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The Spread of Tuberculosis Cases in the Highlands and Coastal Areas of Padang

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Abstract

The current tuberculosis (TB) worldwide situation is very concerning in terms of the number of cases and the death toll, as well as the environmental factors that contribute to its transmission. This has driven policy decisions that aim to enhance contemporary TB control efforts. This study aimed to map the pattern of TB spread based on geographic location, particularly in the highland and coastal areas of Padang City, West Sumatra Province, Indonesia. This study employed a quantitative descriptive analysis using secondary data from 6 primary health care (PHC) from April 2022 to March 2023, comprising 896 cases. Data analysis was conducted using the ArcGIS program, as well as applying Nearest Neighbor Analysis across the PHC areas. The results indicated that TB cases were more prevalent in coastal areas. The distribution pattern was comparable between the mountainous and coastal areas, as indicated by similar clusters. Geographic differences did not affect the TB transmission pattern in Padang City. The reason for the occurrence of transmission was likely due to close contact, spreading from one person to another. Therefore, more effective education efforts, case detection, and restriction of TB patient movement are necessary to address the issue of interest.

Keywords: coastal, highlands, spread, tuberculosis

Introduction

In the era of Sustainable Development Goals (SDGs), tuberculosis (TB) control programs are transitioning from the STOP TB program of the Millennium Development Goals (MDGs) period to the END-TB Program. The objective of the END TB Program is to end the Pulmonary TB epidemic throughout the world.[1] Nowadays, the number of those affected by the diseases is increasing, along with the number of mortality, both on a global and regional scale, such as in Indonesia.[2,3] Currently, Indonesia occupies the second place with the highest number of TB cases in the world after India.[2] In Indonesia, the kinematic rate of TB has recently reached 150,000 cases (one person every 4 minutes), an increase of 60% from 2020, with 93,000 kinematic cases of TB and a kinematic rate of 55 per 100,000 population.[3] In 2021, West Sumatra Province had 8,216 cases and was ranked 12th out of 38 provinces.[4] According to the Padang Health Office's Division of Communicable Disease Prevention and Control, 14 primary health cares (PHCs) had a consistently high proportion of TB patients in 2021 and 2022.[4]

The current high number of TB transmissions is greatly influenced by environmental factors, including physical, biological, and sociocultural elements. These factors include inadequate housing, residential density, and cramped spaces that increase the risk of TB transmission, especially among children.[5,6] Poor home conditions, such as unsuitable temperature, high humidity, inadequate lighting, poor air circulation,[7] and air pollution[8] are among the significant determinants. Additionally, the physical environment of a house has become an indicator of pulmonary TB transmission.[9]

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The biotic elements of the environment related to TB transmission are age-related, as babies, children, and the elderly are highly susceptible to TB.[10,11] More than 18% of TB cases are found to occur in children (aged 0-16 years), while more than 69% of sufferers are determined to be men.[12] On top of that, the TB condition can be aggravated by the habit of smoking,[13] low education,[14] HIV/AIDS infection, malnutrition, diabetes, and alcohol addiction.[15] From social and cultural elements, several aspects that influence TB transmission include beliefs, values, habits, interaction in a large group,[16] unemployment, poverty,[14] difficulties in accessing health service,[17] and low economic condition.[18] Social culture and environmental physique increase exposure to pathogens and exacerbate people's vulnerability to TB infection.[19]

The process of transmitting TB is influenced by the interaction of the third element environment (abiotic, biotic, and cultural (social culture).[20] In this context, the pattern and duration of social contact are more influential than the frequency of contact.[9] For instance, 1 in 30 household contacts will develop active TB, with most of these cases occurring outside the house.[21] Therefore, the issue is postulated to depend on the density of residence and population.[22]

Geographical location is also closely related to air temperature, humidity, wind speed, season, and rainfall.[23] Cold temperatures can weaken the human body's resilience and, as a result, affect the physical home environments and public social culture. In colder temperatures, people are more likely to gather indoors, increasing prolonged close contact.[24] The spread of TB is also associated with limited access to healthcare services, especially in coastal regions.[25] It is important to consider factors of the season and different heights when implementing a prevention approach to control pulmonary TB.[26]

The current global challenge in controlling TB lies in the persistently high transmission rates.[27,28] Mapping the spread of TB is a key effort to limit its transmission within communities and effectively manage multimorbidity by identifying TB zones.[29] This study aimed to map the pattern of pulmonary TB spread based on geographical locations, specifically in highland and coastal regions. The novelty of this study is the development of a new database map of TB transmission risk areas, which is considered critical information that can serve as a foundation for future studies.

