motivational posters (intervention II), or control. The totals of all beverages sold and machine revenue were recorded.						beverage sold	
Bingham et al. (2012)	USA	Increase the supply of healthy foods at the two main eating environments in the military setting, garrison refectories and soldier's homes cafeterias	Education with providing	No	Mix	8	Week	FFQ	Yes
Bjelland et al. (2011)	USA	Providing lessons with student booklet, posters, weekly fruit and vegetable breaks and activity breaks in classroom, sports equipment for recess activities, active commuting, fact sheets for parents and an inspirational course for physical education teachers.	Education in school	Yes	Mix	80	Week	FFQ	No

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Duration (week)**	**Frequency-every**	**Assessment method**	
Bleakley et al. (2015)	USA	The effects of emotional appeals in public service advertisements on adolescent's intention to sugar-sweetened beverages consumption was investigated.	Education in school	Yes	Only SSB	4	Week	Behavioral intention questionnaire	Yes
Bleich et al. (2014)	USA	Providing caloric information on SSBs in stores.	Education in school	Yes	Only SSB	4	2 weeks	Type and volume of beverage purchased	Yes
Blum et al. (2008)	USA	Reducing availability of sugar-sweetened beverage and diet soda among students.	Changing buffet law	Yes	Mix	18	Week	FFQ	Yes
Cloutier et al. (2015)	USA	The intervention was designed to increase maternal skills in goal-setting, stimulus control and problem-solving, engage family members to support changes, link mothers to neighborhood resources.	Education at home	Yes	Mix	24	12 weeks	FFQ	Yes

(Continues)

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Cradock et al. (2011)	USA	Restricting the sale of sugar-sweetened beverages in vending and à la carte settings.	Changing buffet law	Yes	Only SSB	24	Week	24-h recall	Yes
Cullen et al. (2008)	USA	The guidelines apply to all school food sources, including vending machines. For middle schools, the policy restricts the portion sizes of high-fat and sugar snacks It also sets limits on the frequency of serving high-fat vegetables such as French fries.	Changing buffet law	Yes	Mix	12	Week	Food record	Yes
Cunha et al. (2013)	Brazil	Encouraging students to change their eating habits and food consumption in the school year. Trained nutritionists gave monthly 1-h sessions in the classrooms.	Education in school	Yes	Mix	24	Month	FFQ	No
Delpier et al. (2013)	USA	Adolescents initially were provided with a pamphlet and related oral teaching concerning SSBs by the FNP students, as well as a water bottle to encourage healthy fluid intake.	Education in clinics	Yes	Only SSB	4	Week	24-h recall	Yes

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Dwyer et al. (2003)	USA	Implementing the Eat Smart program to decrease fat and sugar-sweetened beverages consumption among students.	Education in school buffet	Yes	Mix	5	Week	Analyzing total nutrients for each menu	Yes
Ebbeling et al. (2006)	USA	The intervention group received weekly home deliveries of noncaloric beverages. Also refrigerator magnets were mailed to subjects, with each magnet conveying a message under the theme of "Think Before You Drink."	Education with Providing	Yes	Only SSB	25	Week	Two 24-h dietary recall	No
Epstein et al. (2001)	USA	Families with obese parents and nonobese children were randomized to groups in which parents were provided a comprehensive behavioral weight-control program and were encouraged to increase fruit and vegetable intake or decrease intake of high-fat/high-	Education in families	Yes	Mix	24	4 Week	FFQ	Yes

(Continues)

TABLE 3 (Continued)

Author: year	Country	Dietary intervention: Description in the intervention group	Type of intervention	Use of technology	Only SSB OR Mix	Duration (week)	Frequency-every	Assessment method	Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
		sugar foods. Child materials targeted the same dietary changes as their parents without caloric restriction.							
Ezendam et al. (2012)	Netherlands	The computer-tailored intervention wes performed to help prevent excessive weight gain among adolescents. Separate modules ($n = 8$) addressed the issues of weight management and energy balance-related behaviors.	Education in school	Yes	Mix	16	10 weeks	FFQ	Yes
Feng et al. (2016)	USA	A bilingual school-based curriculum emphasizing knowledge and skills for healthy eating containing 10 weekly hour-long lessons per grade level, along with take-home workbooks,	Education in school	Yes	Only SSB	88	10 week	Some questions	Yes
Folta et al. (2013)	USA	In the before-school environment, the pre-existing free breakfast program was changed to increase the fresh fruit, low-fat	Changing buffet law	Yes	Mix	96	32 week	A 68-item Family Survey Form	Yes

TABLE 3 (Continued)

Author: year	Country	Dietary intervention: Description in the intervention group	Type of intervention	Use of technology	Only SSB OR Mix	Duration (week)	Frequency-every	Assessment method	Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
		milk, and whole grains served; In the school environment, changes to school lunch were realized and a classroom curriculum was implemented.							
Fukuoka et al. (2015)	USA	The curriculum was adapted from the Diabetes Prevention Program, with the Frequency of in-person sessions reduced from 16 to 6 sessions and group exercise sessions replaced by a home-based exercise program. A study-developed mobile phone app and pedometer augmented the intervention and provided self-monitoring tools.	Education using technology	Yes	Mix	20	2 weeks	FFQ	Yes
Fung et al. (2013)	Canada	A population-level school food and nutrition policy was implemented. The Nova Scotia Nutrition Policy (NSNP) is intended to increase access to and enjoyment of health-	Changing buffet law	Yes	Mix	-	-	YAQ and Canadian Nutrient File	Yes

(Continues)

TABLE 3 (Continued)

Author: year	Country	Dietary intervention: Description in the intervention group	Type of intervention	Use of technology	Only SSB OR Mix	Duration (week)	Frequency-every	Assessment method	Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
		promoting, safe, and affordable food and beverages served and sold in public schools.							
Goldberg et al. (2015)	USA	Messages and activities were designed to promote altruistic beliefs about the value of environmentally sound nutrition practices. A color workbook with in-class and family activities supported the 30-min classroom lessons.	Multiple intervention	Yes	Mix	28	Week	Digital-photography and checklist	No
Hernández-Cordero and Popkin(2015)	USA	Women were randomly allocated to the water and education provision (WEP) group or the education provision (EP) only group. The WEP group received biweekly water deliveries and both groups received equal monthly nutrition counseling. During nutrition counseling, the WEP group sessions included activities to encourage	Education with providing	Yes	Mix	36	12 weeks	24-h dietary recall	No

TABLE 3 (Continued)

Author: year	Country	Dietary intervention: Description in the intervention group	Type of intervention	Use of technology	Only SSB OR Mix	Duration (week)	Frequency-every	Assessment method	Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
		increased water intake, reduced SSB intake, and substitution of water for SSB.							
Kattelmann et al. (2014)	USA	The intervention consisted of 21 mini-educational lessons and e-mail messages (called nudges).	Education using technology	Yes	Mix	60	12 weeks	8 items questionnaire	Yes
Kenney et al. (2015)	USA	The intervention had 2 components. First, to promote water's appeal, posters highlighting water source locations and encouraging consumption were displayed near cafeteria water access points. Second, to make consuming water easier, cup dispensers were installed next to cafeteria water fountains and stocked with 5-ounce recyclable cups chosen by BPS Food and Nutrition Services.	Education in school buffet	Yes	Mix	3	Week	Direct observation by trained research assistants	Yes

(Continues)

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Kerr et al. (2016)	Australia	A mobile food record and text messaging support was performed to decrease sugar-sweetened beverage use and improve nutrition behaviors.	Education using technology	Yes	Mix	24	Week	FFQ	Yes
Knowlden and Sharma-(2016)	USA	providing information about the four child behaviors to mothers. Audio visual lessons, interactive worksheet, online discussion Boards, telephone counseling sessions, and E-mail announcements were applied.	Education in clinics	Yes	Mix	48	4 weeks	Instrument developed by the investi-gators	Yes
Lo et al. (2008)	Canada	Six sessions of Fluids Used Effectively for living nutrition education were delivered by using 2 peer educator models (multiple and single), and the intervention was delivered in a 45-minute weekly class session over a 6-week period.	Education in school	Yes	Mix	6	Week	FFQ	Yes

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Mendoza et al. (2010)	USA	The guidelines applied to all school food environments, including snack bars and vending. For middle schools, the policy restricted portion sizes of snacks and high-fat foods, sales of sweetened beverages, and the fat content of all foods.	Changing school low	Yes	Mix	96	48 weeks	Food record	Yes
Mozaffarian et al. (2010)	USA	Offering fresh fruit or vegetable options daily, not serving foods with trans fats, offering water as the primary beverage daily, not serving sugar-sweetened beverages, and serving more whole grains instead of processed grains (including cookies and desserts).	Changing buffet law	Yes	Mix	52	Week	Food record	Yes
Nanney et al. (2014)	USA	Implementation of school health policies and educational practices, including, physical activity, food service, and nutrition.	Education	Yes	Mix	96	Week	Food record	Yes

(Continues)

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Partridge et al. (2016)	Australia	Each intervention participant received the 3-month program consisting of five personalized coaching calls with a dietitian, eight weekly gender and stage-of-change specific text messages targeting fruit and vegetable consumption, take-out meal consumption, SSB consumption and physical activity levels, weekly emails and access to smartphone applications and study website.	Education using technology	Yes	Mix	36	12 weeks	Validated short questions	Yes
Rodearmel et al. (2007)	USA	Families were asked to make 2 small lifestyle changes: Physical Activity Changes and dietary Changes. Each AOM family participant was instructed to eliminate 420 kJ/day (100 kcal/day) from his or her usual diet; replacement of dietary sugars alone or in food products with	Multiple inter-vention	Yes	Mix	24	2 weeks	Recording	Yes

TABLE 3 (Continued)

		Dietary intervention							
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	**Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs**
		Splenda no-calorie sweetener packet or granular products or sucralose-containing beverages was emphasized. Families were also educated on the benefits of eating breakfast, eating and preparing meals at home, and the 5-a-day campaign to increase fruit and vegetable consumption.							
Rodríguez-Ramírez et al. (2015)	USA	Providing general information about a healthy diet. The intervention group received water and education activities oriented to reducing the intake of SSBs and substituting water consumption. Bottled water (2 L/d per person) was home-delivered during the intervention period.	Education with providing	Yes	Mix	36	Week	24-h dietary recalls	Yes
Schwendicke et al. (2016)	German	A taxation on sugar-sweetened beverages.	Changing law	Yes	Only SSB	480	48 weeks	Get information from Nutrition Survey II	Yes

(Continues)

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Shapiro et al. (2008)	USA	All families participated in a total of three educational group sessions (90 min each) weekly. The goal for session 3 was zero SSB per day for both child and parent. Families were monitored using SMS.	Family education	Yes	Mix	8	Week	Questions	Yes
Sharma et al. (2014)	Australia	Taxation on the sugar-sweetened beverages	Changing law	No	Only SSB	52	Week	Information on purchases	Yes
Sichieri et al. (2013)	Brazil	Nutritional program administered over one school year that focused on reducing the consumption of sodas.	Education in school	Yes	Only SSB	48	Week	24-h recall	Yes
Simon et al. (2013)	USA	Prohibiting the sale of most SSBs on school campuses	Changing school law	No	Only SSB	240	48 weeks	Questions	Yes
Simons et al. (2015)	Netherlands	The adolescents assigned to the intervention group received a PlayStation Move upgrade package to play the active video games on a PlayStation 3	Education using technology	Yes	Mix	40	16 weeks	Questions	Yes

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
		console in their homes. The participants in the intervention group received four active Move video games with different game genres (Sport Champions, Move Fitness, Start the Party and Medieval Moves).							
Souza et al. (2013)	Brazil	A nutrition educational program was implemented in the schools in question through messages, activities and printed educational materials encouraging reduced levels of added sugar in school meals and in the school lunch cooks' own intake.	Education in school	Yes	Only SSB	28	2 weeks	FFQ	Yes
Story et al. (2012)	USA	School environment intervention, supplemented with family involvement, to reduce excessive weight gain by increasing physical activity and healthy eating practices.	Education in school	Yes	Mix	31	14 weeks	FFQ	Yes

(Continues)

TABLE 3 (Continued)

		Dietary intervention							
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	**Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs**
Sturm et al. (2010)	USA	Taxing on the sugar-sweetened beverages	Changing law	No	Mix	48	-	Questions	Yes
Taveras et al. (2011)	USA	Intervention practices received primary care restructuring, and families received motivational interviewing by clinicians and educational modules targeting TV, fast food, and sugar-sweetened beverages.	Education	No	Only SSB	96 week	48 week	FFQ	Yes
Temme et al. (2011)	Netherlands	Three replacement scenarios were compared with the nutrient intake "as measured" in the Dutch consumption survey. The foods not complying with health logo criteria were replaced either by "virtual" foods exactly complying with the health logo criteria, with real 2007 market shares (scenario I) and 100% market shares (scenario II), or by existing similar foods with a composition that already	Providing	Yes	Mix	-	-	24-h recall	Yes

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
		complied with the health logo criteria (scenario III).							
van de Gaar et al. (2014)	Netherlands	The water campaign consists of lessons at school combined with integrated community activities that promote water consumption in various ways.	Multiple inter-vention	No	Only SSB	48	Week	Frequency of SSB being brought to school	Yes
van Grieken et al. (2014)	Netherlands	During the well-child visit and in up to three additional visits, parents of overweight children were offered tailored information regarding a healthy lifestyle.	Education in clinics	Yes	Mix	96	Week	Questions	Yes
Visscher et al. (2010)	Netherlands	Placing water coolers in school canteens, providing free water to pupils, without any communication such as les-sons or media messages.	Providing	No	Only SSB	12	2 weeks	Sales of beverages	No
Waterlander et al. (2014)	Netherlands	Taxation on the sugar-sweetened beverages	Changing law	Yes	Mix	-	-	purchased quantity	Yes

(Continues)

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Whatley Blum et al. (2007)	USA	Offering only nonfat or 1% low-fat milk (including flavored milk), 100% juice, and water. Portion sizes were limited.	Changing law	No	Mix	36	12 weeks	Number of items offered, and nutrition information for each item	No
Zoellner et al. (2016)	USA	Participants were educated on recommendations for all beverage categories. The 6-month multi-component intervention was applied using three small-group classes, one live teach-back call, and 11 interactive voice response calls.	Educational in community	Yes	Only SSB	24	12 weeks	FFQ	No
Romo and Abril-Ulloa (2018)	Ecuador	An educational and behavioral intervention that included games, singing, and storytelling was developed. The activities of the intervention were focused on 3 principal goals: (1) drinking	Education using technology	Yes	Only SSB	40	Week	Questions	Yes

TABLE 3 (Continued)

Author: year	Country	Dietary intervention: Description in the intervention group	Type of intervention	Use of technology	Only SSB OR Mix	Duration (week)	Frequency-every	Assessment method	Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
		water instead of sugar-sweetened beverages; (2) eating fruits and vegetables at snack times; and (3) engaging in physical activity rather than screen time during free time.							
Daivadanam et al. (2018)	India	Interventions were delivered for a period of 1-year at household level at 0, 6, and 12 months, including counselling sessions, telephonic reminders, home visits and general awareness sessions through the respective neighborhood groups in the intervention arm.	Education in community	No	Mix	48	0–6–12 months	24-h recall	Yes
Chang et al. (2017)	USA	Providing culturally sensitive videos in DVD format and peer support group teleconferences. The 20-minute video lessons featured peers from the target audience ("featured mothers") who explained and demonstrated	Education in community	Yes	Mix	16	Baseline and 16 weeks	Questions	No

(Continues)

TABLE 3 (Continued)

Author: year	Country	Dietary intervention: Description in the intervention group	Type of intervention	Use of technology	Only SSB OR Mix	Duration (week)	Frequency-every	Assessment method	Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
		practical tips for making positive lifestyle changes. Groups of 10 participants were asked to dial into their designated peer support group teleconference (30 min per session) during the week after watching each lesson.							
Hawkins et al. (2018)	USA	A multi-component intervention focused on modifying environmental and behavioral factors to help prevent inappropriate weight gain in children. Primary prevention strategies expose all individuals to the prevention program. Additionally, the intervention targets the foodservice environment by promoting the Child Nutrition Program.	Multiple intervention in school	Yes (in second program)	Mix	112	12 weeks	Digital photography of foods and plate waste	Yes
Kaufman-Shriqui et al. (2016)	Israel	The intervention was implemented on three levels: children,	Education in school	No	Mix	12	Every 2 weeks, 3 months,	Questions	Yes

TABLE 3 (Continued)

Author: year	Country	Dietary intervention: Description in the intervention group	Type of intervention	Use of technology	Only SSB OR Mix	Duration (week)	Frequency-every	Assessment method	Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
		mothers, and teachers. The intervention (IArm) included nutrition classes for children, mothers, and teachers and physical activity (PA) classes for children; the control (CArm) received PA only.					and 6 months from the baseline		
Lane et al. (2018)	USA	Kids SIP*smart*ER consisted of 6 lessons grounded in the Theory of Planned Behavior, media literacy, and public health literacy and aimed to improve individual SSB behaviors and understanding of media literacy and prevalent regional disparities.	Education in school	No	Only SSB	6	Baseline, 3 months later	Beverage Intake Questionnaire-	Yes

(Continues)

TABLE 3 (Continued)

		Dietary intervention							Results (a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs
Author: year	**Country**	**Description in the intervention group**	**Type of intervention**	**Use of technology**	**Only SSB OR Mix**	**Dura-tion (week)**	**Frequency-every**	**Assessment method**	
Ickovics et al. (2019)	USA	Implementation of nutrition policies (e.g., alternatives to food-based rewards/celebrations) and physical activity policies (e.g., opportunities for physical activity during/after school).	Changing in school laws	No	Mix	144	-	Questions	Yes
Liu et al. (2019)	China	A list of environmental elements in implementing the ANGELO framework was prioritized including school-level policies, health education activities, improvement of physical activity, and improvement of school lunches.	Multiple interven-tions in school	No	Mix	48	-	Questions	Yes

Abbreviations: FFQ, Food Frequency Questionnaire; SSBs, sugar-sweetened beverages.

in health centers and military services (Bingham et al., 2012; Delpier et al., 2013; Knowlden & Sharma, 2016; van Grieken et al., 2014) and home (Albala et al., 2008; Cloutier et al., 2015; Ebbeling et al., 2006; Shapiro et al., 2008; Simons et al., 2015; Taveras et al., 2011). Educational materials were presented in the form of booklets, posters, parental guides, computer programs, and video messages. From 44 interventions that used technological devices to convey educational purposes, 36 ones were successful.

2. Changing rules and policies includes increasing taxes and altering the prices (Schwendicke et al., 2016; Sharma et al., 2014; Sturm et al., 2010; Waterlander et al., 2014). Changing school rules included providing healthy food or water instead of SSBs (Temme et al., 2011; Visscher et al., 2010) or reducing the availability of SSBs in menus or vending machines (Blum et al., 2008; Cradock et al., 2011; Cullen et al., 2008; Fung et al., 2013; Folta et al., 2013; Mendoza et al., 2010; Mozaffarian et al., 2010; Simon et al., 2013; Whatley Blum et al., 2007). Studies on increasing taxes were all successful. Furthermore, the intervention of changing school policies was successful in all cases except for one study (Whatley Blum et al., 2007). In some studies, the intervention was providing healthy food or water accompanied by education in military services, household or community (Albala et al., 2008; Bergen & Yeh, 2006; Bingham et al., 2012; Ebbeling et al., 2006; Hernández-Cordero & Popkin, 2015; Rodríguez-Ramírez et al., 2015).
3. Multiple interventions were applied in schools (Goldberg et al., 2015; Hawkins et al., 2018; van de Gaar et al., 2014) or among families (Rodearmel et al., 2007), including launching different campaigns to promote healthy life style, advertisement, altering the prices, and providing food. Except one study (Goldberg et al., 2015), multiple interventions in families and schools were successful in decreasing SSBs intake.

The examples of interventions performed in the studies are as follow: delivering the milk beverages to homes (Albala et al., 2008), providing instructions to the family (Shapiro et al., 2008), installing labels plus motivational posters on vending machines (Bergen & Yeh, 2006), increasing the supply of healthy foods at the eating environments in the military setting (Bingham et al., 2012), providing student booklet, posters, weekly fruit and vegetable breaks in classroom (Bjelland et al., 2011), taxation on SSBs (Schwendicke et al., 2016; Sharma et al., 2014), placing water coolers in school canteens, and providing free water to pupils (Visscher et al., 2010).

List of interventions based on the country

Of the 59 articles reviewed, 38 studies were performed in unites states. The other countries sugar lowering interventions were performed were as follows: Netherlands, Germany, China, Chile, Brazil, Canada, Australia, India, and Israel.

USA

Education about decreasing SSB intake using technology, putting labels plus motivational posters on the vending machine, increase the supply of healthy foods at the two main eating environments in the military setting, performing lessons with student booklet, posters, weekly fruit and vegetable breaks and activity breaks in classroom, sports equipment for recess activities, active commuting, fact sheets for parents, providing caloric information on SSBs in stores at schools, reduce availability of SSB and diet soda among students, increase maternal skills in goal-setting, stimulus control and problem-solving, engage family members to support changes, link mothers to neighborhood resources, encouraging

students to change their eating habits and food consumption in the school, home deliveries of noncaloric beverages, performing a bilingual school-based curriculum emphasizing knowledge and skills for healthy eating, performing campaign kits for participants with reusable food containers and a packing guide with information about purchasing and packing healthy lunches and snacks, monthly parent newsletters, sent home in children's backpacks, a school-wide poster contest and presentations to parents at school events, monthly emails to teachers provided tips for integrating and sustaining program messages, nutrition counseling and the water and education provision (WEP) group sessions included activities to encourage increased water intake, reduced SSB intake, and substitution of water for SSB, restricted portion sizes of snacks and high fat foods, sales of sweetened beverages, and the fat content of all foods, taxing on the SSBs, performing culturally sensitive videos in DVD format and peer support group teleconferences, performing a multi-component intervention focused on modifying environmental and behavioral factors to help prevent inappropriate weight gain in children.

Netherlands

Performing a computer-tailored intervention to help prevent excessive SSBs intake among adolescents, providing a PlayStation Move upgrade package to play the active video games, implementing replacement scenarios in the Dutch consumption survey, performing the water campaign consists of lessons at school combined with integrated community activities that promote water consumption in various ways, providing information for parents regarding a healthy lifestyle, placing water coolers in school canteens, taxing on the SSBs.

Germany

Taxation on SSBs.

Australia

A mobile food record and text messaging support to decrease SSB use and improve nutrition behaviors, a taxation on SSBs.

Chile

Delivering milk to their and to not consume SSBs.

Brazil

Encouraging students to change their eating habits and food consumption, implementing nutritional program administered over one school year that focused on reducing the consumption of sodas, providing printed educational materials encouraging reduced levels of added sugar in school meals.

Canada

Changing buffet law in schools, providing class sessions of Fluids Used Effectively for living in schools.

India

Implementing counselling sessions, telephonic reminders, home visits, and general awareness sessions at household levels.

Israel

Providing nutrition classes for children, mothers, and teachers.

China

Performing multiple interventions at school-level including health education activities, improvement of physical activity, and improvement of school lunches.

Results of studies based on reducing sugar intake as a main goal

From 59 studies, 41 had combinatory goals of which 35 were successful (85%). In 18 studies, reducing sugar intake was the main goal of the study, of which 15 were successful (83.3%).

The effectiveness of studies

Table 4 represents the effectiveness of sugar reduction interventions based on variables investigated in the study. We identified the reported results as successful or effective if they caused a significant ($p < 0.05$) decrease in the intake of SSBs or sugar, the intention to consumption of SSBs, or the purchase of SSBs. To calculate the effectiveness rate, the total number of effective interventions was divided by the total number of interventions and reported as percentage. Among all the interventions, 48 were successful (81.3%) and 11 were unsuccessful (18.6%) in decreasing sugar intake. Of the 48 effective studies, 45 studies (93.7%) had low risk of bias. We reported the effectiveness results in all included studies and low risk of bias studies as follows:

The effectiveness of sugar reduction interventions in all included studies

As can be seen in Table 4, interventions performed at schools were more successful than those in community or household setting. Interventions implemented on children was more successful (95.4%) than the other target groups. Studies designed to decrease sugar intake by changing the rules were more effective than educational or multiple interventions. The number of studies with a duration of less than 8 weeks was 10, and all of them were successful. Interventions which had a duration of 24–48 weeks were less successful than

TABLE 4 The effectiveness of interventions on reducing sugar intake based on the study variables

Variable	Subgroups	Study (*n*)	Low/ high risk of bias	Effective intervention (*n*) (all included studies)	Effective intervention (*n*) (low risk of bias studies)	Effectiveness (%) (all included studies)[a]	Effectiveness (%) (low risk of bias studies)[b]
Location/Context of study	Community	17	15/2	14	12	82.3	80.0
	Schools	31	29/2	29	24	93.5	82.7
	Household	9	9/0	8	8	88.8	88.8
	Healthcare and military centers	2	1/1	2	1	100.0	100
Participants[c]	Children	22	21/1	21	20	95.4	95.2
	Adolescents	17	15/2	11	9	64.7	60.0
	Adults and elders	17	14/3	14	11	82.3	78.5
Type of intervention	Educational	39	37/2	32	31	82.0	83.7
	Multiple	5	5/0	4	4	80.0	80.0
	Change in law/ Providing	15	12/3	13	10	86.6	83.3
Only sugar intake or multicomponent intervention	Combination	41	36/5	35	30	85.3	83.3
	Only sugar intake	18	18/0	15	15	83.3	83.3
Study duration[d]	8 weeks and less	10	8/2	10	8	100.0	100.0
	9–24 weeks	8	8/8	6	6	75.0	75.5
	24–48 weeks	18	18/0	13	13	72.2	72.2
	48 weeks and more	20	18/2	19	16	95.0	88.8
Intervention frequency[e]	Weekly	24	22/2	21	19	87.5	86.3

TABLE 4 (Continued)

Variable	Subgroups	Study (*n*)	Low/ high risk of bias	Effective intervention (*n*) (all included studies)	Effective intervention (*n*) (low risk of bias studies)	Effectiveness (%) (all included studies)[a]	Effectiveness (%) (low risk of bias studies)[b]
	Every 2–5 weeks	9	9/0	8	8	88.8	88.8
	Every 5–16 weeks	12	11/1	8	8	66.6	72.7
	Every 16–49 weeks	8	6/2	7	5	87.5	83.3

[a]The total number of effective interventions was divided by total number of interventions.

[b]The total number of effective interventions with low risk of bias was divided by total number of low risk of bias interventions.

[c]In three studies schools and vending machines were evaluated and in one study both children and adolescents were studied.

[d]Was not reported in three studies.

[e]Was not reported in six studies.

TABLE 5 Quality assessment of the included studies

	RCTs													
Study	**Was true randomization used for assignment of participants to treatment groups?**	**Was allocation to treatment groups concealed?**	**Were treatment groups similar at the baseline?**	**Were participants blind to treatment assignment?**	**Were those delivering treatment blind to treatment assignment?**	**Were outcomes assessors blind to treatment assignment?**	**Were treatment groups treated identically other than the intervention of interest?**	**Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately analyzed?**	**Were participants analyzed in the groups to which they were randomized?**	**Were outcomes measured in the same way for treatment groups?**	**Were outcomes measured in a reliable way?**	**Was appropriate statistical analysis used?**	**Was the trial design appropriate?**	**Risk of bias assessment**
Albala et al. (2008)	Y	Y	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	Low
Davy et al. (2017)	Y	Y	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	Low
Bergen and Yeh (2006)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	U	Low
Bingham et al. (2012)	U	U	U	N	N	N	Y	Y	Y	Y	N	Y	Y	High
Bjelland et al. (2011)	Y	Y	U	U	N	U	Y	Y	N	Y	Y	Y	Y	Low
Bleakley et al. (2015)	Y	U	U	U	U	U	Y	Y	Y	Y	U	Y	Y	Low
Bleich et al. (2014)	N	N	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	Y	Low
Cloutier et al. (2015)	Y	Y	U	U	U	U	Y	Y	N	Y	Y	Y	Y	Low
Cullen et al. (2008)	U	U	Y	U	N	U	Y	Y	U	Y	Y	Y	Y	Low
Cunha et al. (2013)	Y	Y	Y	N	N	U	Y	Y	N	Y	Y	Y	Y	Low
Dwyer et al. (2003)	Y	Y	Y	U	U	U	Y	Y	U	Y	Y	Y	Y	Low

TABLE 5 (Continued)

	RCTs													
Study	**Was true randomization used for assignment of participants to treatment groups?**	**Was allocation to treatment groups concealed?**	**Were treatment groups similar at the baseline?**	**Were participants blind to treatment assignment?**	**Were those delivering treatment blind to treatment assignment?**	**Were outcomes assessors blind to treatment assignment?**	**Were treatment groups treated identically other than the intervention of interest?**	**Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately analyzed?**	**Were participants analyzed in the groups to which they were randomized?**	**Were outcomes measured in the same way for treatment groups?**	**Were outcomes measured in a reliable way?**	**Was appropriate statistical analysis used?**	**Was the trial design appropriate?**	**Risk of bias assessment**
Ebbeling et al. (2006)	Y	Y	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	Low
Epstein et al. (2001)	Y	U	Y	U	U	U	Y	Y	U	Y	Y	Y	Y	Low
Ezendam et al. (2012)	Y	Y	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	Low
Folta et al. (2013)	N	U	Y	N	N	U	Y	Y	U	Y	U	Y	Y	High
Fukuoka et al. (2015)	Y	Y	Y	U	U	Y	Y	Y	Y	Y	Y	Y	Y	Low
Fung et al. (2013)	U	U	Y	N	N	U	Y	Y	U	Y	Y	Y	U	Low
Goldberg et al. (2015)	Y	Y	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	Low
Hernández-Cordero and Popkin (2015)	Y	Y	Y	U	U	U	Y	Y	U	Y	Y	Y	U	Low
Kattelmann et al. (2014)	Y	Y	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	Low

(Continues)

TABLE 5 (Continued)

	RCTs													
Study	**Was true randomization used for assignment of participants to treatment groups?**	**Was allocation to treatment groups concealed?**	**Were treatment groups similar at the baseline?**	**Were participants blind to treatment assignment?**	**Were those delivering treatment blind to treatment assignment?**	**Were outcomes assessors blind to treatment assignment?**	**Were treatment groups treated identically other than the intervention of interest?**	**Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately analyzed?**	**Were participants analyzed in the groups to which they were randomized?**	**Were outcomes measured in the same way for treatment groups?**	**Were outcomes measured in a reliable way?**	**Was appropriate statistical analysis used?**	**Was the trial design appropriate?**	**Risk of bias assessment**
Kenney et al. (2015)	Y	Y	Y	U	Y	U	Y	Y	Y	Y	N	Y	Y	Low
Kerr et al. (2016)	Y	Y	Y	U	U	Y	Y	Y	Y	U	Y	Y	Y	Low
Knowlden and Sharma (2016)	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Low
Lo et al. (2008)	N	N	U	N	N	U	Y	Y	N	Y	Y	Y	U	High
Mendoza et al. (2010)	U	U	Y	U	U	U	Y	Y	U	Y	Y	Y	U	High
Mozaffarian et al. (2010)	U	U	Y	U	U	U	Y	Y	U	Y	Y	Y	Y	Low
Nanney et al. (2014)	Y	Y	Y	Y	U	U	Y	Y	Y	Y	N	Y	Y	Low
Partridge et al. (2016)	Y	Y	Y	Y	U	Y	Y	Y	N	Y	Y	Y	Y	Low
Rodearmel et al. (2007)	U	Y	Y	U	U	U	Y	Y	U	Y	Y	Y	Y	Low

TABLE 5 (Continued)

	RCTs													
Study	**Was true randomization used for assignment of participants to treatment groups?**	**Was allocation to treatment groups concealed?**	**Were treatment groups similar at the baseline?**	**Were participants blind to treatment assignment?**	**Were those delivering treatment blind to treatment assignment?**	**Were outcomes assessors blind to treatment assignment?**	**Were treatment groups treated identically other than the intervention of interest?**	**Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately analyzed?**	**Were participants analyzed in the groups to which they were randomized?**	**Were outcomes measured in the same way for treatment groups?**	**Were outcomes measured in a reliable way?**	**Was appropriate statistical analysis used?**	**Was the trial design appropriate?**	**Risk of bias assessment**
Rodríguez-Ramírez et al. (2015)	Y	Y	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	Low
Shapiro et al. (2008)	Y	Y	Y	U	U	U	Y	Y	Y	Y	N	Y	Y	Low
Sichieri et al. (2013)	Y	U	Y	U	U	U	Y	Y	U	Y	Y	Y	Y	Low
Simon et al. (2013)	Y	U	Y	U	U	U	Y	Y	U	Y	Y	Y	U	Low
Simons et al. (2015)	Y	Y	Y	U	U	N	Y	Y	N	Y	Y	Y	Y	Low
Souza et al. (2013)	Y	Y	Y	U	U	U	Y	Y	U	Y	Y	Y	Y	Low
Story et al. (2012)	Y	Y	Y	U	U	U	Y	Y	U	Y	Y	Y	Y	Low
Taveras et al. (2011)	Y	Y	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	Low
Temme et al. (2011)	U	U	Y	U	U	U	Y	Y	U	Y	Y	Y	U	High

(Continues)

TABLE 5 (Continued)

	RCTs													
Study	**Was true randomization used for assignment of participants to treatment groups?**	**Was allocation to treatment groups concealed?**	**Were treatment groups similar at the baseline?**	**Were participants blind to treatment assignment?**	**Were those delivering treatment blind to treatment assignment?**	**Were outcomes assessors blind to treatment assignment?**	**Were treatment groups treated identically other than the intervention of interest?**	**Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately analyzed?**	**Were participants analyzed in the groups to which they were randomized?**	**Were outcomes measured in the same way for treatment groups?**	**Were outcomes measured in a reliable way?**	**Was appropriate statistical analysis used?**	**Was the trial design appropriate?**	**Risk of bias assessment**
Van de Gaar et al. (2014)	U	Y	Y	N	U	N	Y	Y	N	Y	Y	Y	Y	Low
van Grieken et al. (2014)	Y	Y	Y	U	U	U	Y	Y	N	Y	N	Y	Y	Low
Visscher et al. (2010)	N	N	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	Low
Waterlander et al. (2014)	Y	Y	Y	Y	U	U	Y	Y	N	Y	Y	Y	Y	Low
Whatley Blum et al. (2007)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Low
Zoellner et al. (2016)	Y	Y	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	Low
Daivadanam et al. (2018)	Y	Y	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	Low
Chang et al. (2017)	Y	Y	Y	U	U	U	Y	Y	N	Y	Y	Y	Y	Low
Hawkins et al. (2018)	Y	Y	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	Low

TABLE 5 (Continued)

RCTs

Study	Was true randomization used for assignment of participants to treatment groups?	Was allocation to treatment groups concealed?	Were treatment groups similar at the baseline?	Were participants blind to treatment assignment?	Were those delivering treatment blind to treatment assignment?	Were outcomes assessors blind to treatment assignment?	Were treatment groups treated identically other than the intervention of interest?	Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately analyzed?	Were participants analyzed in the groups to which they were randomized?	Were outcomes measured in the same way for treatment groups?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?	Was the trial design appropriate?	Risk of bias assessment
Kaufman-Shriqui et al. (2016)	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	U	Y	Y	Low
Lane et al. (2018)	Y	Y	Y	U	U	U	Y	Y	Y	Y	Y	Y	Y	Low
Ickovics et al. (2019)	Y	Y	Y	N	N	Y	Y	Y	Y	Y	U	Y	Y	Low
Liu et al. (2019)	Y	Y	Y	N	N	U	Y	Y	U	Y	N	Y	Y	Low

Quasi-Experimental Studies

Study	Is it clear in the study what is the "cause" and what is the "effect"	Were the participants included in any comparisons similar	Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Was there a control group?	Were there multiple measurements of the outcome both pre and post the intervention/exposure?	Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?	Were the outcomes of participants included in any comparisons measured in the same way?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?	Risk of bias assessment

(Continues)

TABLE 5 (Continued)

Quasi-Experimental Studies										
Blum et al. (2008)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Low
Cradock et al. (2011)	Y	Y	Y	Y	Y	N	Y	Y	Y	Low
Delpier et al. (2013)	Y	Y	Y	N	Y	Y	Y	Y	Y	Low
Feng et al. (2016)	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
Schwendicke et al. (2016)	Y	Y	Y	N	Y	Y	Y	Y	Y	Low
Sharma et al. (2014)	Y	Y	Y	N	Y	Y	Y	Y	Y	Low
Sturm et al. (2010)	Y	Y	Y	N	Y	Y	Y	N	Y	Low
Romo and Abril-Ulloa (2018)	Y	Y	Y	N	Y	Y	Y	U	Y	Low

Abbreviations: N, no; RCT, randomized clinical trials; U, unclear; Y, yes.

the others. Interventions with the repetition span of more than 1 month were less successful than the others.

The effectiveness of sugar reduction interventions in studies with low risk of bias

As can be seen in Table 4, we also analyzed the effectiveness of interventions in studies with low risk of bias. As nearly 94% of effective studies had a low risk of bias, the results did not change in most of the variables. However, based on the studies analyzing low risk of bias, interventions in schools were not effective more than household setting. In addition, almost all types of interventions (educational, multiple, and changing in law) had same effectiveness on reducing sugar intake.

Quality assessment of studies

As Table 5 shows, all studies had one or more domains characterized as high risk of bias. Of 59 studies, 55 cases had a good quality in terms of having more low-risk domains than high-risk ones (93.2%). In addition, 12 studies had selection bias due to a nonrandom selection of participants. Most of the studies had performance bias due to the unblinding of participants or personnel. Also, 13 studies had high detection bias accusations due to subjective and unreliable outcome measures.

DISCUSSION

Out of 1384 articles retrieved from different databases, 59 articles were finally included in the study. Based on the quality assessment of studies, 93.7% of the effective studies were rated as high-quality surveys. We could not include studies in the meta-analysis because the outcomes were not measured in a similar way to be mathematically combined.

As noted in the result section, most of the interventions were conducted in high-income countries especially in the United States. This could be related to the greater research budgets, adequate numbers of researchers, high levels of health and safety awareness, and near universal literacy. In high-income countries, different intervention methods and techniques had been used compared to low and middle-income ones. While, numerous policy interventions developed in high-income countries are potentially transferable to low-income countries, considering country-specific factors such as costs, feasibility, sustainability, and barriers is critical all of which must be factored into the assessment of effectiveness in specific low-income countries settings (Daniels et al., 2000; Lapão, 2015).

The results of our study showed that most of the interventions were educational, and most of them were successful in reducing sugar intake. Although many experts believe that the effectiveness of educational interventions alone is in doubt, it seems that training can be effective if it is targeted and accompanied by other interventions to change behavior (Guevara et al., 2003; Menezes et al., 2016). Also, studies on increasing taxes were all successful. An important consideration for SSB taxes is what the optimal tax rate would be. Experiments have generally concluded that soda sales taxes (ranging from 1% to 8%) are too low to result in any population effects (Sturm et al., 2010; Waterlander et al., 2014). Moreover, a review found that SSB might be more price-sensitive than previously reported and showed a price elasticity of demand of −1.21 (Andreyeva et al., 2010). Larger increases (such as 18%) would have larger effects than any existing differential sales tax

(Schwendicke et al., 2016; Sharma et al., 2014; Sturm et al., 2010; Waterlander et al., 2014). Also, studies found larger effects of differential soda sales taxes among children who are heavier and have lower family income or watch a great deal of TV (Sharma et al., 2014; Sturm et al., 2010; Waterlander et al., 2014).

In most studies, children were the target group for the interventions of which 95.4% were successful in reducing sugar intake. Schools and other educational environments are the main targets for educating nutrition facts because children spend most of their time at schools. Moreover, individual food habits develop in school environments and during childhood and children are regarded as an important connection between school and family. One possible reason for the high effectiveness of school interventions can be due to the type of intervention and easier control over student dietary intakes in schools. The low effectiveness of interventions in middle-aged and elderly people may also be due to the consolidation of dietary habits and other behaviors in these people; so, modifying their behavior is very difficult (Rizvi, 2009; Young et al., 2003).

Interventions that lasted less than 8 weeks and those repeated every 2–5 weeks were more effective. The possible reason for effectiveness of long-term interventions may be due to the fact that all of them were conducted in schools and provided healthy foods instead of SSBs. However, it should mention that any short-term change in human behavioral patterns can simply return to the basic state, but the longer-term change increases the likelihood of a sustained change in behavior (Plante, 2012; Ryan, 2009). So, long-term and aim-oriented interventions would be desirable.

The main advantage of our systematic review is the low risk of subjective data selection. Study searches, assessment, and data synthesis were based on predefined criteria and were performed using well-established tools by two independent reviewers. Nevertheless, our analysis had some limitations. First, publication bias cannot be excluded, that is, ineffective interventions are less likely to be published. In this study, most of the included studies were effective in reducing sugar intake and only a limited number of interventions showed low efficacy. It is clear that systematic reviews are only as good as the included studies. In this review, only some of the included trials seemed methodologically sound. The potential limitations existing in the included studies are as follows: unclear or inadequate allocation concealment, no intention-to-treat analysis, inadequate information about controlling confounders, and applying different questionnaires for evaluating SSBs intake. One of the most important limitations of the present study is the dispersion and variability of the reported indices for the effectiveness of interventions in the studies, so performing the quantitative analysis (meta-analysis) was implausible.

CONCLUSION

According to the results of the present systematic review, educational interventions and changes in purchase patterns might reduce sugar intake in healthy populations. Applying all the interventions together would be most effective. However, it should be noted that the implementation of the proposed interventions and settings depends on the limitations, resources, and facilities present in different countries. So, long-term and high-frequency interventions focusing on decreasing sugar intake are suggested in different settings and countries.

AUTHOR CONTRIBUTIONS

Mahdieh A. Farhangi and Jafar S. Tabrizi designed the project and aided in interpreting the results; Leila Nikniaz directed the project, developed the theoretical framework, and drafted the manuscript; Mohammad-Salar Hosseini performed the analysis, designed the figures

and interpreted the results; Zeinab Nikniaz, Mahdieh A. Farhangi, and Sanaz Tahmasebi searched the literature, selected the studies and extracted the data. All authors provided critical feedback and helped shape the research, analysis and manuscript.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

If requested, data will be available at https://hsri-en.tbzmed.ac.ir/

ETHICS STATEMENT

This study is a systematic review and no ethical statement is needed.

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ORIGINAL ARTICLE

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The Framework Convention on Tobacco Control (FCTC) and implementation of tobacco control policies: Lessons learned from Indonesia and Thailand

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Abstract

The threat that the tobacco epidemic poses to public health underscores the importance of comprehensive tobacco-related regulation. Despite aiming to reduce the prevalence of smoking, Indonesia still falls short of this goal. In contrast, within the same region, Thailand's achievement in controlling tobacco serves as a potential role model for Indonesia. To understand the issue, we conducted a literature review of the current regulatory framework as well as the implementation of the World Health Organization's Framework Convention on Tobacco Control (FCTC) and MPOWER framework in both countries. The review was supplemented with a Focus Group Discussion and an in-depth interview with stakeholders in Thailand and Indonesia. This study finds that: (1) Indonesia currently lacks a strong tobacco control policy champion, whereas Thailand has several authorities that focus on the issue; (2) Thailand's tobacco product advertising and promotion and smoking bans are more restrictive compared to Indonesia's policies; and (3) Thailand's policies on tobacco pictorial health warnings, pharmacotherapy, and excise taxes are more extensive than Indonesia's. We recommend that Indonesia ratify the FCTC as the foundation of tobacco control policies while also strengthening and coordinating organizations working on tobacco control, encouraging subnational governments to introduce regulations, and enforce control, as well as improving excise policies to reduce the affordability of tobacco products.

KEYWORDS
Framework Convention on Tobacco Control, MPOWER, tobacco control

Key Points

- Indonesia has yet to make significant progress in reducing smoking prevalence.
- Comprehensive tobacco control regulations are needed.
- Indonesia currently does not have a strong tobacco control policy, while Thailand has several authorities that focus on this issue.
- Indonesia needs to ratify the FCTC as a cornerstone of tobacco control policies and strengthen regulations on tobacco control.

INTRODUCTION

Considering the significant and global threat of the tobacco epidemic to public health, there have been many attempts to persuade governments to implement tobacco control policies. However, tobacco control regulations have not been effective in controlling the prevalence of smoking in Indonesia. The WHO (2021) estimated that the daily prevalence of smoking in Indonesia's adult population (aged 15 years or higher) stands at 31%, which remained relatively unchanged from 2008. The trend of smoking prevalence in Indonesia's youth (aged 10–18 years) was even worse; the number increased to 9.1% in 2018 from 7.2% in 2013 (Ministry of Health of the Republic of Indonesia, 2018), indicating that smoking behavior has begun to increase in the last few years. Smoking has been known to lead to direct health consequences, such as lung cancer and cardiovascular diseases (Kondo et al., 2019; Lee, 2018), as well as indirect adverse effects, such as stunting and poverty (Dartanto et al., 2018; Semba et al., 2008, 2011). Therefore, it is crucial for Indonesia to make a serious attempt to tackle the issue of tobacco control. Fortunately, it can learn useful strategies from its neighbor to combat the tobacco problem.

One nation that has been making tremendous efforts in implementing tobacco control policies is Thailand. As one of the first countries in Southeast Asia to sign the WHO's Framework Convention on Tobacco Control (FCTC), the government of Thailand has taken drastic measures over the course of several years to reduce tobacco prevalence in the country. While Thailand does not have the lowest smoking prevalence among Southeast Asian countries (see Figure 1; WHO, 2021), the number comes close to the region's average and is far lower than Indonesia's. As such, Thailand's achievement in taking measures to implement tobacco control serves as an interesting comparison and potential role model for Indonesia.

The difference between Thailand's and Indonesia's tobacco control policies may initially be attributed to the FCTC, which Thailand has ratified but Indonesia has not. Craig et al. (2019) showed that the FCTC was reported to have benefited the whole process of establishing tobacco policies and regulations in 12 countries. Therefore, a government's stance on the FCTC may eventually be reflected in the implementation of tobacco control policies. In line with the FCTC, the WHO introduced MPOWER in 2008. Aiming to assist countries in reducing the demand for tobacco, MPOWER is a package comprising six tobacco control measures: (1) monitor tobacco use and prevention policies (M), (2) protect people from tobacco smoke (P), (3) offer help to quit tobacco use (O), (4) warn about the

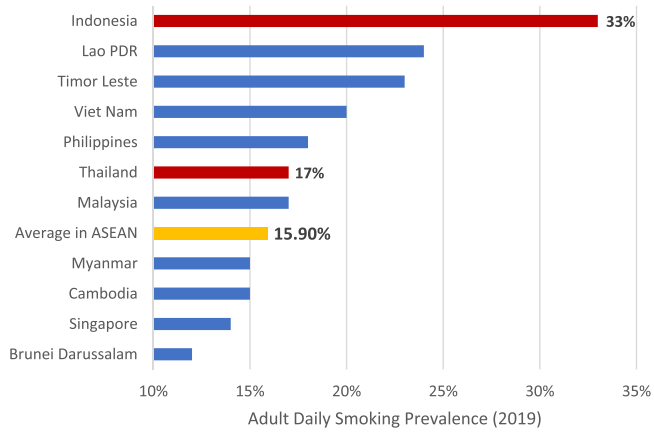

FIGURE 1 Adult daily smoking prevalence in Southeast Asian Countries (2019).*Source*: WHO (2021)

dangers of tobacco (W), (5) enforce bans on tobacco advertising, promotion, and sponsorship (E), and (6) raise taxes on tobacco (R) (WHO, 2008).