Method

This study employed a quantitative descriptive approach with a total of 896 cases, consisting of all secondary data on TB patients from 6 PHCs, with the highest number of cases from April 2022 to March 2023. The PHCs were categorized by geographical regions: mountainous areas (Lubuk Kilangan, Belimbing, and Air Dingin PHCs) and coastal areas (Lubuk Buaya, Pegambiran, and Padang Pasir PHCs). The data were sourced from the TB information system of each PHCs. The data analysis was conducted using the Arcview version 3.1 program, which is a tool for creating, analyzing, and visualizing spatial and geographical data. Nearest Neighbor Analysis (NNA) was used with the following formula:

$$\boldsymbol{Rn = 2D\sqrt{(n/a)}}$$

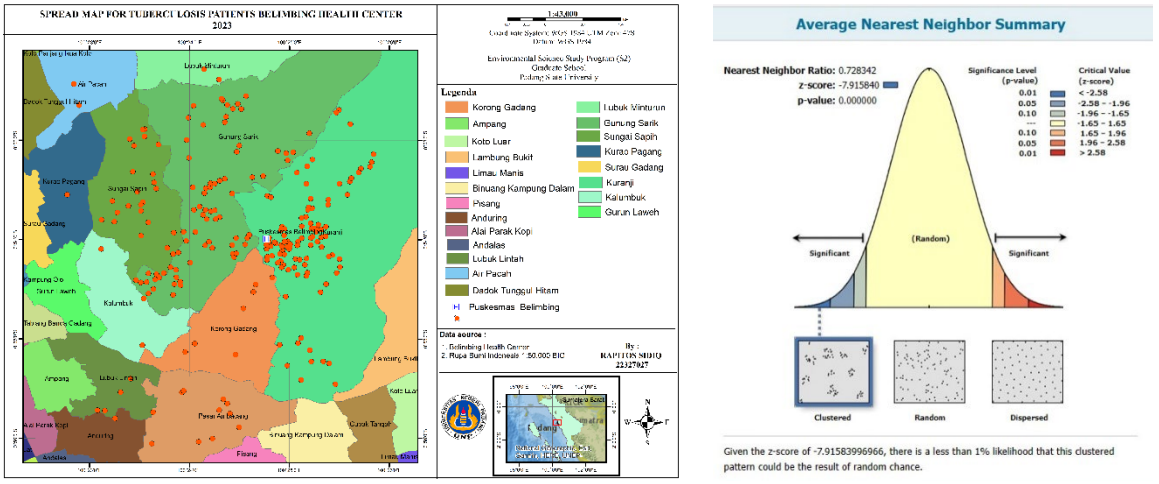
Rn is the nearest neighbor index, *D* is the average distance between each point and its nearest neighbor, *n* is the number of points under study, and *a* is the size of the area. The nearest-neighbor analysis generated an *Rn* (nearest-neighbor index) value, which measured whether case transmission patterns were clustered, random, or regular. A clustered pattern was indicated by an *Rn* value of 0, where all points were close to a single point. Meanwhile, a random pattern showed an *Rn* value of 1.0, with no discernible pattern. A regular pattern was shown by an *Rn* value of 2.15, which indicated a perfectly uniform distribution where each point was equidistant from its neighbors. The main data included in the analysis process was related to geographic location, such as latitude and longitude coordinate point data and size scale.

Results

This study identified several characteristics of TB patients from various aspects, including sex, age, occupation, and the number of cases per service area. This study found that most TB patients were male, approximately 612 individuals (68.3%), and aged 17-65 years. A significant portion of TB patients were unemployed, and most of them resided in coastal areas. Of the 896 cases, 514 (57.4%) were distributed across three PHC areas: Lubuk Buaya, Pegambiran, and Padang Pasir. Based on the NNA analysis, it was found that in all service areas, whether in highland or coastal regions, the distribution pattern of TB cases was clustered (Figures 1-6).

The distribution pattern of TB cases in the six PHC working regions (Belimbing, Air Dingin, Lubuk Kilangan, Lubuk Buaya, Pegambiran, and Padang Pasir) was explained based on each region's demographic parameters. The working regions of Belimbing PHC were densely populated and covered a relatively large area, including hilly terrain, agricultural