While an analysis of the level of success in MPOWER measures is essential to explain the current status of tobacco use in the two countries, it is equally critical to make a thorough comparison between Indonesia and Thailand to identify gaps in existing policies and address them. Therefore, this study aims to compare the regulations for tobacco control in the two countries. Addressing gaps in policy is an important step toward improving tobacco control interventions. Progress in this area should lead to a healthier current and future generation as part of the pursuit of sustainable development goals.

METHODS

This study employed a qualitative approach within a constructivist paradigm to gain an understanding of the FCTC and MPOWER implementation in two countries: Indonesia and Thailand. We collected the data through a literature study and in-depth interviews with several stakeholders from March 2019 to June 2020.

During data collection, key informants were selected, taking into consideration the settings (where the research was conducted), actors (who were to participate in the interviews), events (that were to be carried out by the actors), and processes (see Table A1 for details on key information collected). Data collection for Thailand was done by conducting in-depth interviews directly in Thailand with six informants who were representatives of the following organizations: the Thai Health Promotion Foundation, the Customs Department, the Ministry of Health, the Fiscal Policy Office, the Excise Department, and the World Health Organization (WHO). In addition, we gathered data for Thailand from the cigarette consumption control training held at Thai Health in March 2019. As for the data collection for Indonesia, we obtained presentation materials for direct exposure during webinars or public discussions held by the Center for Social Security Studies, Universitas Indonesia (CSSS-UI), or with other ministries or organizations in the country. These discussions involved panelists from the Ministry of Finance, the Coordinating Ministry for Human Development and Cultural Affairs, the Ministry of National Development Planning, and the Ministry of Health, who were asked questions on several topics regarding tobacco control measures (see Table B1).

Data collection and analysis were carried out simultaneously. Researchers transcribed audio recordings verbatim within 24 h of the interview and reviewed the results to ensure the

accuracy of the data. The interviews, original transcripts, and data analysis were conducted in English. The data analysis utilized a form of content analysis that systematically summarizes the results of the interview in an organized and concise manner. Raw data from interviews, transcribed verbatim into categories or themes, was subjected to further analysis as a process of data abstraction at each step (Erlingsson & Brysiewicz, 2017). The first step was to re-read and understand the interview transcripts to ascertain key points from the interviewees. After that, we reformulated these ideas into smaller units while retaining their meaning (compacting). A coding process was employed to view the actual content that is visible in the data. The researchers plotted the coding for classification into each part of MPOWER.

Meanwhile, a literature study was also carried out to review aspects of the MPOWER framework. We searched for sources that satisfied a number of criteria, including using sources from within the last 5 years, searching for keywords that were relevant to MPOWER on Google, and taking sources from reports or journal articles that have been published in reputable sources or journals. The literature review and interviews that we conducted complemented each other, where interviews with stakeholders confirmed or enriched the data that we had gathered from the literature review. The interview specifically provided technical insights that were not gained during the literature review.

RESULTS

WHO FCTC

As the first international treaty to be negotiated under the auspices of the WHO, the FCTC was developed to respond to the globalization of the tobacco epidemic and ensure the highest health standards for all people. Although unanimously adopted by all 192 member countries of the WHO, Indonesia has never signed and ratified the FCTC despite the massive burdens caused by the tobacco issue within the country (Astuti et al., 2020) and the fact that the FCTC had accelerated and strengthened tobacco control measures in other countries (Craig et al., 2019).

Another indicator of the implementation of tobacco control policies can be observed based on MPOWER measures.[1] Even in 2019, Indonesia's tobacco control policies were still inadequate when assessed using several MPOWER indicators (see Table 1). On the other hand, as one of the first 60 countries to ratify the FCTC in 2004, Thailand demonstrated more success in achieving the standards set by MPOWER indicators. By 2019, regarding the MPOWER measures framework, the majority of Thailand's tobacco control policies were already at the “complete” level, with only cessation programs, warnings in mass media, and advertising bans deemed by the WHO as still at the “moderate” level.

The MPOWER perspective

Tobacco prevention and monitoring policies (M)

Tobacco control monitoring strengthens the evidence base that can be used to guide tobacco prevention and control policies (WHO, 2017). Tobacco control monitoring includes monitoring indicators of tobacco use (often understood as the surveillance of patterns and trends in tobacco use), exposure to tobacco smoke, and policies designed to reduce tobacco use or exposure to tobacco smoke. In general, both Thailand and Indonesia have established several governmental and nongovernmental institutions that provide tobacco control monitoring. However, the strength of these groups varies due to the differences in synergy and coordination between the two countries.

TABLE 1 Summary of MPOWER measures in Indonesia and Thailand, 2019

MPOWER measure		Indonesia	Thailand
M	Monitoring	Complete	Complete
P	Smoke-free policies	Minimal	Complete
O	Cessation programs	Moderate	Moderate
W	Health warnings	Moderate	Complete
	Mass media	Complete	Moderate
E	Advertising bans	None (0/10)	Moderate (6/10)
R	Taxation	Moderate (58.5%)	Complete (78.6%)
	Cigarettes less affordable since 2008	No trend change	No trend change

Source: WHO (2009, 2019b), compiled by authors.

Thailand creates a structure for monitoring tobacco control by involving governmental and nongovernmental institutions to work together and focus on tobacco control while also periodically collecting data on smoking behavior at the national level. Tobacco control in Thailand includes numerous parties, such as government ministries or agencies, non-governmental organizations (NGOs), international organizations, and other institutions that are mutually sustainable (see Table C1 for the list of institutions). Thailand also monitors tobacco control through nationally representative population-based surveys used to calculate estimates of tobacco use, conducted by the National Statistical Office through the Smoking and Drinking Behavior Survey every 3 years and the Health and Welfare Survey every 2 years.

In contrast, tobacco control monitoring in Indonesia is mostly spearheaded by nongovernmental institutions with no strong support from their counterparts in the government, with data on smoking behavior being collected annually. A number of ministries and agencies are involved in tobacco control, including the Ministry of Health, the Ministry of Women's Empowerment and Child Protection, the Coordinating Ministry for Human Development and Culture, the Ministry of National Development Planning, and Commission IX of the House of Representatives. However, tobacco control in Indonesia is only one of the many issues tackled by the aforementioned ministries or government agencies. This has led to the creation of the tobacco control network, which was pioneered by five diverse groups: well-connected social activists; NGOs; health professionals; public health and economics researchers; and international organizations. It has since evolved into the Indonesia Tobacco Control Network (Rosser, 2015).

In addition, tobacco control in Indonesia is also monitored through surveys intended to understand patterns and trends in tobacco use through the Basic Health Research (*Riset Kesehatan Dasar*, Riskesdas), which is conducted every 5 years by the Ministry of Health. Starting from 2015, data on smoking prevalence was collected through the annual National Socioeconomic Survey (*Survei Sosial Ekonomi Nasional*, Susenas), conducted by the Central Bureau of Statistics. This allows smoking prevalence to be measured annually.

Restrictions on tobacco smoking in public places (P)

Another restriction placed on tobacco products is the locations in which tobacco smoking is permitted. In Indonesia, the regulations designate locations that are considered nonsmoking areas and recommend that local governments implement smoke-free policies (SFP).[2] The

Presidential Decree provides further information by prohibiting the smoking of tobacco products in places that have adopted SFP, including health and educational facilities. In comparison, Thailand imposes restrictions on smoking in public places and sets guidelines for designated smoking areas.[3] In general, the two countries have regulations that limit the usage of tobacco products in public places, with varying levels of restriction (see Table D1).

Thailand has placed a total ban on smoking in most public places, creating 100% smoke-free locations through national-level regulations that must be followed by all levels of the government (Campaign for Tobacco-Free Kids, 2021). Since 1992, Thailand has begun to implement smoking restrictions and continued to make updates to promote awareness and enforcement of regulations aiming for a smoke-free Thailand, improve public understanding of smoke-free laws, and increase the officials' capacity in several provinces to achieve "100% Smoke-Free Thailand" (Kungskulniti et al., 2018). However, these regulations have not reached the point of full implementation in places such as hospitals (Vitavasiri & Pausawasdi, 2010) and hospitality venues (Yong et al., 2010).

On the other hand, while Indonesia has restricted the usage of tobacco products in several public facilities through national-level regulations, it is more crucial to the effective implementation of these restrictions that they be adopted by subnational governments. Unlike Thailand, the current national-level regulations have only banned the use of tobacco products in several public facilities such as hospitals, shops, restaurants, schools, and public transportation, and these are considered to be "minimal"[4] by the WHO's standards (Table 1). However, due to decentralization, the implementation of smoke-free laws is more dependent on the adoption of these laws by subnational governments. As the national government has not set a deadline for the adoption of SFPs, only 67% of districts have done so (Wahidin et al., 2020). Moreover, the contents of the regulation may differ among the districts, and compliance rates are dependent on the institutional qualities and resources of the districts themselves (Wahyuti et al., 2019).

Tobacco cessation policies (O)

Services or tools to support smoking cessation are important for helping smokers who would like to quit, and some of the relevant means include a nonpharmacological approach (such as counseling therapy) complemented by pharmacotherapy interventions (Galanti, 2008). In the 2008 guidelines for the pharmacological approach to smoking cessation, nicotine replacement therapy (NRT), bupropion, and varenicline were considered first-line treatments, while nortriptyline and clonidine were considered second-line treatments (Reichert et al., 2008). In general, the two countries provide a variety of both nonpharmacological and pharmacological approaches to smoking cessation.

Thailand offers a wide array of alternatives for both nonpharmacological and pharmacological approaches to smoking cessation. Thailand's counseling therapy service for smoking cessation is supported by the Thai Health Promotion Foundation (ThaiHealth) through the Thailand National Quitline (TNQ), which was established in 2008. TNQ services offer reactive and proactive behavioral counseling to help callers develop and follow a plan to quit smoking. Several studies have shown that these interventions may be effective (Meeyai et al., 2015; Rojnawee et al., 2019). In addition, the results of the interview indicated that Thailand also makes Smoking Cessation Clinics (SCCs) available for direct consultation. However, the SCCs are only provided at the provincial and sub-provincial levels. As for the pharmacological approach, tobacco dependence treatments in Thailand utilize NRT in the form of legally sold products that can be purchased at pharmacies without a prescription (WHO, 2019a). Bupropion and varenicline are legal as well and can be purchased at pharmacies with a prescription.

On the other hand, as pharmacological alternatives are often limited, Indonesia's efforts for smoking cessation focus on a wide provision of nonpharmacological tools. Since 2016, the Ministry of Health has made smoking cessation services accessible toll-free via telephone, having them cover all areas of Indonesia. In addition, clinic services for smoking cessation in the form of in-person consultation are spread across several city hospitals and public health centers (*Pusat Kesehatan Masyarakat*, Puskesmas). Concerning the pharmacological cessation approach in Indonesia, NRT is a legally sold product and can be purchased at the pharmacy without a prescription. However, bupropion and varenicline are not legally available.

Warning about the dangers of tobacco (W)

The use of graphic images demonstrating the harm of tobacco use can be especially effective in convincing users to quit smoking. In addition, PHWs were perceived as more effective than text-only warnings in preventing the start of a smoking habit among non-smokers and encouraging smoking cessation among smokers (Ratih & Susanna, 2018).

Thailand was one of the early adopters of PHW while also implementing sizes for PHW beyond the FCTC's requirements. Based on the information gathered from the interviews, Thailand requires large, graphic health warnings on both the front and back of the packaging. Thailand was the fourth country to implement PHW, following Canada, Brazil, and Singapore. In 2005, in accordance with the WHO FCTC requirements, Thailand's PHW covered 50% of the two front panels of the cigarette packs (WHO, 2003). In 2010, the image size was increased to 55% on both sides. Later in 2013, the PHW requirement was increased to 85% on both sides, currently the largest percentage in ASEAN (Southeast Asia Tobacco Control Alliance, 2019), and it included 10 different pictures in one cigarette box. Starting from September 2019, all cigarettes in Thailand must be sold in drab, brown-colored packs with cigarette brand names printed in a standardized font type, size, color, and location, without brand colors or logos.

Meanwhile, as of present, Indonesia has not complied with the FCTC's requirements for the size of PHW. In 2009, Indonesia issued a regulation regarding the obligation to include health warnings on cigarette products produced in or imported to the country,[5] which has only led to written warnings (Ministry of Health of the Republic of Indonesia, 2009). In 2013, the regulation had been updated to require that health warnings include PHW and health information on the packaging of tobacco products[6] (Ministry of Health of the Republic of Indonesia, 2013b). By June 2014, Indonesia has implemented five different types of PHW signs on up to 40% of cigarette packs. In accordance with the Roadmap for Controlling the Impact of Cigarette Consumption for Health, the size of health warnings in the form of images and text would be increased to 75% on the front and back packaging in 2015–2019, and a decision has been made to switch to plain packaging in 2020–2024[7] (Ministry of Health of the Republic of Indonesia, 2013a).

Promotion and advertisement of tobacco products (E)

The promotion and advertising of tobacco products are a crucial expenditure for tobacco companies. To take an example from Indonesia, the total spending for cigarette advertisements reached 7.2 trillion rupiahs (Nielsen Media, 2020) in 2019. The promotion and advertising of tobacco products have led to the initiation and continuation of smoking behavior among young adults (Lienemann et al., 2019; Prabandari & Dewi, 2016). Thus, both countries have regulated tobacco promotion and advertisements, although Thailand has stricter regulations compared to Indonesia (see Table E1). Indonesia prohibits the broadcast of promotions of tobacco products that show the product itself,[8] and there are several conditions for tobacco advertising, including

content restrictions and media and location prohibitions.[9] In contrast, Thailand's regulation prohibits advertising tobacco products (the product and logo) in printed media, entertainment, sponsorship, and other forms of media.[10]

Thailand has banned most forms of promotion and advertising of tobacco products. This includes bans on promotions and advertising on TV, the radio, the internet, billboards, retail points of sale, and direct marketing. The regulation explicitly mentions and defines each form of media from which tobacco promotion and advertisements are banned. However, with the development of the internet, the borderless and dynamic nature of online media presents major challenges to this ban.

On the other hand, Indonesia still allows tobacco advertisements in several media, albeit with restrictions on time, location, or content, with subnational governments making specific stipulations. For example, time restriction refers to the ban on TV, which only allows tobacco advertisements to be run between 9:30 p.m. to 5:00 a.m. local time, when most children do not watch TV. Location-specific restrictions do not permit domestic media explicitly targeted at kids or outdoor advertising located on main roads. Content restrictions prohibit tobacco advertisements from showing the product itself. Moreover, several restrictions on tobacco advertisements and promotions are relegated to the jurisdiction of subnational governments, such as outdoor advertising or points of sale. For example, in June 2021, Jakarta only recently banned "billboards for cigarettes or addictive substances indoors and outdoors, including displaying cigarette packs or addictive substances at points of sale," making it the 14th city to ban advertising through points of sale.[11]

Tobacco product taxation (R)

Goods that are subject to excise are associated with certain characteristics related to their consumption that need to be controlled. In other words, their circulation needs to be monitored, as their use can harm society or the environment, and requires state levies in the interest of justice and balance (Republic of Indonesia, 2007). Based on the results of the interviews, excise provides two functions, which are to generate revenue and limit consumption. Structurally, Indonesia and Thailand impose three identical cigarette levies, namely, excise, VAT, and cigarette taxes (Vanessa & Murwendah, 2020). The tobacco tax burden in Thailand is 70% of the retail price,[12] while in Indonesia, the maximum tobacco tax rate is 57% (Vanessa & Murwendah, 2020).

Thailand utilizes a mixed levy system for tobacco products and a minimum price policy to adjust the prices of tobacco products with a two-tier cigarette structure. The taxes on some tobacco products in Thailand are levied based on the hybrid system, namely an ad valorem rate as a percentage of the suggested retail price (SRP) and a fixed rate per unit of the product (Ministerial Regulation Prescribing Excise Tariff B. E. 2560, 2017). Thailand has a two-tier cigarette tax structure based on the SRP: (1) cigarettes priced at 60 baht and less per pack and (2) cigarettes priced at above 60 baht per pack (Ministerial Regulation Prescribing Excise Tariff B. E. 2560, 2017). In 2017, Thailand underwent an excise tax reform wherein the country changed its tax base from factory price to retail price.

In contrast, Indonesia currently utilizes a specific levy system for tobacco products and a minimum price policy to adjust tobacco product prices with several tiers for cigarettes. It used the ad valorem system until 2007. Between 2007 and 2008, a hybrid system was employed, while the specific system has been in effect since 2009. Excise rates for tobacco products in Indonesia are determined using the price in rupiah for each stick or gram of the product[13] (Ministry of Finance of the Republic of Indoneisa, 2020). Since 2022, Indonesia has adopted an eight-tier cigarette tax structure based on four categories, namely, (1) production volume, (2) production technique (e.g., machine-made vs. handmade), (3)

flavoring (e.g., with cloves or *kretek* vs. without cloves), and (4) retail price (Prasetyo & Adrison, 2019). In addition, since 2007, the Minister of Finance's regulation on tobacco product excise rates has stipulated the minimum retail selling price (*Harga Jual Eceran*) for cigarettes. However, retailers can still sell their cigarettes below this price (up to 85%).

DISCUSSION

Both Indonesia and Thailand encounter similar challenges in terms of monitoring and evaluating the results of policy implementation (see Table 2). Indonesia currently lacks strong proponents for tobacco control policies, whereas Thailand has empowered several authorities in the area of tobacco control. Moreover, Thailand's bans on smoking and the promotion of tobacco products are more restrictive than Indonesia's, and Thailand's policies on PHWs, pharmacotherapy, and excise taxes are more extensive than their Indonesian counterparts.

While Indonesia has implemented tobacco control policies due to its obligation as an ASEAN member, without any substantial progress in ratifying the FCTC, it remains one of the countries with the weakest tobacco control in the region, along with Laos and Myanmar (Amul & Pang, 2018). Government Regulation No. 109/2012, which is the Indonesian national-level policy on tobacco control, is considered to be vague and susceptible to significant loopholes in its implementation. Some aspects of government regulations are also left to the discretion of local governments, contributing to more potential delays, that is, due to

TABLE 2 Summary comparison of tobacco control policies

Tobacco control aspect	Indonesia	Thailand
FCTC	Not yet ratified	Ratified since 2004
Monitor tobacco use and prevention policies	Not well-structured and not yet a priority agenda; national smoking prevalence data collected annually	More structured by involving many parties; national smoking prevalence data is collected periodically
Protect people from tobacco smoke	Restrictions on smoking in certain public places; highly dependent on subnational government regulations	Total ban on smoking in nearly all public places
Offer help to quit tobacco use	Smoking Quit Line available Nicotine Replacement Therapy (NRT) is legally sold	Smoking Quit Line available Nicotine Replacement Therapy (NRT), bupropion, and varenicline are legally sold
Warn about the dangers of tobacco	PHW size 40%	PHW size 85%
	Stop Smoking Quit Line included in each PHW	Plain packaging
		National Quit Line number is included in each PHW
Enforce bans on tobacco advertising, promotion, and sponsorship	Restrictions on tobacco advertising, promotion, and sponsorship; highly dependent on subnational government regulations	Total ban on tobacco advertising, promotion, and sponsorship
Raise taxes on tobacco	A tobacco tax with a maximum rate of 57%	The tobacco tax burden is 70% of the retail price
	Specific system of the tax structure	Hybrid system of the tax structure
	Eight-tier cigarette tax structure	Two-tier cigarette tax structure

Source: Authors' compilation.

a lack of political will or the interference of the tobacco industry in policymaking. On the other hand, Thailand ratified the FCTC in 2004, reflecting its general approach to tobacco control. In Thailand, tobacco control policies have been formulated at the national level, and the involvement of the tobacco industry was prohibited (Vathesatogkit & Charoenca, 2011).

Regarding monitoring, the stakeholders of tobacco control in Thailand are more structured and holistic compared to Indonesia, whereas the data on tobacco use is collected more routinely in Indonesia than in Thailand. The involvement of many parties that are mutually sustainable and have the same goals has helped to establish a well-organized structure for monitoring and controlling tobacco use in Thailand. Meanwhile, in Indonesia, the monitoring and prevention of tobacco use is not a priority agenda of the Indonesian government, with the movement mostly led by NGOs. Moreover, there is a lack of coordination between ministries, government agencies, and NGOs, which hinders attempts to support tobacco control policies in the country. As for data collection, both Thailand and Indonesia have national surveys to monitor tobacco use, with Indonesia carrying out the survey every year while Thailand does so once every 2–3 years. Therefore, Indonesia must improve coordination and synergy with governmental and nongovernmental institutions, as Thailand has done, to achieve stronger results in tobacco control advocacy and monitoring.

In terms of smoking restrictions, the two countries differ significantly on the parts of the government that bear the responsibility for regulation. In Indonesia, upholding restrictions on smoking in public becomes complicated as national regulations relegate the creation of smoking ban regulations to their subnational counterparts. The Indonesian government has not set any specific deadlines for subnational governments to establish these regulations, allowing a lack of compliance to go without any consequences. Without regulations at the subnational level, local enforcement of bans on tobacco product usage becomes difficult. On the contrary, Thailand does not allow subnational governments to have separate regulations on smoking bans; thus, all regulations are determined at the national level as befitting the standards of the FCTC. Nevertheless, the enforcement of these policies still needs improvements (Kungskulniti et al., 2018).

Regarding smoking cessation, both countries already have nonpharmacological counseling programs and pharmacological therapy. The two countries provide nonpharmacological methods for smoking cessation remotely and face-to-face, with Indonesia's SCC being more accessible than Thailand's. Moreover, both countries have implemented pharmacotherapy interventions for tobacco cessation, albeit with different coverage of drugs. In the case of both Thailand and Indonesia, NRT for smoking cessation is legally sold and can be purchased at pharmacies without a doctor's prescription. However, bupropion and varenicline are not legally sold in Indonesia, whereas Thailand allows the drugs to be purchased at pharmacies with a doctor's prescription.

In terms of warnings on tobacco products, the size of PHW in Indonesia has plenty of room to improve compared to Thailand. The PHW on tobacco products in Indonesia are still relatively small, covering 40% of the packaging. When comparing PHW size among other countries, Indonesia is ranked 117th, which is behind its Asian peers such as Vietnam and the Philippines at 50%, Malaysia at 55%, Singapore at 75%, India at 85%, Myanmar at 80%, Thailand at 85%, Nepal at 90%, and even East Timor at 92.50%. It is recommended for Indonesia to gradually enlarge the size of PHW, as has been implemented in Thailand, to achieve the requirements for PHW per the WHO FCTC guidelines (50%).