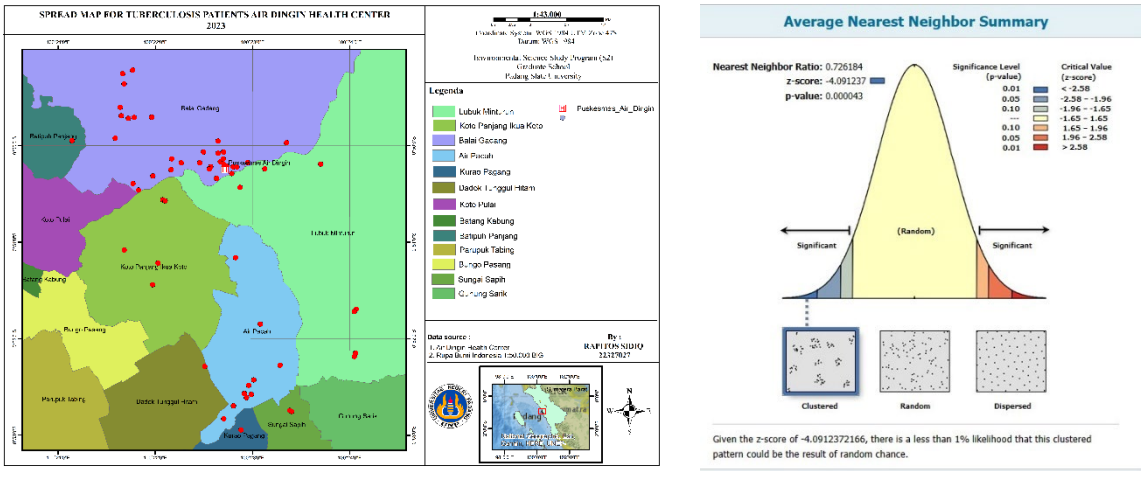
land, and plantations. These neighborhoods contained dense housing developments and various public services, with a mix of residential zones (Figure 1). According to the map, multiple cases occurred in heavily populated residential areas and public marketplaces within these regions. Hence, it could be suggested that transmission may spread from nearby areas such as Air Dingin, Ambacang, and Kuranji.



Notes: health center, *puskesmas* = primary health care

Figure 1. Belimbing Primary Health Care Working Regions

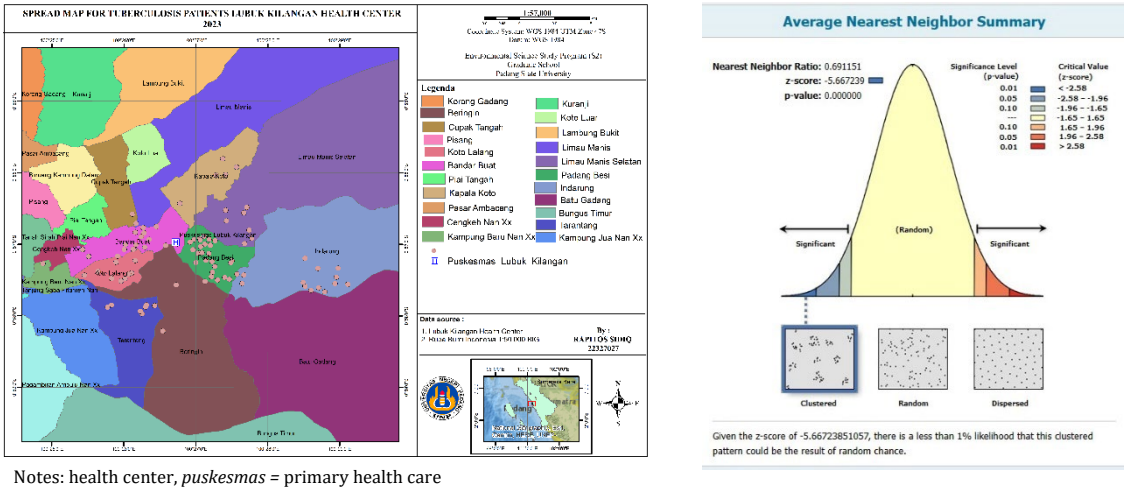
Air Dingin PHC's working regions were located on the outskirts of Padang City, near mountains, forests, and agricultural land, with occupations distributed unevenly (Figure 2). Case mapping in this area revealed clusters of pulmonary TB cases, with a total of 59 recorded cases. Meanwhile, the working regions of Lubuk Kilangan PHC were located in mountainous and industrial areas with a highly heterogeneous population (Figure 3). This area bordered the working regions of the Pauh, Pegambiran, and Lubuk Begalung PHCs, with a total of 92 TB cases. Mapping results showed clusters of pulmonary TB cases within these regions.