In terms of tobacco product advertising and promotion, the two countries also show notable differences in the importance of the government's role in regulation. The state of tobacco advertisements and promotion in Indonesia is strongly related to the subnational government's willingness to tackle this issue. Up until 2018, only 345 districts (67% of 514 districts) had adopted SFPs that include bans on smoking, advertising, promotion, and sale within areas of public facilities (Wahidin et al., 2020). Moreover, the compliance rate in these

regions varied from 17% in the city of Jayapura to 78% in the city of Bogor (Wahyuti et al., 2019). Public Order Agencies appeared to be unfamiliar with the regulations, while higher-level regulations had not banned advertising, and no digital application had been established to assist surveillance (Astuti et al., 2018). Furthermore, the restrictions on the sale of tobacco to minors were not strongly enforced in minimarkets or more informal enterprise settings (Dewi et al., 2020). In contrast, Thailand has not allowed subnational governments to establish more local laws, requiring them to adhere to national smoke-free regulations. It thus falls to the national government of Indonesia, together with nongovernmental institutions, to advocate for subnational governments to adopt tobacco control policies in local regulations.

The policy of increasing the excise tax on tobacco products has been proven effective in reducing the prevalence of smoking, which may vary depending on the excise system (Vanessa & Murwendah, 2020). Concerning this point, Surjono (2013) determined that the elasticity of excise on cigarette prices depended on the excise taxation system, wherein a 1% increase of excise in the ad valorem system would increase the retail selling price by 0.675%, 0.689% in the hybrid system, and 1.085% in the specific excise system. Furthermore, a tobacco tax scorecard has been developed to facilitate a comprehensive comparison of the current status of cigarette tax policies in various countries by integrating multiple best practices (Chaloupka et al., 2020). In 2018, Indonesia received a total score of 1.63, whereas Thailand received a higher score of 1.75. The significant difference in the score was due to the tax share aspect. This implies that the proportion of taxes for the retail price of cigarettes is higher in Thailand than in Indonesia, thus generating more revenue for the government.

The current tier structure used by Thailand for cigarette excise is simpler than Indonesia's. Multitier excises create variations in cigarette prices, allowing producers and consumers to switch to cheaper products (known as "switching" or "downtrading") and hindering the decline in cigarette consumption (Prasetyo & Adrison, 2019). However, Indonesia continues to strive to reduce the number of cigarette excise tiers. From 2009 to 2011, Indonesia defined 19 tiers of cigarette excises, gradually decreasing them to eight tiers in 2022. On the other hand, Thailand has moved from having a one-tier to a two-tier regulatory structure since 2017. Since then, Thailand has adjusted its ad valorem tax rates for all types of tobacco products and imposed a specific tax rate on cigarettes to discourage downtrading (Southeast Asia Tobacco Control Alliance, 2021). Lestari (2018) stated that increasing the retail selling price of cigarettes as part of the simplification of the excise tariff structure was more effective at reducing cigarette consumption than raising tobacco excise rates. For this reason, both countries are expected to continue to simplify tiers to optimize the increase in cigarette excise taxes.

CONCLUSION AND POLICY RECOMMENDATIONS

Indonesia's current vision is known as "Better Human Resources for an Advanced Indonesia." The third sustainable development goal is "Good Health and Well-Being," emphasizing the importance of the population's health. However, the high prevalence of smoking threatens to induce direct and indirect adverse effects on the population, which may cripple Indonesia's efforts to achieve this vision and the sustainable development goal. In addition, smoking prevalence among youth is at an all-time high in the last 5 years, putting the health of Indonesia's future leaders at risk. The absence of comprehensive plans for tobacco control may jeopardize the ambitious target of Indonesia's National Medium Term Development Plan (*Rencana Pembangunan Jangka Menengah Nasional*) to lower the youth smoking prevalence from 9.1% in 2018% to 8.7% by 2024. Therefore, benchmarking peers that have achieved success in tobacco control policies, such as Thailand, may offer insights about addressing the current status of tobacco control in Indonesia.

Indonesia and Thailand provide two starkly different examples of the implementation of tobacco control policies. While Thailand has succeeded in adopting the FCTC, Indonesia has yet to sign the convention. Numerous indicators, such as MPOWER measures, illustrate that Indonesia is still far behind its neighboring countries in terms of controlling tobacco. For example, Thailand's bans on smoking and tobacco product advertising and promotion are significantly more restrictive compared to Indonesia's. Moreover, Thailand's policies on tobacco PHWs, pharmacotherapy, and excise are more extensive than those in Indonesia. Indonesia's failure in tobacco control policies is due to several underlying factors, including interference by the tobacco industry, a lack of political will, and other potential causes. Without a push to sign and ratify the FCTC, regulations at the lower level may be stymied because the convention serves as the foundation for all tobacco control policies. It is therefore of utmost importance for Indonesia to ratify the FCTC to strengthen policies and regulations regarding tobacco control. However, in the absence of the FCTC, Indonesia still lacks a strong proponent (champion) that is highly committed to pursuing tobacco control in the long term, with the Ministry of Health as the sole advocate for these policies (Astuti et al., 2020). Moreover, the Ministry of Health is not considered strong enough to generate the interest of other ministries and coordinate advocacy efforts and movements with other institutions. Thus, it is essential to invest in conditions that would create a competitive environment for nurturing a dedicated base of support within the country. Furthermore, Indonesia should also bolster and coordinate organizations working on tobacco control, encourage subnational governments to adopt regulations and enforce tobacco control, as well as improve excise policies to reduce the affordability of tobacco products. On the other hand, while Thailand has most regulations for tobacco control in place, it remains vital for the country to consolidate its undertaking of implementation and enforcement.

Future studies should consider conducting an evaluation of MPOWER measures and implementation at subnational levels in Indonesia or Thailand. Particularly in Indonesia, this should be carried out in regions that have or have not adopted local tobacco control policies. Our study has provided a broad overview of national-level evaluation; further research should gather evidence on the progress of tobacco control at the subnational level, which plays a strong role in the implementation of these tobacco control policies.

AUTHOR CONTRIBUTIONS

Conceptualization: Renny Nurhasana and Danty Novitasari. *Methodology*: Danty Novitasari, Ni Made Shellasih, Inayati, and Murwendah. *Formal analysis*: Renny Nurhasana, Faizal Rahmanto Moeis, Fandy Rahardi, Danty Novitasari, and Ni Made Shellasih. *Investigation*: Faizal Rahmanto Moeis, Fandy Rahardi, Danty Novitasari, Ni Made Shellasih, Inayati, Murwendah, Paibul Suriyawongpaisal, and Roengrudee Patanavanich. *Resources*: Renny Nurhasana, Danty Novitasari, and Ni Made Shellasih. *Writing—original draft preparation*: Renny Nurhasana, Faizal Rahmanto Moeis, Fandy Rahardi, Danty Novitasari, Ni Made Shellasih, Paibul Suriyawongpaisal, Roengrudee Patanavanich, and Suci Puspita Ratih. *Writing—review and editing*: Renny Nurhasana, Faizal Rahmanto Moeis, Fandy Rahardi, Danty Novitasari, and Ni Made Shellasih. *Supervision*: Renny Nurhasana.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

The research conducted for this study did not involve any human subjects, but is based on interviews with policymakers to talk about their policies, and therefore was not subject to the need for an ethical committee's approval.

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NOTES

[1] WHO classified each MPOWER measure into one of the possible five groups: "Complete," "Moderate," "Minimal," "None," or "Weak" policy, and "Not categorized" or "No data". Each score group has different criteria for each measurement. For instance, a "complete" for advertising bans requires bans for all forms of direct and indirect advertising, whereas a "complete" for taxation necessitates a tax rate that comprises >75% of the retail price.

[2] This is regulated in Law No. 36/2009 about Health and Government Regulation No. 109/2012 about the safeguarding of materials containing addictive substances in the form of tobacco products in the interest of health (Ministry of Health of the Republic of Indonesia, 2009; Republic of Indonesia, 2012).

[3] This is regulated in the 2017 Tobacco Products Control Act (Government of Thailand, 2017).

[4] For SFPs, the WHO designates "minimal" for when three to five public places are completely smoke-free, "moderate" for six to seven, and "complete" if all public places are completely smoke-free (or at least 90% of the population covered by complete subnational legislation).

[5] Law No. 36/2009 on Health, article 114 (Republic of Indonesia, 2009).

[6] Government Regulation No. 109 of 2012 and the implementation of the Minister of Health Regulation (*Peraturan Menteri Kesehatan*, Permenkes) No. 28 of 2013 (Ministry of Health of the Republic of Indonesia, 2013a, Republic of Indonesia, 2012).

[7] Minister of Health Regulation No. 40 of 2013 (Ministry of Health of the Republic of Indonesia, 2013b).

[8] Law No. 32/2002 on broadcasting (Republic of Indonesia, 2002).

[9] Government Regulation No. 109/2012 (Republic of Indonesia, 2012).

[10] Products Control Act, which was initially ratified in 1992 and has since been updated in 2017.

[11] Governor Decree No. 8/2021 (Provincial Government of Jakarta, 2021).

[12] This is according to WHO recommendations that stipulate a minimum tariff of 70% of the retail price (Vanessa & Murwendah, 2020).

[13] Regulation of the Minister of Finance of the Republic of Indonesia Number 198 of 2020 (Ministry of Finance of the Republic of Indonesia, 2020).

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APPENDIX A

see: Table A1

TABLE A1 Key informants and key issues in Thailand and Indonesia

Thailand		Indonesia	
Informants	**Issue**	**Informants**	**Issue**
Thai Health Promotion Foundation	How ThaiHealth contributes to tobacco control	Ministry of Finance	Raising the price of tobacco and related policies
Ministry of Health	Graphic health warning in Thailand	Coordinating Ministry for Human Development and Cultural Affairs	- Tobacco advertising, promotion, and sponsorship
			- Protect people from tobacco smoke
Fiscal Policy Office	Tobacco excise tax policy in Thailand	Ministry of National Development Planning of the Republic of Indonesia	- Monitor tobacco use and tobacco industry
			- Tobacco packaging in Indonesia
Ministry of Finance	Raising the price of tobacco	Ministry of Health	- Offer help to quit tobacco use: lesson learned from Thailand
			- Protect people from tobacco smoke
World Health Organization	Tobacco control policy in Thailand and the WHO contribution to encouraging the tobacco control in Thailand		
Tobacco Control Research and Knowledge Management Center, Mahidol University	- Tobacco advertising, promotion, and sponsorship		
	- Protect people from tobacco smoke		
	- Monitor tobacco use and tobacco industry		
Rangsit University, Thailand	- Comprehensive tobacco advertising control: Thailand overview		
Southeast Asia Tobacco Control Alliance (SEATCA)	- Overview of Tobacco control in Thailand and way forward		

TABLE A1 (Continued)

Thailand		Indonesia	
Informants	**Issue**	**Informants**	**Issue**
Action on Smoking and Health Foundation	- Fight tobacco industry interference - Tobacco packaging and labeling in Thailand		
Thailand Medical Association	- Offer help to quit tobacco use: lesson learned from Thailand		

APPENDIX B

see: Table B1

TABLE B1 Focus group discussion and dissemination events in Indonesia

Date	Issue and organizer	Attending ministries
March 2019	"RPJMN as an Instrument Towards Child-friendly Indonesia through Tobacco Control Programs" by National Committee on Tobacco Control	Ministry of National Development Planning of the Republic of Indonesia
June 2019	"Seminar on Smoking and Lung Disease" by TCSC IAKMI	Ministry of Health
June 2019	Public Discussion "Prohibition of Cigarette Advertising in Online Media" by TCSC IAKMI.	Ministry of Health
July,2019	Press conference "Social Assistance, Smoking Behavior, and Socioeconomic Indicators in Indonesia" (quantitative study) by CSSS-UI	Ministry of National; Development Planning; Ministry of Social Affairs; Head of Customs and Excise Policy, Ministry of Finance; Deputy for the Study and Management of Strategic Economic Issues, House of Representatives
July 2019	Dissemination of Research Results of the 2018 Indonesian Tobacco Control Research Network by the Center for Islamic Economics and Business, University of Indonesia	Ministry of Finance
September 2019	National Consultation "Tariff Policy and Simplification of Excise on Tobacco Products to Support Superior Human Resources" by CSSS-UI and CISDI	Ministry of Finance; Ministry of Health; Coordinating Ministry for Human Development and Cultural Affairs
October 2019	Discussion Meeting on the Draft National Strategy for Beginner Smoker Control	Ministry of Health
November 2019	Seminar "Increase in Excise and Cigarette Prices, Can Reduce the Prevalence of Smokers?" by TCSC IAKMI	Ministry of Finance
November 2019	Seminar "What's up with the Ban on Cigarette Advertising in Online Media?" by TCSC IAKMI	Ministry of Health; Ministry of Communication and Information Technology

(Continues)

TABLE B1 (Continued)

Date	Issue and organizer	Attending ministries
December 2019	Discussion on controlling cigarette consumption	Ministry for Human Development and Cultural Affairs
February 2020	Synergy of the RPJMN and the Ministry's Strategic Plan to Support Tobacco Control to Realize Superior Human Resources	Ministry for Human Development and Cultural Affairs; Ministry of Health
May 2020	"Larger Pictorial Health Warning on Tobacco Packs: Building Awareness on Covid-19 and Tobacco Use"	Ministry of Health
May 2020	Webinar "Advertising, Promotion and Sponsorship of Cigarettes in the Midst of the Covid-19 Pandemic".	Ministry of National Development Planning of the Republic of Indonesia; Ministry of Health
June 2020	Launching of the Indonesian Tobacco Atlas 2020 "Data-Based Policy Advocacy Efforts to Protect Children and Teenagers Become the Target of the Cigarette Industry" by TCSC IAKMI	Ministry of Health; Ministry of National Development Planning of the Republic of Indonesia

Abbreviations: CSSS-UI, Center for Social Security Studies, Universitas Indonesia; IAKMI, Ikatan Ahli Kesehatan Masyarakat Indonesia; RPJMN, Rencana Pembangunan Jangka Menengah Nasional; TCSC, Tobacco Control Support Center.

APPENDIX C

see: Table C1

TABLE C1 Institutions in Thailand tobacco control

Type of institution	Institutions Involved	Explanation
Government ministries/ agencies	National Committee for the Control of Tobacco Use (NCTTU) ▪ Ministry of Public Health ▪ Ministry of Education ▪ Ministry of Finance ▪ Ministry of Interior ▪ Ministry of Justice, ▪ Ministry of Social Development and Human Security ▪ Department of Public Relations ▪ Consumers Protection Board ▪ Food and Drug Administration ▪ Media Representative	The National Committee for the Control of Tobacco Use (NCCTU) was appointed in 1989. NCCTU have responsible for making policy and guidelines on tobacco control in the country, cooperating with other organizations concerning tobacco control activities, accelerating, controlling, monitoring, and evaluating the law enforcement of notifications issued by the Ministry of Public Health.
	Tobacco and Alcohol Control Group (TACG), Non-communicable Disease Department, Ministry of Public Health	Responsible for coordinating tobacco control activities in the district and works in close collaboration with the regional disease prevention and control center.
Nongovernmental organization	Action on Smoking and Health Foundation (ASH)	Plays a vital role in launching media campaigns against tobacco,

TABLE C1 (Continued)

Type of institution	Institutions Involved	Explanation
		particularly in smoke-free environments, empowering young people.
	Thailand Health Promotion Institute (THPI)	Advocates for tobacco policy and law and provides information to the general public about the tobacco industry's strategies.
	Thai Health Professionals Alliance Against Tobacco (THPAAT)	Encourages health professionals to be role models for a smoke-free, healthy life and be active advocates of the antismoking campaign.
	Southeast Asia Tobacco Control Alliance (SEATCA)	Focusing on seven Southeast Asian countries was created to share the Thai tobacco control experience. Areas of work include technical assistance for policy change, monitoring the tobacco industry, research, study tours, sharing best practices, regional/country workshops, fellowships, and seed grants for national capacity building.
Other institutions	ThaiHealth Promotion Foundation (ThaiHealth)	An autonomous government agency was established by the Health Promotion Foundation Act in 2001. Its mission is to support and develop health promotion interventions leading to improvements in the health of the Thai people through 12 programs, one of which is tobacco control.
	Tobacco Control Research and Knowledge Management Center (TRC)	The Tobacco Control Research and Knowledge Management Centre (TRC) atMahidol University is responsible for developing a database for tobacco control monitoring and surveillance, supporting research activities, and evaluating tobacco control programs and projects.
International organization	World Health Organization Tobacco Free Initiative (WHO TFI), Thailand	Collaboration with the Ministry of Health and the Government of Thailand, WHO is working to protect present and future generations from the devastating health, social, economic, and environmental consequences of tobacco consumption and exposure to tobacco smoke.

Source: Thailand Report Card (2008) and WHO (2011), compiled by authors.

APPENDIX D

see: Table D1

TABLE D1 Promotion and advertising media regulation comparison of Indonesia and Thailand

Media	Indonesia	Description	Thailand	Description
Domestic TV and radio	Restricted	Tobacco advertising in broadcast media is only allowed between 9:30 p.m. and 5:00 a.m. local time. Advertisements also must not show cigarette products.	Full ban	Tobacco advertising is prohibited in radio broadcast and television broadcasts.
Domestic newspaper and magazines	Restricted	Tobacco advertising is not allowed on the front and back cover of print media. Also, it is not permitted in media targeted at children, adolescents, and females and may not take one page. Advertisements also must not show cigarette products.	Full ban	Tobacco advertising is prohibited in printed media.
Internet promotion	Restricted	Advertisements must not show cigarette products.	Full ban	Tobacco advertising is prohibited in electronic media.
Outdoor advertising (poster, billboards)	Restricted	Outdoor advertising may not be larger than 72 m^2, placed on main or traverse roads, and in smoke-free zones. Advertisements must not show cigarette products.	Full ban	Tobacco advertising is prohibited in printed media and advertising signs.
Point of sale products display	Allowed	Retail establishments are allowed to display tobacco products.	Full ban	Displaying tobacco products in retail establishments is prohibited.
Direct person to person marketing	Allowed	There are no prohibitions on the direct marketing of tobacco products.	Full ban	Marketing communications for tobacco products are prohibited.
Sponsorships	Restricted	The tobacco industry may sponsor activities as long as there is no intent in promoting products and no trademarks names or logos may be used. Sponsorship is also prohibited if the media cover the activity.	Restricted	Publicized sponsorships are not allowed. However, unpublicized sponsorships are permitted.

Source: CTFK (2021).

APPENDIX E

see: Table E1

TABLE E1 Smoking ban regulation comparison of Indonesia and Thailand

Location	Indonesia	Description	Thailand	Description
Indoor Workplaces	Restricted	Workplaces must have smoking areas that may be located inside or outside the workplace.	Full Ban	All workplaces are 100% smoke-free.
Hospitals	Restricted	Nationally, regulations do not allow smoking in hospitals. However, this depends on local regulations that determine smoking-free zones, which have not been passed by all local governments.	Full Ban	All Public health service and promotion are 100% smoke-free.
Hotels/Lodging	Unclear	There are no specific regulations regarding smoking in hotels. Moreover, this is very dependent on local regulations which not all local governments have created specific regulations.	Full Ban	All hotels, lodging, resorts, and homestay are 100% smoke-free.
Restaurants	Restricted	Nationally, regulations do not allow smoking in workplaces and public places. However, this depends on local regulations that determine smoking-free zones that have not been regulated by all local governments, and some shops are located outdoors (exempted from smoking regulation).	Full Ban	All air-conditioned indoor and outdoor places selling food or beverages are 100% smoke-free.
Shops	Restricted	Nationally, regulations do not allow smoking in workplaces and public places. However, this depends on local regulations that determine smoking-free zones that have not been regulated by all local governments, and some shops are located outdoors (exempted from smoking regulation).	Full Ban	All public areas, including shopping malls and shopping centers, are 100% smoke-free. Moreover, smoking is banned in shops that sell consumer goods and pharmacies.

(Continues)

TABLE E1 (Continued)

Location	Indonesia	Description	Thailand	Description
Schools (Primary and Secondary) and Universities	Restricted	Nationally, regulations do not allow smoking in educational facilities. However, this depends on local regulations that determine smoking-free zones that have not been regulated by all local governments.	Full Ban	All area of education institutions is 100% smoke-free. However, specifically for universities, smoking is allowed in designated smoking areas outside of the university facilities.
Public Transportation (including Taxis and Aircraft)	Restricted	Nationally, regulations do not allow smoking in public transportation. However, this depends on local regulations that determine smoking-free zones, which have not been passed by all local governments.	Full Ban	All public transportation is 100% smoke-free.

Source: CTFK (2021).

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ORIGINAL ARTICLE

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Leader gender, country culture, and the management of COVID-19

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Abstract

As early as two months into the COVID-19 pandemic, popular media started reporting that women leaders, compared to men leaders, were managing COVID-19 better. This paper empirically examines the impact of women leaders in managing pandemic health outcomes one year after the onset of the pandemic. Further, we consider leader effectiveness within the context of country culture. We find that women's leadership is indeed associated with better containment of the pandemic. We also find that certain country-level cultural traits play a significant role in pandemic outcomes. More hierarchical societies experience higher COVID-19 cases and death. Individualistic cultures and masculine cultures are associated with more deaths from the pandemic. Some cultural traits modulate women's ability to manage COVID-19. Our findings have implications for health policy and provide rationale for promoting gender equity in political leadership.

KEYWORDS

COVID-19, culture, women leaders

Key points

- Women's leadership is associated with better containment of the COVID-19 pandemic.
- Certain cultural traits have an impact on pandemic outcomes. Hierarchical societies have higher rates of COVID-19 cases and deaths. Individualistic cultures and masculine cultures are associated with more COVID-19 deaths but not cases.

- The effect of women leaders on COVID-19 rates and deaths is modulated by cultural traits. More specifically, short-term orientation and indulgent cultures seem to boost women's effectiveness in tackling the pandemic.
- The mechanism of how culture influences the effectiveness of women leaders needs to be studied further.

INTRODUCTION

As early as late spring 2020, popular media reported better management of the COVID-19 pandemic in countries led by women as opposed to countries led by men. Headlines such as "What Do Countries with the Best Coronavirus Responses Have in Common? Women Leaders" from Forbes (Wittenberg-Cox, 2020), and "Why are Women-Led Nations Doing Better with Covid-19" from the *New York Times* (Taub, 2020) had the general population and researchers deliberating the validity of such claims.

Researchers have taken up the challenge of empirically investigating the reported association between women leaders and COVID-19 health outcomes. Within-country analysis by Sergent and Stajkovic (2020) found that, as of May 2020, US states with women governors had fewer COVID-19 deaths per capita than those governed by men. On an international level, researchers have found that countries with women leaders showed reduced COVID-19-related deaths per capita and that women were more effective in introducing the mitigating policy, such as country-level shutdowns, mask mandates, and contact tracing against COVID-19 (Abras et al., 2021; Coscieme et al., 2020; Garikipati & Kambhampati, 2021; Park, 2021).

However, the overall country culture also seems to affect COVID-19 rates (Ibanez & Sisodia, 2020; Mayer et al., 2020). Furthermore, researchers such as Windsor et al. (2020) have concluded "women are able to attain national leadership positions in countries where core cultural values reward traits often found in women leaders, such as a long-term orientation, a collectivist (rather than individualist) focus, and fewer power disparities in society" (p. 2). Thus, it is important to consider and separate out country culture when examining the specific, unique impact of women's leadership on pandemic outcomes. Very few studies have evaluated the impact of both leader gender and country-level cultural variables on pandemic outcomes. So far, to our knowledge, Windsor et al. (2020) and Garikipati and Kambhampati (2021) are the only researchers to include both leader gender and some measure of culture or social norms when assessing COVID-19 outcomes. The results of each highlight the need to investigate this relationship further. Windsor et al. (2020) found that including cultural level variables in their model reduced the association between women's leadership and lower COVID-19 death rate to a non-statistically significant trend. From this, they concluded that country-level cultural values were confounding the effect of women-led countries having better COVID-19 outcomes. However, Garikipati and Kambhampati (2021) found support for the popular media claims while accounting for a proxy for gender-related cultural differences. They used nearest-neighbor matching to control for country-level differences on the Gender Inequality Index, a proxy for gender inequality in the context of health, educational attainment, political participation, and labor market participation. Results showed that women-led countries had lower death rates from COVID-19.