Notes: health center, *puskesmas* = primary health care

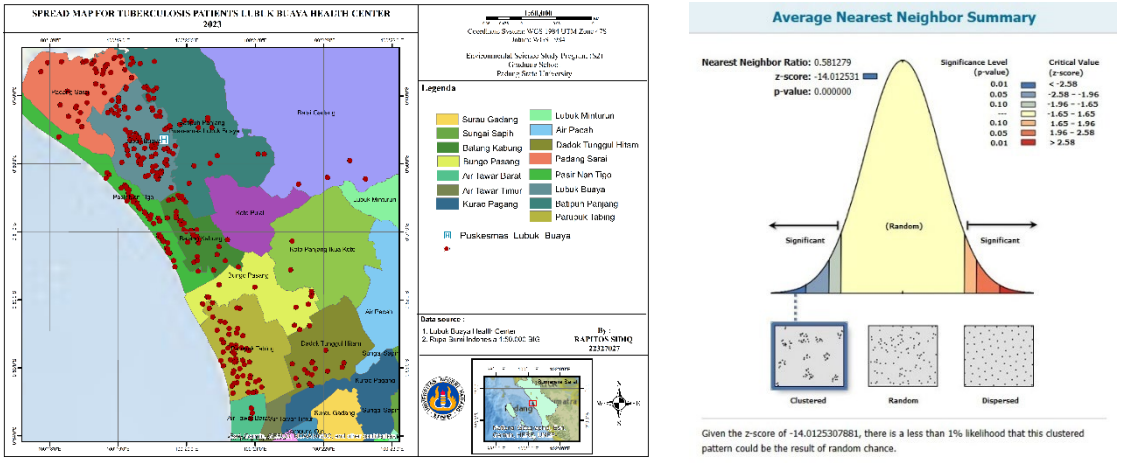
Figure 2. Air Dingin Primary Health Care Working Regions

The working regions of Lubuk Buaya PHC were densely populated coastal areas with inadequate environmental sanitation (Figure 4). These regions bordered the working areas of Anak Air Tawar PHC and have the highest number of cases in Padang (302 cases). Mapping results indicated TB cases in groups or clusters, with numerous cases reported in densely populated areas and along the coast. Furthermore, disease transmission was likely influenced by proximity to the nearby Anak Air working area.



Notes: health center, *puskesmas* = primary health care

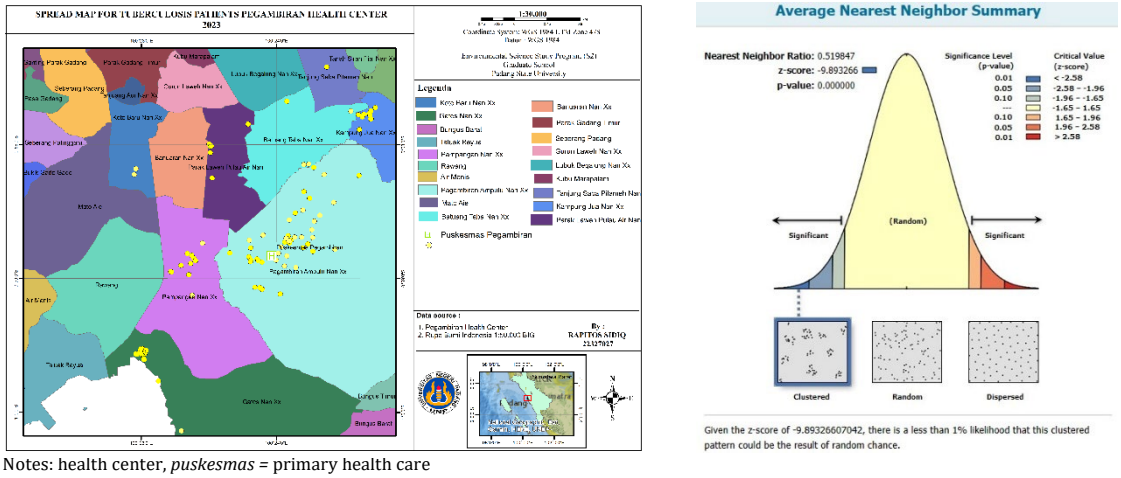
Figure 3. Lubuk Kilangan Primary Health Care Working Regions



Notes: health center, *puskesmas* = primary health care

Figure 4. Lubuk Buaya Primary Health Care Working Regions

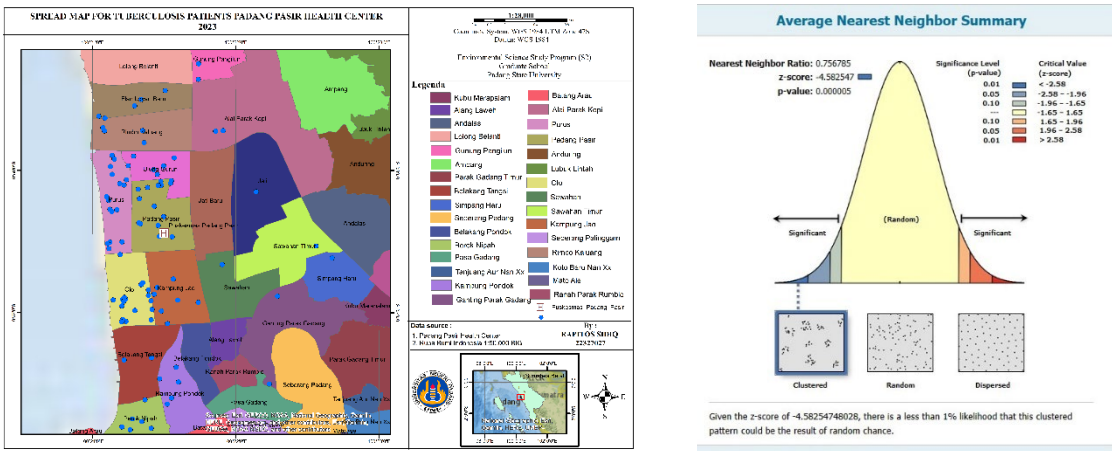
Pegambiran PHC's work area was densely populated and extensive, consisting of hilly areas, agricultural land, and rubber processing companies, with various public services, including markets, port, and railway transportation. Several densely populated housing areas were also adjacent to the Lubuk Begalung, Rawang, and Pauh PHCs. There were several residential neighborhoods in this area (Figure 5). With 115 cases, this area ranked fourth in the country, with one case originating from outside the region. Mapping results revealed clustered or group TB cases. According to the map, several clusters of cases occurred in various densely populated communities around the PHC, as well as along the roadsides and near the port. In particular, those clusters of cases were located near the Lubuk Begalung and Rawang PHCs working regions.



Notes: health center, *puskesmas* = primary health care

Figure 5. Pegambiran Primary Health Care Working Regions

Padang Pasir PHC working region was located in the center of Padang City, surrounded by other busy areas such as supermarkets, public facilities like office buildings, hospitals, and coastal areas, with a highly heterogeneous population (Figure 6). According to the data, the number of recorded pulmonary TB cases was 97. Upon closer examination, the distribution of TB cases was found to be concentrated along the coastline. In this location, there was a residential facility (apartment complex) that housed many residents. This densely populated condition made it easy for transmission to occur in a cluster pattern.



Notes: health center, *puskesmas* = primary health care

Figure 6. Padang Pasir Primary Health Care Working Regions

Discussion

This study indicated that most TB cases were found in coastal areas rather than highland areas. The results contrast the prevailing theory, suggesting that TB is more prevalent in areas with a cool climate or highland regions with heavy rainfall.[20] The assumption was based on the low oxygen levels in cold air, which can weaken the body's immune system, as well as environmental conditions, all of which may influence TB transmission from a socioeconomic perspective. Limited access to healthcare services in rural or mountainous areas also contributes to TB spread.[22] As discussed earlier, population density is a more influential factor in TB transmission than geographic features like elevation above sea level.[30]

This study also found that the results of NNA for all study areas showed a clustered pattern of TB distribution. This means that TB cases tended to appear in specific groups or areas rather than being randomly distributed. This result indicated the presence of specific factors that propel the spread of the disease in those areas. One of the arguments explaining this clustered pattern of TB distribution in this location included the occurrence of local transmission. This was because the clustered pattern of TB cases often indicated local transmission. In other words, the disease spreads from one person to another within close-knit communities or groups. This is especially the case for households or community groups with frequent interactions.[9,31]

Another factor that may contribute to the clustered spread of TB is social and economic factors, such as poverty levels, population density, or limited access to healthcare services.[14] This is further exacerbated by the stigma surrounding TB in the community,[32] though this argument has not yet been proven. Stigma has a significant impact on the transmission of pulmonary TB. It causes individuals with TB to delay seeking treatment, which in turn leads to further spread of the disease within the community.[33,34] Other factors that can contribute to the spread of TB in certain areas are environmental conditions such as poor ventilation, overcrowded living spaces, and damp environments.[35]

Environmental conditions are a current trend in large cities as rapid urban growth continues worldwide,[36] including Padang City, a central coastal city. Many of its population lives along the beach, in crowded areas like Padang Pasir, Lubuk Buaya, and Pegambiran. This high population density is likely a more significant factor in TB transmission[37] than temperature and humidity, as there is minimal difference in these conditions between the higher plains and coastal areas within Padang City. The factor of population density plays a larger role in TB transmission in Padang City since interactions among people with TB increase the chances of transmission.[38] This condition resulted in a similar spread pattern between the high plains and coastal areas, where cases form clusters, indicating that this pattern arose due to environmental or social factors influencing TB transmission in the area.