This paper contributes to the literature examining leaders' effectiveness, through the lens of gender, in health policy and on community-level health outcomes

(e.g., Chattopadhya & Duflo, 2004; Cole et al., 2017; Eagly & Karau, 2002; Eagly et al., 1995; Macmillan et al., 2018; Paustian-Underdahl et al., 2014; Swers, 1998). More specifically, we examine whether having an elected female political leader during the pandemic is associated with a lower number of COVID-19 cases and death per capita after controlling for country-level cultural values. Our paper contributes to the scarce existing literature on leader gender, country culture, and pandemic outcomes. To our knowledge, only two previous studies, by Windsor et al. (2020) and Garikipati and Kambhampati (2021), have investigated similar dynamics. Our research adds to the conversation in the following ways.

First, we look at a longer time horizon than Windsor et al. (2020) and Garikipati and Kambhampati (2021), who carried out their analyses in mid-2020. Unlike Windsor et al. (2020) who focus on pandemic outcomes 30, 60, 90, and 120 days after the onset of the pandemic, we focus on the cumulative cases a full year after the start of the pandemic. Thus, we are less interested in the efficacy of the emergency response immediately after the onset of the pandemic and more focused on the longer-term management of the health crisis. We expect that a 1-year overview of the pandemic would reveal different patterns of leadership than previous research. Our findings suggest that female leadership is associated with lower COVID-19 deaths in the longer run while Windsor et al. (2020) find no statistically significant effect in the immediate aftermath of the onset of the pandemic.

Second, similar to Windsor et al. (2020), we control for a broader number of cultural dimensions, using Hofstede's six domain cultural model, that are likely to confound the impact of female leadership on health outcomes. This is unlike Garikipati and Kambhampati (2021) who proxy for culture with the Gender Inequality Index. Our results with respect to women's leadership and pandemic outcomes include robust cultural variables.

WOMEN IN LEADERSHIP: COUNTRY-LEVEL CONCEPTUAL FRAMEWORK

Until the late 20th century and early 21st century, globally there have been few women in political power at the national level. It was therefore challenging to decipher empirically the effect of women's leadership, as compared to men's leadership, on political policies and outcomes (Perkins et al., 2013). Now that 75 countries have had women as leaders (O'Neill, 2021), 46 of whom have been elected into their position, it is becoming possible to test the effectiveness of women as leaders. The COVID-19 pandemic set the stage for a comparison of effectiveness between women and men leaders. During the pandemic, 16 women have held the position of head of state; of the 16 women, 13 were elected. Table 1 lists the names of the female leaders during the pandemic, their term start and/or end date and their position.

Health outcomes in communities with women leaders

Existing research (e.g., Cole et al., 2017; Eagly & Karau, 2002; Macmillan et al., 2018; Swers, 1998) has demonstrated and confirmed that women in politics have developed a niche in domestic health and social policy. Multiple factors, influenced by social roles, could explain the fact that women in political leadership focus on and effectively improve community-level health outcomes. First, women are traditionally and disproportionately responsible for child rearing, caring for elderly family members, and all other domestic duties (Bowles & McGinn, 2008; Eagly & Carli, 2007). Care for the health of family members has made women more aware of shortcomings of the health system and potentially likely to seek

TABLE 1 Female leaders since the pandemic started

Name	Date term started	End of term date	Official position
Serbia (Ana Brnbic)	2017	Ongoing	Prime minister
Estonia (Kersti Kaljulaid)	2019	Ongoing	Prime minister
Myanmar (Aung San Suu Kyi)	2015	February 2021	State counsellor (prime minister)
Germany (Angela Merkel)	2005	Ongoing	Chancellor
Bangladesh (Sheik Hasina)	2009	Ongoing	Prime minister
Denmark (Mette Fredricksen)	2019	Ongoing	Prime minister
Taiwan (Tsai Ingwen)	2016	Ongoing	President
Norway (Erna Solberg)	2013	Ongoing	Prime minister
Belgium (Sophie Wilmes)	2019	October 2020	Prime minister
New Zealand (Jacinda Ardern)	2017	Ongoing	Prime minister
Finland (Sanna Marin)	2019	Ongoing	Prime minister
Iceland(Katrin Jacobsdottir)	2017	Ongoing	Prime minister
Lithuania (Ingrida Simonyte)	December 2020	Ongoing	Prime minister
Tanzania (Samia Hassan)	March 2021	Ongoing	President
Trinidad and Tobago (Paula Mae Weeks)	2018	Ongoing	President
Bolivia (Jeanine Anez)	November 2018	November 2020	Prime minister

out political action to fix these healthcare issues (Bratton, 2005; Giles-Sims et al., 2012; Macmillan et al., 2018; Mavisakalyan, 2014; Swers, 1998). Second, because of these societal roles, women traditionally obtain leadership and influence by reaching prominence in fields that match cultural views of female gender roles such as nursing, hospice care, mental health, and education (Eagly, 1987; Eagly & Karau, 2002; Eagly et al., 2000; Okimoto & Brescoll, 2010; Wolfram et al., 2020). Previous meta-analyses and studies have shown that leadership emergence has often been based on gender and role congruence. In other words, men tend to emerge as leaders in stereotypically male occupations and women tend to emerge as leaders in stereotypically female occupations (Ayman & Korabik, 2010; Eagly & Carli, 2007; Eagly & Karau, 1991; Okimoto & Brescoll, 2010; Wolfram et al., 2020). This expertise and focus on "female" domestic occupations then follow women into their political careers.

Research studies have found that women can be more effective than men in leadership domains that are more congruent with cultural views of women (Eagly et al., 1995; Paustian-Underdahl et al., 2014). For example, Schwartz and Rubel (2005) found that women leaders are more likely to focus on, and highlight, the well-being of others than male leaders. Combining this particular leadership style with occupations such as education, social services, and health care allows women to be more effective leaders in those occupational settings (Eagly et al., 1995). Women's leadership is theorized to improve health outcomes in communities as shown by Chattopadhyay and Duflo (2004), who found that female executive village heads in India focused on health projects more than their male counterparts did. Female legislators have also been found to positively influence child and maternal outcomes in other less developed countries (Bhalotra & Clots-Figueras, 2014;

Obasanjo, 2019; Swiss et al., 2012; Westfall & Chantiles, 2016). In developed countries, female parliamentarians tend to be on social sector-related committees (Park & Liang, 2019; Swers, 1998) and thus have had success in promoting legislation and new laws in these areas.

Beyond the focus on female leaders' policy priorities, women's leadership style is another important factor in determining the effectiveness of health outcomes. Research has shown that women use a more participative and democratic leadership decision-making style (van Engen & Willemsen, 2004). Many theorize this is due to the prejudice and pushback women leaders face when behaving in a more autocratic style traditionally associated with masculine behavior (see Ayman & Korabik, 2010). Women leaders have also been found to use more transformational leadership, a style of leadership that strives to be inspiring, supportive, and respectful of their followers (Ayman et al., 2009; Bass & Avolio, 1993; Eagly et al., 2003). In the leadership literature overall, transformational leadership has been found to produce more long-lasting and effective results (e.g., see Ayman et al., 2009; Podsakoff et al., 1990; Rafferty & Griffin, 2004). Women also tend to use more transactional contingent reward behaviors, a leadership style that rewards followers with public recognition or material rewards for performing specific tasks (Ayman et al., 2009; Bass & Avolio, 1993; Eagly et al., 2003). The combination of these leadership styles might help women be better leaders than men in domains such as health and social policy where involvement and participation by a wide range of individuals are crucial for success. Consequently, we propose that, holding everything else constant, women leaders are more effective at managing the COVID-19 pandemic (a healthcare domain) than their male contemporaries.

Accounting for culture

To properly gauge the impact of women's leadership on health outcomes, and in particular on pandemic outcomes, we need to control for country-level cultural dynamics which have been shown to affect people's willingness to get vaccinated, follow government mandates on mask wearing and social distancing (Bartscher et al., 2021; Ng & Tan, 2021; Salvador et al., 2020). Culture can also influence the likelihood of women being voted into positions of national leadership (Windsor et al., 2020). In addition, cultural traits can impact the effectiveness of women leaders to bolster healthcare outcomes. For example, Ayman et al. (2009) found that in more hierarchical cultures, where male subordinates are more likely to belittle women's leadership, any benefit from participative, transformational, or contingent reward behaviors is lost.

Culture has been viewed as a multidimensional experience including shared visible characteristics and internal values that guide and define a community (e.g., Connerley & Pedersen, 2005; Hofstede, 2011). This includes demographic, geographic, ethnographic, power status, and moral values (Connerley & Pedersen, 2005). We focus specifically on Hofstede's six domains of culture: 1. power distance (PDI), 2. individualism versus collectivism (IDV), 3. masculinity versus femininity (MAS), 4. uncertainty avoidance (UAI), 5. long-term orientation versus short-term normative orientation (LTOWVS), and 6. indulgence versus restraint (IVR; Hofstede, 1980, 2001; Hofestede et al., 2010). Important to note is Hofstede's distinction between country-level analysis versus individual-level analysis. Specifically, these six domains are strategically meant to discern differences between countries rather than individual people. While the scope of this research is establishing the overall relationship between women's leadership, culture, and COVID-19 outcomes, it is important to consider potential underlying psychological mechanisms for the relationship. The following is a short description of each cultural domain with discussions of potential links to leader gender and the healthcare domain.

Power distance is concerned with acceptance and reliance on hierarchal power structures from all members of society (i.e., those less powerful also expect an unequal distribution of power). Overall, power distance is a description of how a society deals with inequalities among individuals. High power distance is seen in countries where people accept stringent hierarchical order without justification. Countries with low power distance attempt to flatten power distributions among individuals and any inequalities demand justification (Hofstede, 1980, 2001; Hofstede et al., 2010). Power distance could contribute to competing effects on follower behavior. On the one hand, we stipulate that cultures that rely on hierarchal structures (i.e., higher power distance) will be more likely to follow pandemic-related restrictions due to cultural norms in following authority. However, this positive mechanism may be suppressed by bias against women leaders. Women leaders face more difficulty when a culture relies on hierarchal structures (Ayman et al., 2009). This is due to perceived incongruence between the autocratic, masculine leadership style required to gain power and influence in hierarchal structures and cultural perceptions of women as less assertive. Therefore, women in high power distance cultures receive more resistance in gaining and enacting political influence. Other research on perceived effectiveness and style of women leaders supports the theory that low power distance is more conducive for women leaders (e.g., Gannouni & Ramboarison-Lalao, 2019; Paustian-Underdahl et al., 2014). Thus, we posit the effectiveness of women leaders will be higher in countries with low power distance.

In Hofstede's second domain, individualism versus collectivism, higher scores indicate highly individualistic societies, which value more loose social connections. In these cultures, individuals are responsible only for themselves and immediate family. In contrast, lower scores delineate collectivism, in which there is a preference for higher interconnectedness between individuals. This entails expectations for loyalty and care from in-group members outside the immediate family unit (Hofstede, 1980, 2001; Hofstede et al., 2010). In this case, collective cultures should be associated with better COVID-19 outcomes and will interact positively with women's leadership. Collective behaviors include more supporting behaviors throughout a population and women tend to be more community-oriented in their leadership style (i.e., participative decision-making). Thus, we hypothesize that more collectivistic cultures are going to have better outcomes when facing a pandemic.

The masculinity–femininity domain focuses on the relative status placed on masculinity: assertiveness, achievement, competitiveness, material rewards for success, and heroism as opposed to femininity: caring for quality of life, modesty, preference for cooperation, position security, and consensus seeking (Hofstede, 1980, 2001; Hofstede et al., 2010). Higher scores imply more masculinity. We hypothesize that cultures that score lower on the masculinity scale would be more effective at managing the pandemic because of the cultural focus on caring and cooperation. Furthermore, we again expect an interaction effect between female leadership and this cultural dimension. More specifically, we stipulate that women leaders will be more effective in highly feminine cultures and less effective in masculine cultures.

The fourth domain is uncertainty avoidance. Countries high in uncertainty avoidance attempt to control uncertainty and ambiguity with the use of inflexible social norms and an intolerance of unconventional behaviors. Low uncertainty avoidance describes cultures with a more relaxed view of the future; “come what may.” In these countries, persistence in overcoming obstacles is more important than cultural conventions (Hofstede, 1980, 2001; Hofstede et al., 2010). Like power distance, we stipulate the effects of uncertainty avoidance and female leadership will be at odds. Countries with higher uncertainty avoidance will be more likely to follow safety precautions to avoid risks and ambiguity. However, women leaders might hold less influence in high uncertainty avoidance cultures due to female leadership being counter to cultural conventions.

The fifth domain, long-term orientation versus short-term normative orientation evaluates a society's balance between traditionalism and the need for pragmatic modern change. Long-term orientation (high scores on this domain) indicates a society that is focused more on preparing for the future rather than the present or the past (Hofstede, 1980, 2001, 2010). Short-term normative orientation (low scores) denotes a preference to maintain the established status quo and is more resistant to societal change (Hofstede, 1980, 2001; Hofstede et al., 2010). Conceptually, we can see two possible directions, in which long-term versus short-term orientation can affect pandemic outcomes regardless of leader gender. On the one hand, cultures with long-term orientation might have better outcomes during the pandemic due to recognition and acceptance of change. On the other hand, short-term orientation might lead to better outcomes during a pandemic because pandemic health outcomes have immediate and serious health consequences and short-term orientation is linked with the mindset that "most important events in life occurred in the past or take place now" (Hofestede, 2011, p. 15). We do not expect an interaction between leader gender and long-term orientation although it is likely that countries with long-term orientation are more open to electing a woman leader.

The last domain is indulgence versus restraint. Indulgent cultures accommodate hedonism and focus more on finding enjoyment in life. Restraint cultures suppress gratification of natural drives and are guided by stringent social norms (Hofstede, 1980, 2001; Hofstede et al., 2010). A culture of restraint will be far more likely to follow the safety precautions in place despite inconvenience. Conceptually, we do not expect an interaction between leader gender and culture on this domain.

MODEL AND DATA

To explore the impact of women leaders on pandemic outcomes, we estimate the following model:

$$PO_i = \alpha + \beta_1 WL_i + \beta_2 NY_i + \beta_2 PDI_i + \beta_2 IDV_i + \beta_2 MAS_i + \beta_2 UAI_i + \beta_2 LTOWVS_i + \beta_2 IVR_i + X_i'\gamma + e_i,$$

where our dependent variable, *PO*, is pandemic outcome; *WL* is women leadership; *NY* is number of years of female leadership in the country; *PDI*, *IDV*, *MAS*, *UAI*, *LTOWVS*, and *IVR* are Hofstede's cultural variables; *X* is a number of country-level controls; and *e* is the error term.

Dependent variable: Pandemic outcome

Our discussion focuses on two key dependent variables—cumulative total COVID-19 cases per 100,000 population and cumulative total COVID-19 deaths per 100,000 population. The data come from the World Health Organization as of May 15, 2021. The number of COVID-19 cases better captures the effectiveness of overall public health measures initiated specifically for managing COVID-19 and the adherence to these measures while the number of COVID-19 deaths is a better proxy for the quality of the healthcare system and effectiveness of existing health policy. Some of the earlier literature on COVID-19 utilizes measures of the spread of the disease for a particular period of time after the onset of the disease. This approach makes sense for research focusing on the first 3–6 months of the pandemic. However, we are examining a much longer time period and thus resort to the cumulative number of cases.

Leader gender

We utilize two key explanatory variables, *WL* and *NY*, to proxy for the presence of women leaders. The first, *WL*, is a dummy variable equal to one if the person in highest position of executive power since the start of the pandemic was ever a woman. As discussed above, our research focuses on women who won elections to become the political leaders of their countries. We do not include ceremonial or appointed leaders. Our reasoning for this is that appointed women tend to be appointed for short periods of time, primarily as symbolic leaders and thus do not represent the ability of society to abide with the leadership of a woman. Of the 16 countries identified in Table 1, 13 were elected and 11 countries are included in our data set; the rest had missing data and were, consequently, dropped from the regression analysis. These countries had an elected woman leader at some point during the first year of the pandemic.

Our second leader gender variable, *NY*, is the number of years of women's leadership in a country since 1960. To calculate this number, we used Statista data on the number of women in the highest position of executive power from 1960 to 2021. We researched each of the women listed in the database to understand the mechanism of acquiring the executive leadership position (elected, appointed, etc.) and the specifics of the political system in the country. We used 1960 as our starting date since it marked the beginning of the era of mass independence for countries in the global south. The number of years of women leaders is a proxy for the historical level of comfort of countries with women leaders as well as the accumulated effect of policies designed by women leaders over the decades. In our sample, the country with the most extensive experience with women's leadership in national politics is Ireland (21 years), followed by England and Bangladesh (19 years), India and New Zealand (18 years), Philippines (17 years), and Germany and Norway (15 years). Of these countries, four had a female leader during the pandemic. The other seven female leaders during the pandemic were from countries with less extensive experience with female leadership.

Culture

To measure dimensions of culture at the country level, we use Hofstede's cultural variables described in detail in our Accounting for culture section. We use the 2015 updated Hofstede cultural dimensions data, available for research use on Geert Hofstede's website (https://geerthofstede.com/research-and-vsm/dimension-data-matrix/). The original data were collected in the 1970s through a survey of IBM employees across countries. Over the decades, the cultural dimensions expanded and Hofstede collaborated with other researchers to update and expand the data. A number of studies have replicated and validated the Hofstede dimensions over time. "Between 1990 and 2002 six major replications (14 or more countries) used populations of country elites, employees and managers of other corporations and organizations, airline pilots, consumers and civil servants" (Hofstede, 2011, p. 8). Unfortunately, while Hofstede's data is more complete than other cultural databases, it does not cover a significant number of countries in the world. Further, in a number of cases, it only provides regional-level data (e.g. East Africa, West Africa) rather than individual country-level data for four of the cultural indices. Thus, the inclusion of cultural dimensions in our regressions naturally decreases our sample size. Correlation coefficients between the six dimensions of culture do not reveal any significant patterns of complementarities between the different dimensions. All correlation coefficients are between −0.46 and 0.39.

Control variables: Country demographics

Because we are dealing with countries with vastly different demographics, a larger picture of country demographic effects on COVID-19 outcomes is required. Specifically, we identified the five following demographic variables as important controls for our analysis: (a) life expectancy at birth, (b) log GDP per capita, (c) log population density, (d) percent of the population above age 65, and (e) regional dummy variables. We follow the World Bank regional classification to include the following world regions—Eastern Mediterranean, Europe, Western Pacific, South East Asia, Africa, and Americas (our control group).

First, life expectancy at birth and log GDP per capita are both proxies for standard of living and higher quality of health care available to citizens. We expect that they are associated with lower death rates during the pandemic. We expect GDP per capita to have a positive relationship with COVID-19 cases. More specifically, high GDP is related to higher levels of global connections and citizens involved in global travel. As most countries originally acquired cases through global travel (see Petersen et al., 2020), we stipulate that countries with fewer global connections and with fewer residents involved in global travel will have fewer cases. For countries with higher population density, we expect the transmission mechanism of the COVID-19 virus, airborne and close contact, to produce higher numbers of cases and deaths. Finally, since the virus has higher rates of complications for people over age 65, we also expect to see higher death rates from COVID-19 in countries with a higher percent of the population above age 65.

The correlation coefficient between life expectancy and GDP per capita is very high (0.87). Countries with higher GDP per capita and higher life expectancy also have a higher percentage of their populations above age 65 (correlation coefficients are, respectively, 0.60 and 0.64). There is a negative correlation between log GDP per capita and power distance (−0.63) and a positive correlation between log GDP per capita and individualism (0.67). Table 2 provides a list of the countries included in our analysis. Table 3 shows summary statistics for the variables included in our empirical analysis. Table 4 shows the correlation coefficients between the explanatory variables.

TABLE 2 Countries included in our regressions

United Arab Emirates	Colombia	Indonesia	Malta	Singapore
Argentina	Czechia	India	Malaysia	El Salvador
Australia	Germany	Ireland	Netherlands	Serbia
Austria	Denmark	Iran	Norway	Slovakia
Belgium	Spain	Italy	New Zealand	Sweden
Bangladesh	Estonia	Japan	Pakistan	Thailand
Bulgaria	Finland	Republic of Korea	Peru	Trinidad and Tobago
Brazil	France	Lithuania	Philippines	Turkey
Canada	The United Kingdom	Luxembourg	Poland	Uruguay
Switzerland	Greece	Latvia	Portugal	United States of America
Chile	Croatia	Morocco	Romania	Viet Nam
China	Hungary	Mexico	Russian Federation	

TABLE 3 Summary statistics

Variable	Obs.	Mean	SD	Min	Max
Log COVID-19 cases	59	7.866373	1.703235	1.576915	9.644802
Log COVID-19 deaths	59	3.930742	1.56334	.0392207	5.697966
Log GDP per capita	59	9.659524	1.095241	7.129658	11.5266
Log population	59	16.88997	1.725109	13.00595	21.03897
Female leadership during the pandemic	59	0.1864407	0.392805	0	1
Number of years of female leadership	59	3.79661	6.124512	0	21
Power distance	59	58.18644	20.79496	11	100
Individualism	59	47.49153	23.11096	13	91
Masculinity	59	48.69492	20.02262	5	100
Uncertainty avoidance	59	66.64407	22.35201	8	100
Long-term orientation	59	49.45763	22.19609	13	100
Indulgence	59	46.16949	20.83859	0	97
Life expectancy	59	77.76068	4.093064	66.58	83.79
Log population density	59	305.8929	1023.592	3.1	7806.77
Percent of population age 65 or above	59	14.97793	6.054669	1.156549	28.00205

Note: Summary statistics based on sample in the empirical specification in Table 5, Column 2.

TABLE 4 Correlation coefficients

	Power distance	Individualism	Masculinity	Uncertainty avoidance	Long-term orientation	Indulgence
Power distance	1.00					
Individualism	−0.65	1.00				
Masculinity	0.14	0.06	1.00			
Uncertainty avoidance	0.22	−0.20	0.04	1.00		
Long-term orientation	0.04	0.09	0.04	0.02	1.00	
Indulgence	−0.40	0.27	0.06	−0.18	−0.46	1.00

	Life expectancy	GDP per capita (log)	Population density	Population above 65
Life expectancy	1.00			
GDP per capita (log)	0.87	1.00		
Population density	0.15	0.11	1.00	
Population above 65	0.64	0.60	−0.07	1.00

CULTURE, LEADER GENDER, AND PANDEMIC OUTCOMES: EMPIRICAL RESULTS

We estimate the model specified in the Model and data section using ordinary least squares. We base statistical inference on heteroskedasticity-robust standard errors.

Tables 5 and 6 present the results with log COVID-19 deaths per 100,000 residents and log COVID-19 cases per 100,000 residents as the dependent variables, respectively. Column (1) of each table presents the baseline regression results that do not include cultural dimensions as explanatory variables. Column (2) presents results that include cultural dimensions but do not include the leader gender variables. Column (3) presents results with both leader gender and country culture. The results for these specifications are discussed in the Leader gender, Culture, and Demographic indicators sections.