TB spreads primarily through close contact with infected individuals, such as family members, coworkers, or others in shared environments. In most cases, those affected were mostly men (68.3%) in the productive age range (15-55 years).

Transmission within the home is particularly concerning, especially for children.[10] This study found that over 10.4% of TB cases were spreading in children aged 0-5 years. This result provided stronger evidence that TB transmission in Padang City was more due to social contact between pulmonary TB sufferers and the general public. Therefore, in this regard, there was no difference between the high plains and coastal areas. This issue was worsened by poor sanitation in households, especially among people living along the coast, such as in the Gates Nan XX Urban Village and Pegambiran PHC working regions. To address the spread of TB through social contact, several alternative interventions could be considered, such as contact tracing or active case-finding among individuals infected with TB to identify additional cases within clusters.[39]

Other than that, improving sanitation conditions and environmental cleanliness in areas with TB clusters to reduce the risk of transmission through the air or contact with contaminated surfaces can also be done. Additionally, the government needs to focus on educating the public about TB, including its symptoms, methods of contagion, and the importance of prevention and proper treatment.[40] Therefore, identifying cluster patterns of spread is expected to enable more targeted interventions, such as effective contact tracing, routine screening in high-incidence areas, and health education campaigns specifically tailored to at-risk communities.

Conclusion

TB cases are higher in coastal areas compared to the highlands, with cluster distribution patterns in both geographic locations. TB transmission is not related to temperature and humidity factors but is more influenced by population density, where frequent interaction is the most significant risk factor. Additionally, data analysis has successfully mapped the distribution of cases according to these patterns. It can now be used as a reference for controlling TB transmission, including educational efforts and case tracking.

Abbreviations

TB: tuberculosis; PHC: primary health care; NNA: Nearest Neighbor Analysis.

Ethics Approval and Consent to Participate

The analysis performed passed research ethics from the research ethics committee at Andalas Padang University, with an ethical approval number of 501/UN.16.2/KEP-FK/2023.

Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

Data and materials are available from the corresponding authors.

Authors' Contribution

RS was responsible for the entire process, including the manuscript's analysis, writing, and revision. ID, H, and NS were responsible for conceptualization, and LH and AA supervised the findings of the work. All authors discussed the results and contributed to the final manuscript.

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Characteristic and Survival Analysis of Infants with Critical Congenital Heart Disease

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Characteristic and Survival Analysis of Infants with Critical Congenital Heart Disease

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Abstract

Congenital heart disease (CHD) is a major health concern worldwide. This study focused on survival analysis and the factors influencing survival in infants with critical congenital heart disease (CCHD). A total of 79 infants diagnosed with CCHD were identified, with 48.1% (n=38) exhibiting duct-dependent pulmonary circulation, 35.6% (n=28) exhibiting duct-dependent systemic circulation, 6.3% (n=5) exhibiting critical non-duct-dependent, and 10.2% (n=8) exhibiting parallel circulation issues. Of the infants studied, 55.7% (n=44) were male, 78.5% (n=62) had a gestational age of ≥37 weeks, 62% (n=49) had a birth weight of ≥2,500 grams, 59.5% (n=47) exhibited normal fetal growth, 93.7% (n=74) experienced no asphyxia, 91.1% (n=72) had no other congenital disabilities, 87.3% (n=69) had no history of fetal distress, 58.2% (n=46) maintained normal oxygen saturation, and 88.6% (n=70) had an extended stay in the neonatal intensive care unit. The survival analysis indicated that the prognosis of newborns with CCHD was markedly affected by gestational age, birth weight, desaturation, respiratory distress, and hereditary abnormalities. Additional study is required to assess the risk factors influencing the survival of newborns with CCHD.

Keywords: critical congenital heart disease, newborn infant, survival analysis

Introduction

The majority of newborn deaths occur within the first week after birth, primarily due to premature birth, birth asphyxia, infections, and congenital disabilities.[1] In the first five years of life, pneumonia, diarrhea, congenital disabilities, and malaria are the leading causes of death.[1] The World Health Organisation (WHO) estimates that around 240,000 newborns die within one month of birth due to congenital abnormalities, with heart defects, neural tube defects, and Down syndrome being the most common severe abnormalities.[2]

Congenital heart disease (CHD) is the most prevalent congenital disability and presents a significant global health issue. According to The European Surveillance of Congenital Anomalies (EUROCAT) Working Group, 28% of significant congenital anomalies are CHD.[3] The impact of CHD extends beyond the mortality and morbidity of infants and affects the financial burden on families, communities, and countries.[4,5] According to the WHO, congenital impairments cause 7% of newborn mortality, with CHD accounting for 25%.[3] The situation poses a high risk of early infant mortality and necessitates prompt actions to mitigate the issue.[3] Thus, gathering data on survival rates and determinants of survival for infants with CHD is crucial for predicting mortality rates of the disease.