Tables 7 and 8 add an interaction effect between women's leadership and individual cultural components. Section Women leaders' effectiveness: moderating cultural factors discusses the results from these regressions and more specifically the moderating effects of culture on the effectiveness of women's leadership. All specifications include the country demographic variables discussed in the previous section.

The Robustness checks section outlines our robustness checks.

Leader gender

In confirmation of the hypothesis that women leaders have been more successful at managing COVID-19, we see a negative and statistically significant effect of having a female leader on both COVID-19 deaths (−0.8909) and COVID-19 cases (−0.7101) in Column (1) of Tables 5 and 6. This translates into 41% fewer COVID-19 deaths and 49% fewer COVID-19 cases in countries with a woman leader. The historical number of years of female leadership in the country does not have a statistically significant effect on pandemic outcomes.

Controlling for cultural variables in our regressions slightly reduces the impact of female leadership on COVID-19 deaths (Column 3 of Table 5) and makes the impact insignificant for the COVID-19 cases regressions (Column 3 of Table 6). The COVID-19 cases regression is in line with the findings of Windsor et al. (2020). However, the COVID-19 death results indicate that there is more to the relationship than culture can account for. This supports the overall assertion that women leaders have better results in reducing the number of COVID-19 deaths in their countries.

Our conceptual framework outlines a number of possible mechanisms for this result. First, due to having more domestic responsibility for the health care of children and elderly, women may more readily identify gaps in the existing healthcare systems. Second, due to a greater focus on social policies, women leaders may have more intimate knowledge of the healthcare system. Finally, due to their tendency toward participative decision-making, women leaders will be more likely to consult and utilize knowledge of experts from different domains when faced with a pandemic of an unfamiliar virus.

Culture

In terms of Hofstede's six cultural variables, individualistic and masculine cultures were in line with our expectations, while power distance had some unexpected results. The results in Column (2) of Table 5 indicate that three cultural variables are significantly associated with COVID-19 deaths—power distance, individualism, and masculinity. The number of COVID-19 cases is only affected by power distance (see Column 2 of Table 6). The other

TABLE 5 Dependent variable: Log COVID-19 deaths per 100,000 residents

Variables	(1)	(2)	(3)
Female Leader Dummy	−0.8909**		−0.6903**
	(0.3435)		(0.2583)
Years of female leadership	0.0153		0.0158
	(0.0200)		(0.0191)
Power distance		0.0154**	0.0137**
		(0.0062)	(0.0066)
Individualism		0.0158**	0.0148**
		(0.0073)	(0.0067)
Masculinity		0.0106**	0.0083*
		(0.0051)	(0.0047)
Uncertainty Avoidance		0.0055	0.0049
		(0.0069)	(0.0069)
Long-term Orientation		0.0034	0.0056
		(0.0068)	(0.0066)
Indulgence		0.0015	0.0031
		(0.0080)	(0.0080)
Life Expectancy at Birth	−0.0123	0.0314	0.0132
	(0.0602)	(0.0694)	(0.0666)
Log GDP per capita	−0.0961	−0.2308	−0.2140
	(0.1926)	(0.2705)	(0.2688)
Population Density	−0.0001	−0.0000	−0.0001
	(0.0001)	(0.0001)	(0.0001)
Percent population above age 65	0.0373	0.0084	0.0221
	(0.0330)	(0.0393)	(0.0356)
Log Total Population	0.0691	0.0356	−0.0109
	(0.0741)	(0.0738)	(0.0794)
Eastern Mediterranean	−1.3938**	−1.4503*	−1.3374*
	(0.6059)	(0.7253)	(0.7674)
Europe	0.1505	−0.0645	−0.0967
	(0.3329)	(0.4115)	(0.4076)
Western Pacific	−3.3860***	−3.5541***	−3.5253***
	(0.4000)	(0.4958)	(0.4631)
South East Asia	−2.6721***	−2.6825***	−2.5917***
	(0.7660)	(0.7079)	(0.7884)

TABLE 5 (Continued)

Variables	(1)	(2)	(3)
Observations	59	59	59
R^2	0.8164	0.8404	0.8596

Note: The dependent variable in these regression specifications is Log COVID-19 deaths per 100,000 population. All columns control for country demographics. Column (1) shows results with gender leader but without culture. Column (2) shows results with culture but without gender leader. Column (3) shows results with both culture and gender leader. We use country-level data. Robust standard errors in parentheses.

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

three cultural dimensions showed no relationship with COVID-19 outcomes. When we control for women's leadership in Column 3 of both Tables 5 and 6, we find the same qualitative pattern of the association between culture and pandemic outcomes.

The positive and statistically significant association between individualism and COVID-19 deaths (0.0158) and masculinity and COVID-19 deaths (0.0106) matches our expectations. Individualistic societies give precedence to individual rights (Hofstede, 1980, 2001; Hofstede et al., 2010). As a result, society members are less likely to follow pandemic protocols when they interfere with perceived individual freedoms and are therefore more likely to both contract the disease but also expose others who are more vulnerable to complications from the disease. Masculine societies give precedence to competitiveness and have less preference for cooperation, while feminine societies are the opposite (Hofstede, 1980, 2001; Hofstede et al., 2010). It makes intuitive sense that a masculine society will have higher COVID-19 deaths than a feminine society especially considering the amount of caring toward the weak and vulnerable.

Power distance, or an adherence and reliance on hierarchal power within society (Hofstede, 1980, 2001; Hofstede et al., 2010), was associated with both higher number of COVID-19 deaths (0.0154) and COVID-19 cases (0.0222) in our data. While our original hypothesis proposed more hierarchical societies would give higher precedence to following COVID-19 mandates (i.e., higher mask use, better social distancing) and thus lower rates of COVID-19 deaths and cases, our findings suggest the opposite. We provide two plausible explanations for the positive coefficient on power distance. First, the pandemic presented a lot of uncertainty, which combined with a sense of urgency made it challenging for political leaders to know what to do about COVID-19. Thus, individuals in higher power distance cultures would have been more negatively affected if the leader chose an approach to the pandemic that did not follow the medical community's recommendations or if they received conflicting, ambiguous, mandates from multiple individuals in positions of authority (i.e., work place leadership, local government, country leaders). Second, Hofstede (2011) has suggested that for large power distance, "that income distribution in society is uneven" (p. 9) and consequently is associated with a wider range of living conditions. This would suggest people who are not in the top circles are living in conditions that might facilitate the spread of COVID-19.

Women leaders' effectiveness: Moderating cultural factors

As discussed earlier in the paper, cultural variables complicate the relationship between women's leadership and effective COVID-19 management. To assess this, we add an interaction effect between culture and female leadership. We anticipated that power distance and masculinity versus femininity would play a role. However, we do not find a

TABLE 6 Log COVID-19 Cases per 100,000 population

Variables	(1)	(2)	(3)
Female Leader Dummy	−0.7101*		−0.5115
	(0.3804)		(0.3353)
Years of female leadership	0.0120		0.0221
	(0.0308)		(0.0287)
Power distance		0.0222*	0.0221*
		(0.0111)	(0.0118)
Individualism		0.0153	0.0141
		(0.0103)	(0.0095)
Masculinity		0.0018	−0.0004
		(0.0064)	(0.0066)
Uncertainty avoidance		0.0094	0.0092
		(0.0109)	(0.0110)
Long-term orientation		−0.0047	−0.0019
		(0.0088)	(0.0081)
Indulgence		−0.0037	−0.0020
		(0.0117)	(0.0118)
Life expectancy at birth	−0.0578	−0.0384	−0.0480
	(0.0817)	(0.0998)	(0.0959)
Log GDP per capita	0.3512	0.4788	0.4888
	(0.3214)	(0.4066)	(0.4072)
Population density	0.0002**	0.0003*	0.0003*
	(0.0001)	(0.0002)	(0.0001)
Percent population above age 65	0.0161	−0.0016	0.0121
	(0.0517)	(0.0467)	(0.0476)
Log total population	−0.0398	−0.0390	−0.0760
	(0.1089)	(0.1050)	(0.1117)
Eastern Mediterranean	−0.6102	−0.6909	−0.5434
	(0.6997)	(0.7696)	(0.8376)
Europe	0.3293	0.1595	0.0860
	(0.4764)	(0.4687)	(0.4820)
Western Pacific	−3.4659***	−3.3827***	−3.4098***
	(0.8056)	(0.7709)	(0.7578)
South East Asia	−1.6948**	−1.4681	−1.4759
	(0.7855)	(0.8940)	(0.9118)

TABLE 6 (Continued)

Variables	(1)	(2)	(3)
Observations	59	59	59
R^2	0.7190	0.7564	0.7655

Note: The dependent variable in these regression specifications is Log COVID-19 cases per 100,000 population. All columns control for country demographics. Column (1) shows results with gender leader but without culture. Column (2) shows results with culture but without gender leader. Column (3) shows results with both culture and gender leader. Robust standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

TABLE 7 Dependent variable: Log COVID-19 Deaths per 100,000 residents

Variables	(1)	(2)
Woman leader	−2.2671***	0.3943
	(0.6302)	(0.3955)
Power distance	0.0124**	0.0132**
	(0.0055)	(0.0061)
Individualism	0.0085	0.0119*
	(0.0069)	(0.0067)
Masculinity	0.0084**	0.0081**
	(0.0038)	(0.0040)
Uncertainty avoidance	0.0024	0.0050
	(0.0062)	(0.0066)
Long-term orientation	−0.0024	0.0028
	(0.0075)	(0.0069)
Indulgence	0.0057	0.0096
	(0.0072)	(0.0085)
Ltowvs × Woman leader	0.0286***	
	(0.0097)	
Ivr × Woman leader		−0.0240**
		(0.0090)
Controls	YES	YES
Observations	59	59
R^2	0.8813	0.8738

Note: The dependent variable in these regression specifications is Log COVID-19 Deaths per 100,000 population. All columns control for country demographics. The specification in these regressions follows Table 5, Column (3) but adds one interaction effect between women's leadership and a cultural dimension at a time. We only report the regression specifications that have significant interaction effects. Robust standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

TABLE 8 Dependent variable: Log COVID-19 Cases per 100,000 residents

Variables	(1)	(2)
Woman leader	−2.3030**	1.2601*
	(0.8709)	(0.6393)
Power distance	0.0206*	0.0212**
	(0.0106)	(0.0100)
Individualism	0.0069	0.0094
	(0.0097)	(0.0090)
Masculinity	−0.0002	−0.0006
	(0.0058)	(0.0054)
Uncertainty avoidance	0.0064	0.0093
	(0.0105)	(0.0104)
Long-term orientation	−0.0110	−0.0065
	(0.0107)	(0.0088)
Indulgence	0.0010	0.0087
	(0.0118)	(0.0142)
Ltowvs × Woman leader	0.0325**	
	(0.0140)	
Ivr × Woman leader		−0.0393***
		(0.0140)
Controls	Yes	Yes
Observations	59	59
R^2	0.7892	0.7976

Note: The dependent variable in these regression specifications is Log COVID-19 cases per 100,000 population. All columns control for country demographics. The specification in these regressions follows Table 6, Column (3) but adds one interaction effect between women's leadership and a cultural dimension at a time. We only report the regression specifications that have significant interaction effects. Robust standard errors in parentheses.

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

statistically significant effect of either of those cultural traits on the effectiveness of women leaders. Instead, two other cultural variables seem to have a moderating effect on women's leadership effectiveness—long-term vs short-term orientation and indulgence versus restraint. We did not have any expectation for a moderating effect of either of these cultural traits on women's effectiveness as leaders.

The results are presented in Tables 7 and 8. The regressions in Tables 7 and 8 include all of the variables in Tables 5 and 6 and add interaction effects. Each regression specification in Tables 7 and 8 adds one interaction effect at a time. We only report results for regressions where we find a significant interaction effect. We emphasize that the interaction effects should be interpreted with caution given the relatively small number of countries (11) with female leaders in our data set. We provide two figures, Figure 1 and Figure 2, of the support of the distribution of the cultural variables highlighted below for countries with male and female leaders. The figures demonstrate

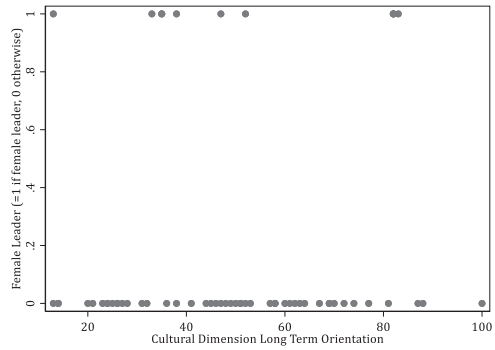

FIGURE 1 Female leader and long-term orientation

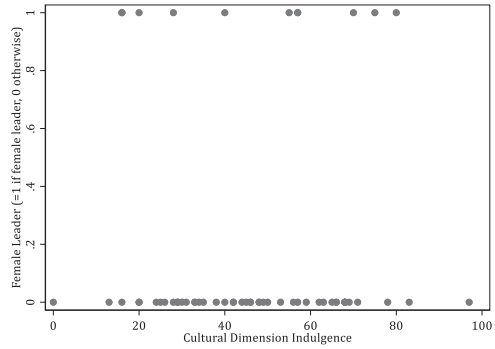

FIGURE 2 Female leader and indulgence

that there are countries with female leaders across the spectrum of the cultural dimensions of interest.

We find that women leaders are more successful at managing pandemic outcomes in countries with short-term orientation, but we do not find evidence that women leaders, as compared to men leaders, are more effective in countries with long-term orientation (Tables 7 and 8, Column 1). Figure 3a shows the estimated effect of the leader's gender on COVID-19 deaths at different values of the long-term orientation cultural dimension. Figure 3b shows the estimated effect on COVID-19 cases. Both figures display the coefficients and horizontal spikes for the 95% confidence intervals. A possible explanation for this result is that in short-term orientation cultures, leaders who give and present information and policies that help save lives are more likely to be followed. Moreover, people in short-term orientation cultures are more likely to follow instructions about health issues having immediate impact on their health, as is the case with COVID-19. Thus, if women leaders have an advantage in tackling urgent issues and health policy, then they will be supported by citizens in short-term orientation societies. The role of women leadership in crisis situations has not been sufficiently studied but there is some evidence that women tend to be elected in post-conflict situations and in times of crisis (Hughes, 2009).

We also find that indulgence cultures seem to bolster women's effectiveness of managing the pandemic while in cultures that score low on indulgence women leaders do not seem to be more effective than men in managing the COVID-19 pandemic (Table 8, Column 2). Figure 4a shows the estimated effect of the leader's gender on COVID-19 deaths at different values of the indulgence cultural dimension. Figure 4b shows the estimated

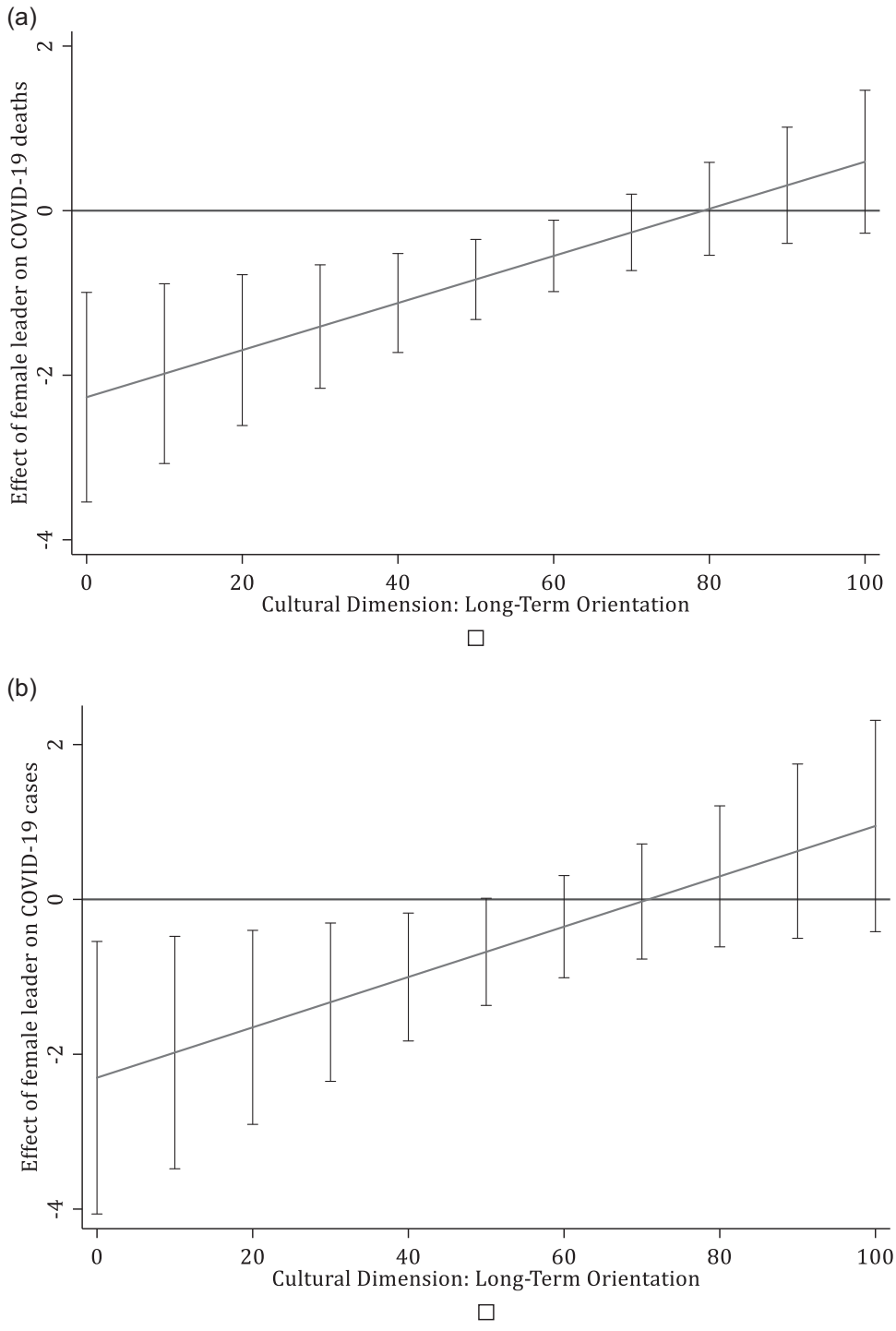

FIGURE 3 (a) The estimated effect of the leader's gender on COVID-19 deaths at different values of long-term orientation. (b) The estimated effect of the leader's gender on COVID-19 cases at different values of the long-term orientation.

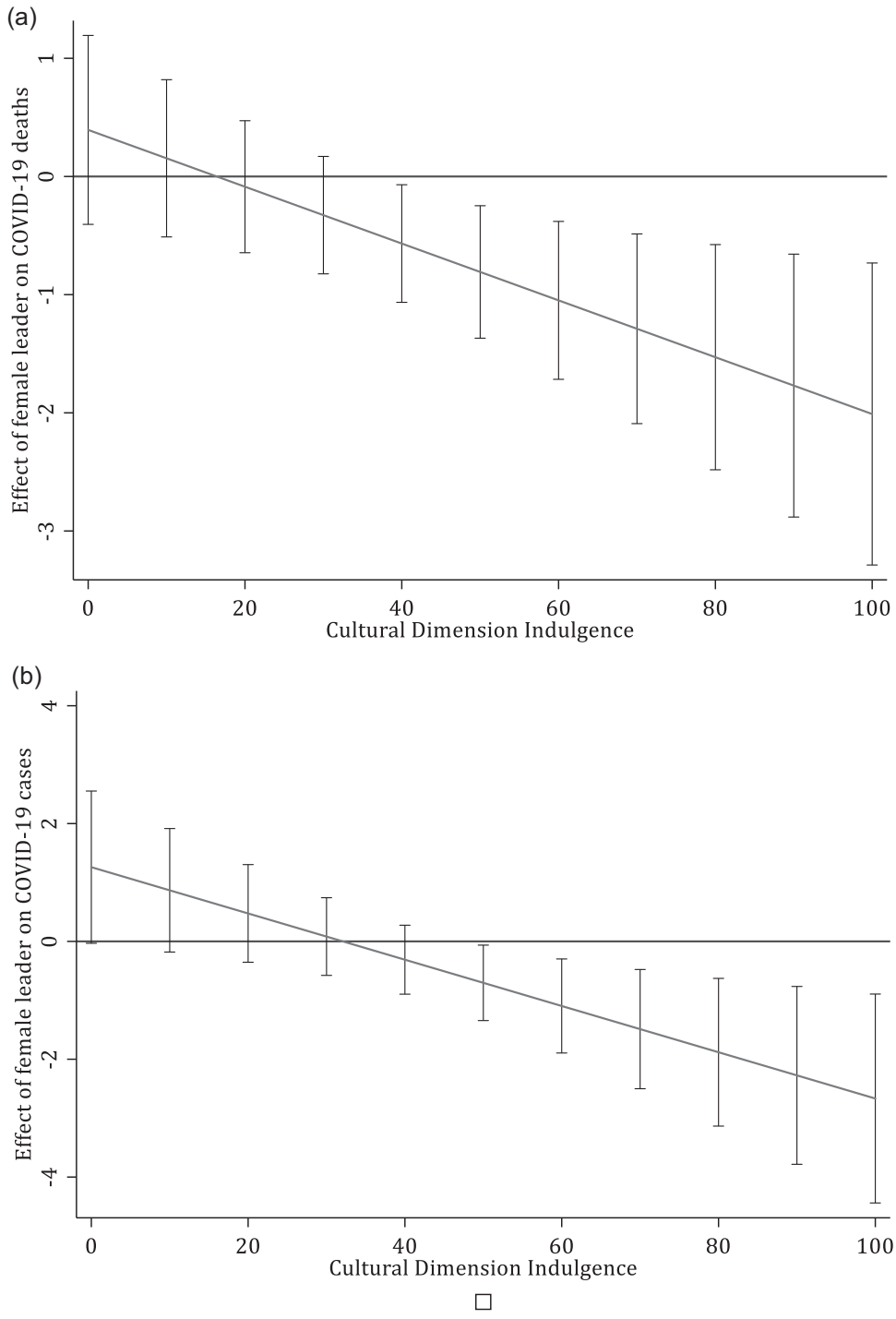

FIGURE 4 (a) The estimated effect of the leader's gender on COVID-19 deaths at different values of Indulgence. (b) The estimated effect of the leader's gender on COVID-19 cases at different values of Indulgence.

effect on COVID-19 cases. Both figures display the coefficients and horizontal spikes for the 95% confidence intervals. This could be due to high restraint cultures' adherence to stringent social norms, which might render female leadership less effective in using innovation and new ideas at tackling a health crisis.

Demographic indicators

The level of development, as measured by both GDP per capita and life expectancy at birth, does not have a significant impact on pandemic outcomes. GDP per capita and life expectance are highly correlated; thus, it is plausible that multicollinearity is driving the insignificant results. Moreover, both variables might be correlated with the geography dummy variables. When we exclude the geography dummy variables, life expectancy becomes statistically significant and is associated with a lower number of cases and deaths. Our findings suggest that holding the level of economic development constant, higher life expectancy at birth, and therefore higher quality of the healthcare system, is associated with better pandemic outcomes. The lack of statistical significance of GDP per capita in all of our specifications seems to suggest two factors working in different directions. On the one hand, a higher level of economic development might affect the number of global visitors the country receives, the number of the country's citizens who travel abroad, and the number of flights entering and leaving the country. On the other hand, a higher level of economic development provides more public resources to tackle the pandemic.

Population density is associated with more COVID-19 cases (Table 6) but not with more COVID-19 deaths (Table 5). The result of pandemic cases aligns with our expectations because higher population density means higher proximity to others and easier transmission of a highly contagious virus.