The prevalence of critical congenital heart disease (CCHD) is estimated to be 20-25% of the prevalence of structural CHD.[6–8] World Population Data in 2021 shows that Indonesia's population is about 281,600,000, with the crude birth rate (CBR) being 16 births per 1,000 individuals, meaning there are 4,401,600 yearly births.[9] Given the population and yearly birth rate, the projected incidence of CHD in Indonesia is around 40,934 cases per year, based on an incidence rate of 9.3 per 1,000 live births in Asia.[10] According to the aforementioned structural CHD projections, it is estimated that around 10,233

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infants with significant CHD will be born annually in Indonesia and require neonatal emergency treatments. This is roughly 20-25% of the overall prevalence of structural CHD.[5] This study aimed to assess the clinical features, survival rates, and main determinants of survival of infants with CCHD.

Method

This study was a retrospective cohort analysis of live-born children diagnosed with severe congenital cardiac disease at the National Women and Children Health Center in Indonesia. Data was obtained from electronic medical records spanning from January 1, 2020, to December 31, 2022. This study encompassed 79 live-born children diagnosed with CCHD. The authors computed Kaplan-Meier survival estimates based on infant characteristics, including sex, gestational age, birth weight, fetal development, fifth-minute asphyxia, other congenital disabilities, history of fetal distress, saturation levels, and duration of stay in the neonatal intensive care unit (NICU).

Results

During the study period, there were 4,397 live births, of which 955 were suspected cases of CHD that underwent neonatal echocardiography. All singleton newborns were incorporated. Cases diagnosed with specific disorders were eliminated from the study, including Persistent Foramen Ovale (PFO), small Atrial Septal Defect (ASD), non-significant Patent Ductus Arteriosus (PDA), Transient Tachypnea of the Newborn (TTN), and Persistent Pulmonary Hypertension of Newborn (PPHN).

Of the 152 newborns who survived CHD, 73 (48%) were classified as non-critical, while 79 (52%) were identified as critical cases at the National Women and Children Health Center. Table 1 outlines the distribution of CHD diagnoses, with pulmonary atresia occurring most frequently at 25.3% (n=20) and Hypoplastic Left Heart Syndrome (HLHS) at 24.1% (n=19). The characteristics of the infants are delineated in Table 2.

Table 1. Total Number of Patients and Time to Life by Diagnosis

Diagnosis	n = 79 (%)	Time to life in days, mean (min-max)	Death (n)
Duct-Dependent Pulmonary Circulation (DDPC)	**38 (48.1)**		
Tricuspid atresia	4 (5.1)	155.3 (3-365)	2
Ebstein anomaly	2 (2.5)	6.5 (3-10)	2
Pulmonary stenosis	3 (3.8)	14.7 (1-28)	1
Severe pulmonary stenosis-IVS	1 (1.3)	(-)	0
TOF	8 (10.1)	81.6 (4-365)	3
Pulmonary atresia	20 (25.3)	100.2 (1-365)	12
Duct-Dependent Systemic Circulation (DDSC)	**28 (35.6)**		
Mitral atresia	4 (5.1)	56.8 (5-208)	3
HLHS	19 (24.1)	10.4 (0-60)	15
IAA	2 (2.5)	8.5 (2-15)	2
IAA, CAVSD, PDA, Dextrocardia Mirror Image	1 (1.3)	(-)	1
Coarctation of aorta, PDA, PH	1 (1.3)	(-)	0
Complex CHD (combination)	1 (1.3)	(-)	1
Critical Non-Duct-Dependent (CNDD)	**5 (6.3)**		
Truncus arteriosus	3 (3.8)	10.7 (2-21)	2
TAPVD	2 (2.5)	33 (6-60)	2
Parallel Circulation (PC)	**8 (10.2)**		
TGA-IVS	1 (1.3)	(-)	0
TGA-VSD	6 (7.6)	51.3 (1-121)	2
DORV-VSD, TGA	1 (1.3)	(-)	0
Total	**79**		**48**

Notes: IVS = Intact Ventricular Septum, TOF = Tetralogy of Fallot, HLHS = Hypoplastic Left Heart Syndrome, IAA = Interrupted Aortic Arch, CAVSD = Complete Atrio-Ventricular Septal Defect, PDA = Patent Ductus Arteriosus, PH = Pulmonary Hypertension, TAPVD = Total Anomalous Pulmonary Venous Drainage, TGA = Transposition of the Great Arteries, VSD = Ventricular Septal Defect, DORV = Double Outlet Right Ventricle.