Robustness checks

We performed a number of robustness checks. First, we re-ran the regression in Table 5, Column (1) but did not restrict the sample to the 59 countries for which we also have cultural variables. The number of countries in this regression was significantly higher ($n = 184$). The coefficient on female leader remained negative and statistically significant. We also ran the regressions in Table 5, Column (3) with and without life expectancy to ensure that the high correlation between life expectancy and GDP per capita did not affect our results. Similarly, we ran the regression in Table 5, Column (3) with and without GDP per capita to check if the regression results with respect to our cultural indices for individualism and power distance changed. The results remained qualitatively the same.

We re-ran the regressions in Table 5, Column (3) but applied the regional cultural variables for East Africa and West Africa for the first four cultural components (power distance, individualism, masculinity, and uncertainty avoidance) to individual countries in the respective regions. In one specification, we included the long-term orientation and indulgence variables; in another, we did not. In the first case, our sample increased to 65 countries. In the second case, our sample increased to 91 countries. In both specifications, our result with respect to the female leader was robust and remained negative and statistically significant. We do not put much weight on the cultural variables in these alternatie specifications because the cultural variables were evaluated at a regional level rather than an individual country level. However, the effect of power distance was robust in all specifications.[1]

CONCLUSION

This paper investigates the impact of women's leadership on health outcomes in the context of the COVID-19 pandemic. Our empirical findings suggest that, after controlling for culture and a number of other country-level demographic factors such as life expectancy, GDP per capita, population density, and population composition, women's leadership is indeed associated with a lower number of deaths from COVID-19. We also find that certain cultural traits have an impact on pandemic outcomes. Hierarchical societies have higher rates of COVID-19 cases and deaths. Higher scores in individualism and masculinity cultural variables are both associated with more COVID-19 deaths, but not number of cases, indicating that these cultural variables do not affect the spread of disease, but rather influence how people care for each other in these societies. Both more individualistic and more masculine cultures prioritize individual rights and competition and thus might jeopardize the health of vulnerable community members.

Finally, culture can help or hinder women's leadership. We find two unexpected cultural factors that moderate women's leadership—long versus short-term orientation and indulgence versus restraint. Counter to expectations, short-term orientation and indulgent cultures seem to boost women's effectiveness in tackling the pandemic. The mechanism by which short-term orientation and indulgent cultures boost women's leadership cannot be determined from our data and warrants further research. One plausible suggestion is a difference in rhetoric used by men and women leaders. Due to relationship-based skills and transformational style women leaders may be better able to express an awareness of, and empathy towards, immediate community needs (short-term orientation) and ability to express understanding of followers emotions toward the limiting nature of necessary COVID-19 restrictions (indulgence) (Sergent & Stajkovic, 2020). In other words, women leaders could be better suited to communicate intended interventions while simultaneously having a calming effect on follower emotions. This in turn might make them more effective in helping communities overcome natural tendencies of short-term and indulgent cultures. Men's more autocratic style of leadership communication may backfire and incur more resistance from followers in short-term orientation and indulgent cultures, making them less effective in promoting COVID-19 preventative measures.

Our results align with the findings of Garikipati and Kambhampati (2021) who found that women country leaders were more effective in managing COVID-19. Our findings also support Windsor et al. (2020)'s finding that culture modulates the effect of women's leadership; however, our analysis reveals that women's leadership is statistically significant even after controlling for culture. This difference might be driven by the fact that we focus on a full year of pandemic outcomes rather than the immediate outcomes after the onset of the pandemic, which is the outcome variable in Windsor et al. (2020).

There are several limitations to our research. First, our analysis only covers the first full year of the pandemic. Equal access to vaccines across countries has become the major hindrance to managing the COVID-19 cases and deaths in the second year of the pandemic. That might change the dynamic between leadership and pandemic outcomes. Further, the pandemic will move to an endemic state eventually and further research should investigate how women's leadership impacts health outcomes in that scenario where there is a need for continuous surveillance and effective outbreak management. Second, due to culture data availability, our research only focuses on a subset of countries; availability of data for those countries might be correlated with a feature of those countries that affects their ability to tackle the pandemic. Third, the number of countries with women leaders is still relatively small and thus our results should be interpreted with caution.

Women leaders in the 21st century are still encumbered by societal notions of who they are and what their place in leadership should be (Ayman & Korabik, 2010;

Eagly & Carli, 2007; Eagly & Karau, 1991). COVID-19 provided a worldwide opportunity to analyze the actual effectiveness of women leaders. Over time as women's national leadership becomes a global norm, it will be important to examine whether the current effect of women's leadership on health outcomes continues and translates into better outcomes in other domains.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

No ethics committee approval was needed since the research uses publicly available data.

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ENDNOTE

[1] Results from robustness checks are available upon request.

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COMMENTARY

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Community-Based Health Insurance scheme implementation in Ethiopia: A mini-review on the experience and its implementation process

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Abstract

The Community-Based Health Insurance (CBHI) scheme was introduced in Ethiopia to overcome the population's over-reliance on direct out-of-pocket expenditures for health care and the associated low level of health service utilization. CBHI is an advance payment arrangement, established on the household level, and targeted mainly at informal sectors in rural areas. After a successful 3-year pilot implementation, the Ethiopian government decided to expand the CBHI scheme implementation. It has received wide interest among community members, especially those living with chronic diseases and perceived impaired family health status. Low enrollment to the scheme was the barrier to its initial expansion due to limited awareness and misconceptions about the program, financial constraints to paying premiums, and dissatisfaction with the health services. The evaluation of CBHI scheme implementation and future implications in Ethiopia could be better seen from both the learning experience during the implementation process and achievements of the policy objectives.

KEYWORDS

Community-Based Health Insurance scheme, Ethiopia, health policy implementation

Key points

- Community-Based Health Insurance (CBHI) was introduced in Ethiopia to reduce out-of-pocket expenditures, ensure citizens' access to and utilization of essential health services

- Various facilitators and barriers to the CHBI scheme enrollment were identified
- The CBHI policy's success in Ethiopia could be better seen from the perspective of both the learning experiences during the implementation process and achievement of its objectives.

BACKGROUND

Ethiopia is one of the low-income countries with a fast-growing economy in Africa. Ethiopia has a federally arranged governmental structure with 11 semi-autonomous regions and 2 chartered city administrations. The federal government is responsible for making policy directives and budgeting for health services (Ministry of Health of Ethiopia, 2014). The regions have downward governmental decentralization authority with Zonal and Woreda administrative units. The woreda structure is the lower administrative entity where basic public services are provided. Thus, the health services and their organizational management is arranged in a similar administrative structure.

Despite the relative improvement of access and health infrastructure development in Ethiopia, low health-seeking behavior and out-of-pocket healthcare spending contributed to the low utilization of health services in the country. Access to healthcare services and achieving Universal Health Coverage (UHC) is one of the main global SDG agendas and a great concern for low-income countries including Ethiopia. Even though the Ethiopian government implemented a reform on healthcare financing using various strategies to mobilize resources and generate revenues; health financing still poses a challenge to provide affordable health services for community members, particularly to those with a lower-economic background (Hailu, 2012). Therefore, to overcome the large population's over-reliance on direct out-of-pocket expenditures for health care and low level of health service utilization, the Community-Based Health Insurance (CBHI) scheme was introduced in Ethiopia in 2010.

HEALTH FINANCING LANDSCAPE IN ETHIOPIA

In 1998, the Federal Ministry of Health (FMoH) began the health financing reforms in Ethiopia when it proposed a health financing strategy to improve and diversify resource mobilization for health, ensure equitable allocation and efficient use of resources, and financial protection of its citizens. Since then the country is progressing forward with timely adoption of sound strategies to maintain progress to domestic resource mobilization and leverage the health financing for its primary health care services (Berman et al., 2018).

The 2010/11 National Health Account report highlighted that foreign donation accounts for the majority (almost 50%) of the funding source of general healthcare, followed by households (33%), and the domestic government covers only 17% of the finance (Federal Ministry of Health Ethiopia, 2014; USAID, 2011). The proportion of health expenditure to the gross domestic product in Ethiopia was 4.7% for 2013/14 (Federal Democratic Republic of Ethiopia Ministry of Health, 2017). In 2018, Ethiopia's health expenditure per capita was US $24, increasing from US $16.10 in 2007/08 (World Health Organization, 2018). This is below the World Health Organization recommendation to be spent in low-income countries to deliver essential health care services which are set to be US $60 by 2015 (Federal Ministry of Health Ethiopia, 2014). Out of pocket expenditure constituted 35% of the current health expenditure in Ethiopia by 2018 which is reduced from 47% in the year 2011. Other Private Health Expenditure contributed for the 5% of Current Health Expenditure (Federal Ministry of Health Ethiopia, 2014). The

catastrophic health expenditure report in Ethiopia is fragmented and its extent is variable across health conditions, regions, urban, and rural households. Catastrophic health expenditure with a 40% capacity to pay in rural households of the semi-pastoral communities of western Ethiopia is reported to be 22.5% (Shikuro et al., 2020). Similarly, it has been reported to be 20% in northeast Ethiopia (Mekonen et al., 2018) and 32.2% in people living with mental disorders (Hailemichael et al., 2019). The introduction of CBHI has brought significant financial protection from catastrophic health expenditures in Ethiopia. In one study, 20% of households had catastrophic health expenditure. Of the households with catastrophic health expenditure, 4.41% were insured and 15.64% were noninsured by the CBHI scheme (Mekonen et al., 2018).

CBHI POLICY DESCRIPTION

On August 19, 2010, Ethiopia passed a bill on community-health insurance with the name "Social Health Insurance proclamation no. 690/2010" (Federal Democratic Republic of Ethiopia, 2010a). The council of ministers under "council of ministers regulation no. 191/2010" passed the decision for the establishment of the Ethiopian Health Insurance Agency with a proclamation no. 691/2010 as an autonomous agency for the purpose of implementing the health insurance system (Federal Democratic Republic of Ethiopia, 2010b).

CBHI is an advance payment arrangement for rural households and informal sectors in the urban areas, in which small contributions are pooled together to alleviate financial barriers and ensure citizens' access to essential health services (Wang et al., 2012). CBHI schemes are the growing system to ensure financial protection for the poor. It aimed to improve access to affordable healthcare and increase national development by breaking the vicious cycle of poverty and ill-health in developing countries (Jütting, 2004).

The CBHI system is working based on household-level of membership. The household head will pay the annual subscription fee (with its eligible dependents and household members) to the scheme. Then, a CBHI membership card (with family details) for the households will be provided to get essential health services from the nearby public health facilities. Membership will be renewed annually and the subscription fee will increase for any addition of a new child or family member (Ethiopian Health Insurance Agency, 2015). In 2013, the yearly average premium per household was ranging from ETB 126 (~US $6.98) to ETB 180 (~US $9.97) (Ethiopia's Community-Based Health Insurance, 2015). In 2020, the annual premium per household was increased to ETB 350 (~US $10) in Addis Ababa and ETB 240 (~US $6.85) in other regions (Ethiopian Health Insurance Agency, 2020).

The health service package of the beneficiaries under the CBHI scheme includes essential health services and critical curative services such as outpatient and inpatient care, delivery and surgical services, diagnostic tests, and generic drugs under the agency's medicine list prescribed by the medical practitioners. But the health insurance scheme excludes treatment for injuries resulting from natural disasters, epidemics, and social unrest; treatment for drug abuse, organ transplants, dialysis, and other nonessential health services; as well as treatments with higher cost implications such as treatment outside of Ethiopia (Federal Democratic Republic of Ethiopia, 2012).

CBHI POLICY IMPLEMENTATION

Ethiopian Health Insurance Agency (EHIA) is the responsible agency within the Ministry of Health to coordinate and administer the implementation of CBHI from the national to the household level. It has its organizational structure within all levels of the health authorities starting from federal, regional, zonal to the woreda health offices. Enrollment to the CBHI

scheme is determined on a household basis instead of individual membership. An awareness campaign will create the opportunity for Kebeles (lowest administrative units) to choose to join the scheme when the majority of villagers are interested. After the kebeles are identified as enrolled in the scheme, households have the individual choice to join the CBHI scheme or not. Once households are interested to join the scheme and apply to participate, kebele officials along with the community members will screen and select the households that they believe to be the poorest to gain the government's targeted subsidy support for the scheme subscription fee (Mebratie et al., 2015). The CBHI implementation flow, organizational structure, and beneficiary's referral pathway are depicted in Figure 1.

Before the official launch of the CBHI implementation, the Ethiopian government rolled out a pilot CBHI scheme to rural households and urban informal sector workers in 13 woredas located in four different regions (Tigray, Amhara, Oromia, and South Nations Nationalities and People [SNNP]) of the country in 2010/11. The pilot implementation was aimed to generate evidence on the impacts of CBHI pilot schemes on access to and utilization of health services, quality of care, reducing members' financial risks, and increasing mobilization of resources for the health sector. The pilot findings recommended scale-up and implementation of CBHI in Ethiopia. The recommendation emphasized further considering and exploring different contexts (such as CBHI in pastoralist communities), legal frameworks, and comprehensive scale-up strategies (Ethiopian Health Insurance Agency, 2015).

After a successful 3-year pilot implementation, the Ethiopian government decided to expand the CBHI scheme implementation to other 161 woreda's in 2013 (Ethiopia's Community-Based Health Insurance, 2015). The implementation has begun by giving training to various stakeholders on CBHI design approaches and strengthening the implementation and monitoring capacity. The CBHI National Coordination office has prepared the financial and administrative management, monitoring, and evaluation plan along with different communication strategies (HFG/HSFR, 2014). In 2020, the CBHI is launched in more than 770 Woredas (75% coverage) of an estimated 1100 woredas (district government) in Ethiopia with 2879 contracted health facilities (Ethiopian Health Insurance

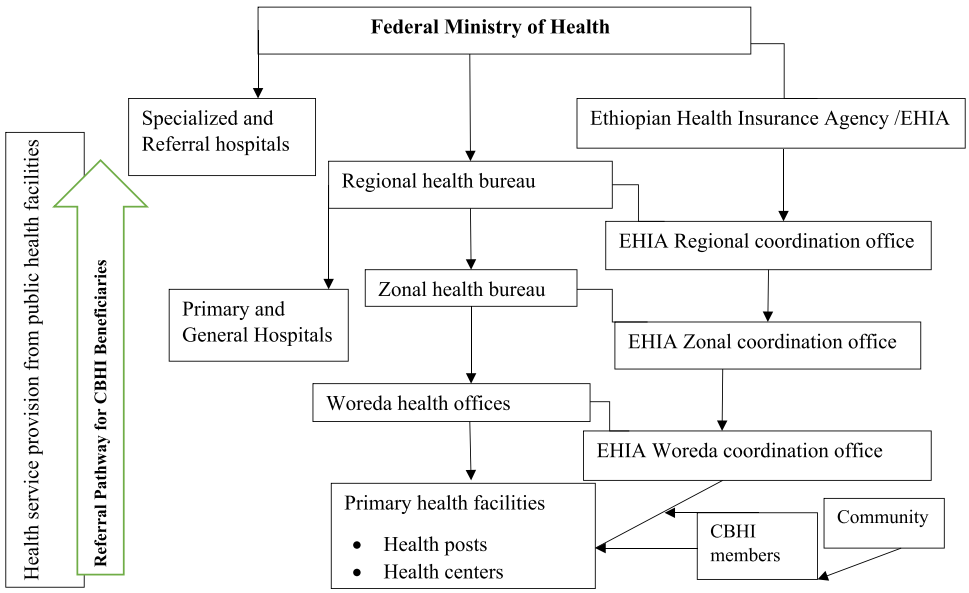

FIGURE 1 Organizational structure for implementation of Community-Based Health Insurance (CBHI) in Ethiopia

Agency, 2020). In the same year, CBHI had enrolled a total of 6,944,784 household members (1,459,123 indigents and 5,485,661 payees) and more than 30 million people are CBHI beneficiaries throughout the country (Ethiopian Health Insurance Agency, 2020, 2021). Thus, it covered more than a quarter of the population, in a country of 112 million people (World Bank, 2019).

CBHI IMPLEMENTATION APPROACH

Political context

The military overthrow of the Dergue regime in 1991gave the opportunity to the transitional government of Ethiopia, the then Ethiopian People's Revolutionary Democratic Front (EP RDF) coalition, to consolidate power and garner more public support to revise the previous health policy and put their perspective in the new 1993 Ethiopian Health Policy. In the new policy, there was an acknowledgment to the contents of previous policy but with strong criticism of the previous regime as a "*totalitarian political system lacked commitment and leadership… to maintain popular participation in translating the policy*" (Federal Democratic Republic of Ethiopia, 1993). With this political essence, the new policy was focused on decentralization, access to basic health services, and preventive health programs. It aligned with wider community participation and resource mobilization to address the needs of the less-privileged rural population which constitutes most of the country's population. Since then, harmonized health strategies hailed from the 1993 health policy were planned and implemented in Ethiopia. The Health Sector Development Plan (HSDP I-IV) with a subsequent 4 phase approach to be implemented across 20 years was the most comprehensive strategy. The HSDP has contributed to the continuous development of health infrastructure and health workforce and improved access to primary healthcare in Ethiopia (Ministry of Health of Ethiopia, 2014). In this regard, 35,000 health extension workers trained, more than 2800 government health centers, and 15,000 health posts were built within 10 years period (Croke et al., 2020).

The massive health facility construction and training of new health workers with less intensive training have resulted in the reduction of distance to health facilities (which has increased health facility delivery by 18.2%) and contributed to reducing child and maternal mortality. This ultimately enabled the achievement of the Millennium Development Goals ahead of time and the Ethiopian government received acknowledgment internally and internationally by the UN and other development partners (Berhan, 2008; Croke et al., 2020). Despite this achievement, Ethiopia has one of the lowest national UHC service coverage in the world with 34.3% in the year 2015 (Eregata et al., 2019). This is mostly due to weak health financing, poor health-seeking behavior, and low utilization of health services fearing the high out-of-pocket expenditures. The CBHI scheme was the health commitment and good political will of the Ethiopian government to achieve UHC through ensuring sustainable health financing. The government of Ethiopia also had a subsidy arrangement for the CBHI system and indigent households who cannot afford to pay the premiums. This subsidy arrangement is intended to support the poor and prevent financial deficits that may compromise the CBHI's sustainability.

Style of policy implementation

The CBHI implementation approach in Ethiopia is following a synthesized model (synthesis of top-down and bottom-up) of policy implementation, which is more inclusive of multiple

dimensions, subordinates, and stakeholder engagements at different layers of policy interfaces. The policy instruments and directives are flowing from the policymakers at the federal government via the Ministry of health and EHIA downwards to regional, zonal, and woreda health offices. But for the implementation community members are expected to enroll and pay their CBHI premiums to enable viable health financing. Lower officers/administrators in the districts can be street-level bureaucrats by manipulating the membership enrollment and scheme beneficiaries. For instance, during the membership screening for scheme subsidy, they may enroll non-eligible members who might not be eligible for indigent subsidy. Further, the region and woreda governments have their own contexts of CBHI members and make decisions to their contexts. For example, the regional and woreda governments may finance premiums of indigents using different arrangements such as some will finance all, most, or none of the membership premiums of indigents. In the case of indigent coverage by regional governments, there are differences in the extent of premium coverage to the indigents. Oromia regional government has high indigent coverage while the southern region has low coverage for indigents (Ethiopian Health Insurance Agency, 2020). Thus, as the services are not funded by direct public tax and slight modifications are employed at lower levels, CBHI followed a bottom-up approach for its financing.

In general, the Ethiopian CBHI scheme implementation has the following major features

- The decision to join the CBHI scheme is determined collectively by the direct participation of the kebele population. However, only if the household decides to pay premiums will it be enrolled in the scheme.
- Woreda-level CBHI scheme is formed by the association of Kebeles CBHI sections.
- Woreda CBHIs work with the woreda administration office and are responsible for pooling and administrating CBHI funds, contracting with and processing reimbursements for health service providers. Woreda-level boards comprising CBHI members are established to ensure schemes are accountable to their members.
- General and targeted subsidies are an essential element of the CBHI scheme design. The federal government provides a general subsidy intended for all members of the CBHI, while the regional and woreda governments provide a targeted subsidy to the very poor who cannot afford the premiums. Scheme managers are employed through the government payroll (Alebachew et al., 2015).
- The federal government provides resources for CBHI contracted health facilities to ensure these facilities deliver some acceptable quality of care for CBHI members (Ethiopian Health Insurance Agency, 2015).

Factors affecting CBHI implementation in practice

Financial risk protection is a critical component to achieve UHC and CBHI is established as one of the comprehensive health financing mechanisms in Ethiopia (Ethiopian Health Insurance Agency, 2015). As such, the policy was praised positively by some while it suffered from barriers to its effective implementation. The factors are summarized below in two broad categories as facilitators and barriers during the CBHI implementation.

Facilitators of the scheme

As the policy is intended for the good cause, that is, as one strategy to achieve UHC, it has enjoyed high acceptance by the majority of international agencies, development partners,

funders, and the wider public. Similarly, it has got wider interest to enroll in the scheme among community members living with chronic diseases and perceived impaired family health as it would give them a relief from out-of-pocket payments and reduce catastrophic health expenditure (Demissie and Atnafu, 2021; Mekonen et al., 2018).

Barriers to the scheme

Member's enrollment and contributions are one of the critical stages to ensure CBHI's financial security. But most of the barriers are concentrated on community members' enrollment in the scheme. Various reasons were reported as a reason for low enrollment to the scheme such as poor awareness (not well-informed, lack of information), misconceptions, and wrong beliefs about the program (poor perception of quality of care, lack of trust in scheme management), financial constraints to pay premiums and dissatisfaction by the health services (Demissie & Atnafu, 2021; Mirach et al., 2019; Nageso et al., 2020). In this regard, low enrollment rates hamper the successful implementation of CBHI schemes. These would affect the sustainability of CBHI schemes since it is not only reducing the size of the insurance pool but also may bear a harmful impression on future enrollment and dropout (Mebratie et al., 2015).

Besides enrollment, limited readiness of contracting health facilities and implementation barriers in terms of utilities, equipment, supplies, and human resources were identified (Ethiopian Health Insurance Agency, 2015). Furthermore, the pilot scheme has experienced resistance initially from regional governments but has got acceptance later. The compulsory approach of enrolling all community members which has resulted refusal in the pilot scheme gave lessons to follow a voluntary enrollment and provided an opportunity for more evidence-based, flexible and comprehensive strategy for the CBHI expansion (Ethiopian Health Insurance Agency, 2015).

Private sector involvement in healthcare service provision and CBHI implementation

The Ethiopian private sector involvement in healthcare is relatively small and fragmented (approximately 20% of the total market share) compared to other countries in the region (e.g., 46% in the Democratic Republic of Congo and about 65% of all health facilities in Kenya are managed by private sector) (Federal Ministry of Health. Ethiopia health private sector assessment, 2019). Generally, CBHI is intended only for the provision of health services for beneficiaries in public health facilities since the government is the main healthcare provider in Ethiopia. Despite the complexities to expand and implement CBHI benefit packages in private health services, the Ethiopian government neglected the approach in nonpublic sector. Thus, it undermines the private health sector which is one way to achieve UHC in a country like Ethiopia where there is relatively limited healthcare access and low health service utilization. Besides, the Ethiopian CBHI policy missed the central idea of New Public Management which the government found itself in "*more rowing health service than steering.*" Even though the government is subsidizing the program generally or targeted to CBHI beneficiaries with funds collected from different mechanisms, it would be benefited by facilitating, at least to some extent, the health services and CBHI with entrepreneurial or market-driven approaches (Osborne & Gaebler, 1992). This will potentially enhance performance-based funding, ensure sustainability, and increase health service utilization.

Evaluation of the policy success

Most policy evaluation decisions whether the policy was a success or failure are determined by the assumptions of underlying implicit models. The starting point (the implicit model) for the CBHI policy design and implementation in Ethiopia was the presence of limited access to health care and low utilization of health services (in existing health facilities) by community members due to financial constraints and related reasons. So, the CBHI's success and failure in Ethiopia are underpinned by this prior background that considers the CBHI objectives and resource-limited context of the policy setting. But the benefits from policy evaluation are far broader than simply knowing what individual policies achieved (Page & Mark-Lawson, 2007).

The evaluation plan may primarily be led by the CBHI policy objectives intended to be achieved and judgments mostly expected from this perspective. Contextual background focused on the experiences during the implementation process and lessons learned to improve the policy are crucial as it is a pioneer health insurance policy implemented so far in Ethiopia. In this regard, there may not be a straightforward answer to determine if the policy has failed particularly. Furthermore, there is no clear line or universal criteria between polarized portrays of policy failure or success. As such, there may be differences in success and failure the across most important policy evaluation realms of processes, programs, and politics (McConnell, 2010). Thus, judgments about CBHI implementation would be specific to the contextual dimensions of the process and outcomes. Hence, most of the formative and qualitative result interpretation will be used as feedback for implementation improvements while the summative evaluation and quantitative data will be used mostly as a performance measure for policy objectives.

In general, to get more focused on the evaluation decision as most policy analysts do, the implicit model assumption explained above which indirectly frames the expected outcomes across different timelines and the lessons learned during the implementation process will be the determinants of the CBHI policy success or failure. Hence, the acceptability of CBHI enrollment (e.g., number of CBHI members, number of woredas reached, the total number of beneficiaries and contracted facilities), progress towards achieving UHC (change attributable to CBHI), percentage of change in health service utilization, members satisfaction with the quality of care and other scheme management lessons could be among the determinants of CBHI policy success.

CONCLUSION

Ethiopia has launched a CBHI scheme to increase universal health coverage and equitable access to health services. The CBHI implementation approach was a synthesis of the top-down and bottom-up models of policy implementation by mobilizing the government sectors at all levels along with wide community participation for its success. The policy's success sought to be understood by the underpinning policy objectives such as increasing healthcare access, service utilization, financial protection to community members, and ensuring sustainable health financing to achieve UHC. Thus, the evaluation of CBHI scheme implementation and future implications in Ethiopia could be better seen from both the learning experience during the implementation process and achievements of the policy objectives.

AUTHOR CONTRIBUTIONS

Yonas Getaye Tefera conceptualized the idea, reviewed literatures, and wrote the first draft. Asnakew Achaw Ayele conceptualized and provided critical inputs to revise the draft. Both authors approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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BOOK REVIEW

WMHP WORLD MEDICAL & HEALTH POLICY WILEY

Camming: Money, power, and pleasure in the sex work industry

Angela Jones

New York University Press, 2020. Paperback. ISBN 978-1-4798-7487-3

In *Camming: Money, power, and pleasure in the sex work industry*, Angela Jones presents multiple perspectives of why individuals participate in online sex work. Jones is an Associate Professor of Sociology at Farmingdale State College, State University of New York, Coordinator for Farmingdale's Women, Gender, and Sexuality Studies Program, and author of numerous articles on sex work, gender identity, and sex. As a supplement to her rigorous analysis of online sex work, Jones opens up about her own personal experiences as a former sex worker and explains that she left the industry due to her struggles with addiction.

The book's chapters are helpfully organized by key topics in sex work, including performing in a sexual field; people of color in the sex industry and sexual racism; and financial benefits. To understand these subjects, Jones interviewed multiple participants in online sex work. These interviews are supplemented by field notes, and demographic data on the sexual orientation, race, gender identity, and geographic location of the book's subjects. The book's central arguments are framed by what Jones calls a "sociological theory of pleasure", which not only helps explain the sex industry's customer base but also why some individuals become sex workers.

Jones explores the various platforms for webcamming sex work and their various marketing tools. She explains that a camscore is, "a number generated by the site that reflects the money made by the model based on the ratio of the number of hours spent online to the amount of money made in tips—models that spend the least amount of time online but generate the most money in tips have the highest camscores" (p. 189). As Jones explains, authenticity is considered critical to camming. At the same time, many participants implied that they would claim to be younger and single when they were in a relationship or married to seem more appealing to customers.

To draw out her subject's policy relevance, Jones discusses the regulation of websites to prevent sex trafficking and how these laws have negatively impacted sex workers. Also, Jones notes, the environment within which camming takes place (physical studios vs. the home of the sex worker) has specific regulations that sex workers must follow due to the websites on which they cam. Throughout the book, Jones provides a detailed picture of the inner workings and regulations of the sex industry. The book concludes with a discussion of new policies and laws that have been put in place and how these regulations could impact the online sex industry.

In addition to problems, Jones discusses the benefits of online sex work, such as financial gain, flexible scheduling, and for some, pure enjoyment. Jones also discloses dangers and barriers to sex work, such as customers finding sex workers' locations, employers finding out that one of their employees is a sex worker, and dangerous sexual behaviors that customers request. For example, one interviewee featured in the book

explains that motivated by money, she would do sex performances that were dangerous to her health. Jones also provides a platform for discussing sex work among different gender identities and sexual orientations to discuss how these self-concepts have implications in sex work. Jones also further discusses the agism, racism, transphobia, and homophobia that is embedded in the sex industry and how sex workers contend with these constructs. As she writes, "when customers select performers based solely on nationality or race, they are motivated by sexual racism" (p. 186). Furthermore, participants discussed how certain variant sexual behaviors are still taboo in an environment that purports to support sexual expression. Not only was homophobia ingrained in the industry through customers' perceptions, but performers feared being labeled "homosexual."

While *Camming* is one of the rare books written about the underground online sex industry, it is also unique in its inclusion of the voices of actual online sex workers, as well as photos to help readers understand what certain terms mean, giving readers a closer look at webcamming. Screenshots of online camming sites illustrate what a customer might see. There is also a useful table at the end of the book with participants' demographics and responses to the survey questions.

Camming: Money, power, and pleasure in the sex work industry challenges social assumptions about gender roles in the sex industry and focuses on the ethical implications of norms that govern those roles. This book is a useful read for those entering the online sex industry; for individuals who advocate for acceptance of sex work in society; for those who are advocating for change and acceptance in the sex industry; and for interdisciplinary professionals to understand the phenomenon of the online sex industry.

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BOOK REVIEW

WMHP WORLD MEDICAL & HEALTH POLICY WILEY

Social injustices and public health

Barry S. Levy

Oxford University Press, 2019. ISBN-13: 978-0190914646.

Social Injustice and Public Health, edited by Barry S. Levy, MD, MPH, former President of the American Public Health Association, is a classic text that should be read by all public officials new to the field as well as career veterans. The concepts, supporting data, and analyses astutely drive home the appropriateness of moral and ethical obligations in transforming the current public health system as well as a reimagined system that is inclusive and universally responsive to the needs of all demographic groups. Fundamental to this premise is the view that health *ought* to be a right and not just a privilege. Such an assertion embraces a human rights framework that requires reinvesting in the infrastructure of the current public health system so that outputs and outcomes can be achieved to meet the needs of all people. Considerable groundwork has already been undertaken in this area (p.11) with the United Nations Universal Declaration of Human Rights as a prime example. However, it is noted that although all member countries promulgate the Declaration, without international law, its impact is limited (p.14).

The introduction of key concepts and definitions in *Part I, The Impact of Social Injustice on Public Health*, establishes a clear foundation for documenting and examining critical root causes of social injustices. Levy's description of the manifestation of inequalities and inequities further justifies the need for a universal approach to eliminate social injustices in public health. Levy also describes the use of two definitions of social justice: The first definition organizes Part II and indicates the "denial or violation of economic, social, cultural, civil, political, or other human rights of specific populations or groups in society based on the erroneous perception of their inferiority by those with more power or influence." Accordingly, Part II, *How Social Injustice Affects the Health of Specific Population Groups*, provides contexts for injustices experienced by diverse population groups. Although the life circumstances of many of the population groups vary considerably, they have common challenges that relate to accessible, affordable, effective, and quality care that ultimately influence their health status and outcomes.

The second definition of Social Justice organizes Part III and "refers to policies or actions that adversely affect the conditions in which people can be healthy" (pp.3–4). *Part III* focuses on *How Social Injustice Affects Areas of Public Health*. The section's authors discuss influencing factors that are common to policies and practices, such as structural inequities, interpersonal bias, stigma, and limited health insurance coverage. They examine the effects of various policies and practices on health outcomes, using outcome measures such as morbidity (often preventable) and mortality (often premature), and disability rates to substantiate their assertions.

The narratives in Parts II and III are enhanced by the integration of brief case studies or special topic discussions. These examples illuminate the application of critical concepts. For example, in the chapter on mental health, a special focus is placed on the *Opioid Crisis and Social Justice* (p.311). Insights are provided about the crisis' impact on populations of color,

the disproportionate overdose rates within certain communities, the role of stigma as a barrier to treatment, unequal treatment access, disparities in health outcomes, and the impacts of self-blame and feelings of worthlessness. Such factors often accompany hesitancy in seeking treatment by persons with addictions. Such insights add perspective about the complexities involved in this crisis. The magnitude of these complexities and other social injustice issues underscores the importance and need for cross-sector engagement to complement efforts undertaken by governments. The authors specifically mention non-governmental organizations (NGOs) and philanthropic organizations as important stakeholders (p.489). Such partnerships offer the potential for a collective impact, which would be invaluable to efforts designed to strengthen the current system and foster sustainable human development.

Part IV, *An Agenda for Action*, explores a feasible and sustainable approach to transform the current public health system into one that is more responsive, effective, and universal in its approach to populations and public health. The approach builds on the evidence presented in the previous chapters and shapes an agenda that responds to these questions: (1) What evidence exists related to social injustices in public health? (2) Why do social injustices exist? (3) What is the value of considering perspectives on science, moral, and ethical concerns related to resolving injustices? (4) What are essential elements of an action-oriented agenda that is supported by human rights principles?

In conclusion, this text is an exceptional resource that masterfully substantiates the value and use of a human rights framework to address social injustices in public health. The authors call for a multifaceted approach that must be accompanied by structural changes to achieve improved outcomes.

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BOOK REVIEW

WMHP WORLD MEDICAL & HEALTH POLICY WILEY

Feeding the hungry: Advocacy and blame in the global fight against hunger

Michelle Jurkovich

Ithaca; London: Cornell University Press, 2020.

Virginia Woolf famously wrote that "One cannot think well, love well, sleep well, if one has not dined well." Yet, an estimated 25,000 people, including more than 10,000 children, die from hunger and related causes daily. How is it possible to improve the last century's economic, social, and cultural life of some many, so little progress has been made in fighting chronic hunger? This question is at the heart of *Feeding the Hungry: Advocacy and Blame in the Global Fight Against Hunger*, by Michelle Jurkovich, a political scientist at the University of Massachusetts Boston whose international relations work focuses on, among other things, the human right to food and food security.

As the title suggests, the book's primary focus is understanding how international non-governmental organizations (INGOs) and large charities have advocated the end of hunger in the past half a century. The core empirical finding is that campaigns to end chronic hunger have not been framed around human rights. Why has this been the case? With this core finding and question as points of departure, Jurkovich's analysis investigates and assesses the advocacy strategies of key NGOs in this field. Chapter 1 looks at the history of international anti-hunger campaigns, discussing the increasing role of INGOs and the human rights framework.

Chapter 2 places these developments in the context of international relations theory, exploring how two models of human rights advocacy apply to her case study. According to the author, these models—the spiral model and the boomerang model—fail to be beneficial to NGOs in shaping their advocacy agenda and narratives around the right to food. The shortcoming of the two models is that they assume a "common, unitary target," typically a government, of human rights violations. In the case of food, though, single-target models are inadequate because other actors, particularly transnational corporations, play a crucial role in food systems, and arguably many of the human rights violations could be imputed to them rather than national governments. Jurkovich proposes the "buckshot" model as the alternative, more effective model to organize human rights advocacy targeting multiple actors. This model theorizes advocacy efforts with multiple targets, involving multiple states and potential alliances or coalitions among INGOs.

As a human rights scholar and advocate, I found the analysis of these theoretical models not very appealing. International relations scholars may be interested in the new model (the buckshot model) proposed by Jurkovich. However, I found these models too abstract and not very useful in capturing the complexity of advocacy, mainly when the issue to be tackled (chronic hunger) is complex, intersectoral, and fraught with conflicts of interest of the various stakeholders, including the INGOs profiled in the book. Chapter 3 focuses on the empirical question of whether the human right to food is a source of norms around hunger. Norms are defined as socially shared believes in the appropriateness of a behavior (p. 112). The author

presents the results of surveys and interviews with more than seventy staff members working at twelve INGOs engaged in anti-hunger campaigns. Details of the methodology behind data collection are presented both in Chapter 3 and in the Appendix, which means that readers need to juggle back and forth to fully understand these data. The goal of the survey was to understand whether the human rights framework is a source of clear blaming norms for chronic hunger ("who should be blamed for what"). The answer is negative as data reveal a single target actor's lack of blame for chronic hunger. Jurkovich draws the lesson that the absence of a single blaming norm limits the ability of the human right to food to provide a strong foundation for an anti-hunger advocacy narrative.

The analysis of a single blaming norm for chronic hunger is expanded in Chapter 5, entitled "The Limits of Law." Here, the author explores why the codification of the right to food in human rights treaties has not translated into a norm. The argument unfolds in three parts:

> (1) many international anti-hunger organizations still do not conceptualize food as a human right, making international human rights law less relevant; (2) when activists do conceptualize food as a human right, they often root their understanding of this right in moral and not legal terms; and (3) activists face the very practical concerns of continued debates regarding the justiciability of the right to food … the precise definition of the right itself.

While this line of argument is persuasive, the analysis omits critical technical aspects of the codification of the human right to food in international treaties. For instance, there is no discussion of the role of the usual norms-building processes of the various UN bodies (HRC, CESCR, Special Rapporteurs). Are the duties connected with the right to food been subject to monitoring? Do the reports of the Special Rapporteurs clarify the norms and duties around the right to food? Why haven't INGOs incorporated them in their advocacy work? The point is that significant aspects of the human rights systems are not accounted for in the book. I wonder if those documents contain elements to develop the single blaming norm that is currently missing.

Nested between Chapter 3 and Chapter 5 is an insightful analysis of the nexus between human rights and development. The gist of the argument, empirically supported with interviews with key players, is that INGOs often find themselves caught between two advocacy strategies, which pull them in different directions. Development advocacy calls for partnering with governments to coordinate setting up and delivering development aid programs. Human rights advocacy calls for blaming the government for inactions, thus creating conflict between INGOs and governments. The two advocacy logics are incompatible and cannot be pursued at the same time. In choosing which one to prioritize, INGOs have almost always favored the development/partnership model. As a legal scholar and human rights advocate, I found the analysis of this tension insightful and helpful in thinking about my work. The narrative choice is particularly valuable to use a quote from an exchange on record with an Oxfam senior executive to convey the message. This interview arises several times throughout the manuscript, becoming a common thread that helps the reader follow an occasionally choppy narrative.

The book closes with theoretical and policy recommendations. If I understand it correctly, the recommendation for theorists is to pay more attention to how the lack of norms affects advocacy campaigns and refine existing human rights advocacy models. Further, the author invites scholars to pay more attention to advocacy around economic, social, and cultural rights, which have suffered from neglect compared to political and civil rights. The recommendations for practitioners are twofold: making use of the buckshot model as a tool

for informing and shaping human rights campaigners and urging the development of explicit human rights norms around chronic hunger to enhance advocacy efforts.

Overall, the book is informative and insightful. The author tried to avoid jargon and explain technical terms when needed. The choice of discussing the legal aspects of the right to food at the end of the book is a bit disorienting. Moreover, splitting the discussion of methodology in the body of the manuscript and its Appendix makes it challenging to follow. The book set out to answer three questions: Who is to blame for chronic hunger? What causes the problem? How can it best be solved? In many respects, the book answers all three, although the truth is that we do not know, but we should know (by developing blaming norms) if we were to become more effective anti-hunger advocates.


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BOOK REVIEW

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All I eat is medicine: Going hungry in Mozambique's AIDS economy

Kalofonos Ippolytos

Berkeley, California: University of California Press, 2021. 287pp. ISBN 9780520289406.

Ippolytos Kalofonos' *All I Eat is Medicine*: *Going Hungry in Mozambique's AIDS Economy* is a study in the anthropology of health and medicine focusing on the experiences of the Southern African nation of Mozambique as it dealt with the HIV/AIDS crisis. As a storyline, the book examines the process and effects of the global scaling up antiretroviral treatment (ART/ARV) in Mozambique. Kalofonos observes that the scale-up treatment for HIV/AIDS at the turn of the 21st century resulted in many seropositive people being treated and having their conditions improve. However, despite this success in accessing treatment, many people's lives were saved, yet they were not healed. The HIV treatment regime in Mozambique guided by foreign donors adopted a vertical biomedical silo approach, which focused solely on HIV and the provision of medication. Any other ancillary horizontal activities like spirituality, material support, especially food aid, were considered frivolous. For Mozambique, the therapeutic economy transformed from the more broad-based relational moral economy of affection to the inward-looking individualistic AIDS economy driven by donors. In sum, *Going Hungry in Mozambique's AIDS Economy* is about the soul-searching paradox of bodies saved from HIV/AIDS but exposed to a new wave of poverty where ARVs are the only "food" available.

Kalofonos presents his study against the background of Mozambique's racist colonial and modernizing past, and the effects of apartheid-ruled South Africa and racist Rhodesia's (now Zimbabwe) destabilization of Mozambique in bids to stave off any influences that would spur the fight for independence in these vestiges of white rule in sub-Saharan Africa. At a global level, the book critically analyses the fight against AIDS in the context of neoliberal racist humanitarianism as an instrument of western onslaughts on socialism and communism. This political-economic context filters down to the individual Mozambican female and male AIDS patient and attendant institutional actors whereby AIDS treatment becomes an arena for a biased contest between a professionalized biomedical approach and relational treatment and caregiving. Kalofonos concludes his study by noting that an AIDS political economy results in the triumph of the international private nongovernmental sector and related priorities at the expense of the Mozambican national health system and its citizenry.

Going Hungry in Mozambique's AIDS Economy comprises six chapters interwoven around three intersecting central themes:

(a) how new technologies—ARVs; practices—positive living and discourses; and medicalization develop an AIDS economy in Mozambique,
(b) how the subjectivities of beneficiaries of HIV treatment are reshaped as they navigate the AIDS economy, and

(c) the soul-searching moment of witnessing persistent hunger and underlying inequities amidst the celebrated HIV/AIDS interventions portrayed as successes in global health amidst global pharmaceutical regimes.

All I Eat is Medicine starts by noting that the roll out of the HIV/AIDS treatment technologies at scale was hailed as a success. Kalofonos considers this success partial and to some extent an instance for soul searching. Celebration was based on rising numbers of lives saved as well as still images of emaciated bodies transformed into "healthy" smiles. However, in real life, these images were people barely managing to survive because of the hunger associated with ARV uptake. The success was partial because this biological narrative of recovery ignored an important dimension of the recovery story—an account of how life changed for the people; patients and caregivers, living in the areas impacted by AIDS and targeted by treatment interventions. In this latter view, it is critical to know more about the ensuing relationships between individuals, social groups, organizations, and sovereign powers and remedies that give meaning and value to the lives saved. Such framing from Kalofonos shows that, in quantitative terms, AIDS interventions may be considered a success, but qualitatively the *modus operandi* is reinforced: exclusion, suffering, individualism, exploitation, and fragility of the Mozambican health social and state systems. In other words, the intervention system parodies the colonial experience of how the West underdeveloped Mozambique and Africa in general. The intervention did not result in the expansion of the health systems in the recipient countries.

An AIDS economy emerges from the intersection of local interpretations of health and illness grounded in social relationships and inward-looking neoliberal informed biomedical logics. In *Going Hungry*, the AIDS economy is presented as an arena where actors adopt certain mannerisms and worldviews as a way of navigating access to food handouts or job opportunities in one of the NGOs. Not all initiatives in the AIDS economy reward individuals in sustainable ways. For instance, where one has a spouse who is employed and deemed able to fend or provide for the family, food is given to what is constituted as more desperate cases. Practices associated with the AIDS economy also demand that the recovering patients abstain from sex or only engage in protected sex, which some people find unpalatable because their identity in the relational economy includes an ability to have children. The AIDS economy also determined the route one chose regarding positive living or *Vida Positive*, especially in disclosing one's status. Disclosure is a cost and at times a benefit. Detrimentally, it would likely expose one to malicious individuals who may unleash malevolent spirits to finish off the victim. Alternatively one could access food assistance for disclosing they were HIV-positive. *Vida Positiva* appealed to a particular group of people in the AIDS economy who had embraced a certain form of modernity, particularly regarding their relationship to traditional beliefs.

Associations of HIV-positive persons were formed to reinforce positive behavior as well as hope for the future through self-care and self-esteem. According to Kalofonos, a trajectory of associations bring into relief experiences of exclusion, the deepening medicalization of the AIDS economy, and further weakening of the Mozambican National Health System. Initially, the associations were operated along faith-based lines while promoting the uptake of bio-medical help. However, with the upscaling of ARV distribution and the involvement of foreign NGOs, the AIDS economy took a more professionalized approach and perspective. The faith dimension of care was gradually edged out, whereas trained medical personnel and positivist metrics gained support and legitimacy. Those who had volunteered in community home-based care, the majority of which were women, had their hopes of obtaining paid employment opportunities lost. At the same time, the Mozambican National Health System continued to suffer as personnel left government service. Donor-sponsored day hospitals became centers for managing HIV treatment. Initial community home-based

care adopted a pragmatic palliative spiritual orientation, as part of relieving suffering and addressing material deprivation. The professionalization of HIV treatment saw a de-emphasis of basic needs provision as part of treatment in what Kalofonos called biomedical tunnel vision and vertical programming promoted by the U.S. President's Emergency Plan for AIDS Relief (PEPFAR).

Kalofonos' book is relevant to students and practitioners of the sociology and anthropology of health and wellness. This book demonstrates how anthropology is relevant to a broad array of practitioners in terms of research methods and as a mode of analysis. A practicing psychiatrist as well as a professor in the Center for Social Medicine and the Humanities at the University of California at Los Angeles, Kalofonos is critical of the global biomedical approach. In contrast, the critical approach used in this book is meant to dissect and analyze the past and present mistakes to make way for a better tomorrow; what Murray Last (1989) calls a "useful anthropology." The prose is accessible and the illustrations are convincing.

A potential weakness of the book is the author's pattern of referring to every cited author's profession (e.g., anthropologist, physician anthropologist), which readers may find tedious. Also, Kalofonos sometimes makes sweeping statements about Southern Africa that suggest a more homogenous community than is the case in fact. For instance, the claim on page 8 that in sub-Saharan Africa, healing is a public event is not entirely correct. In fact, in most cases, healing is a private affair, lest the enemy discover the victim at their weakest. Moreover, Kalofonos states that people do not like the lack of privacy at day clinics because health-seeking practices are private and personal processes. Consultation of traditional healers has always been a very discreet practice with people not often alerting the broader public. Overall, however, *All I Eat is Medicine is a* grounded account showing that humanitarian aid is a double-edged sword. "Each person eats at the cost of another person…that person is eating the blood of the other."

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