A total of 79 infants diagnosed with CCHD were identified as having duct-dependent pulmonary circulation (DDPC) of 48.1% (n=38), duct-dependent systemic circulation (DDSC) of 35.6% (n=28), critical non-duct-dependent (CNDD) of 6.3% (n=5), and parallel circulation (PC) of 10.2% (n=8). Most infants, 60.8% (n=48), died within one year of observation. The majority of infants diagnosed with HLHS died before reaching aged three months.

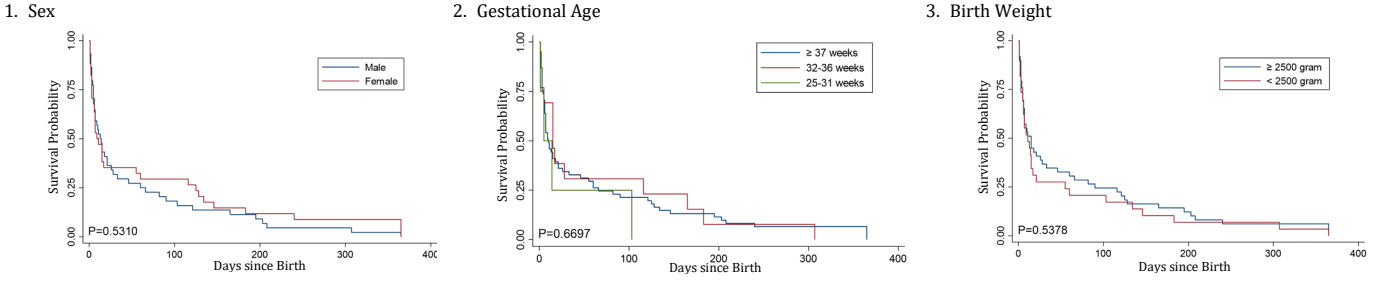
Among the infants, 55.7% (n=44) were male, 78.5% (n=62) had a gestational age of ≥37 weeks, 62% (n=49) infants with birth weight of ≥2,500 grams, 59.5% (n=47) of infants with normal fetal growth, 93.7% (n=74) of infant without asphyxia, 91.1% (n=72) of infants without other congenital disabilities, 87.3% (n=69) of infants without fetal distress, 58.2% (n=46) of infants with normal oxygen saturation, and 88.6% (n=70) of infants with an extended stay in the NICU.

The proportion of infants by characteristics is outlined in Table 2.

Table 2. Characteristics of Infants with Critical Congenital Heart Disease

Characteristic	n = 79 (%)
Sex	
Male	44 (55.7)
Female	35 (44.3)
Gestational age	
≥37 weeks	62 (78.5)
32-36 weeks	13 (16.5)
25-31 weeks	4 (5.0)
Birth weight	
≥2,500 grams	49 (62.0)
<2,500 grams	30 (38.0)
Fetal growth	
Normal	47 (59.5)
IUGR	32 (40.5)
Asphyxia in the fifth minute	
Absent	74 (93.7)
Present	5 (6.3)
Other congenital disabilities	
Absent	72 (91.1)
Present	7 (8.9)
Fetal distress	
Absent	69 (87.3)
Present	10 (12.7)
Saturation	
Normal	46 (58.2)
Abnormal	33 (41.8)
Length of stay in NICU	
<7 days	70 (88.6)
≥7 days	9 (11.4)

Notes: IUGR = Intrauterine Growth Restriction, NICU = Neonatal Intensive Care Unit



No. at risk	0	100	200	300	400
Male	0	36	4	2	2
Female	1	24	6	1	3

No. at risk	0	100	200	300	400
≥37 w	1	48	6	3	4
32-36 w	0	9	3	0	1
23-31 w	0	3	1	0	0

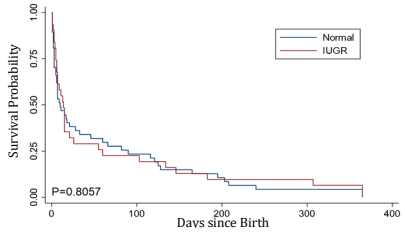
No. at risk	0	100	200	300	400
≥2,500 g	0	37	6	3	3
<2,500 g	1	23	4	0	2

Figure 1. Kaplan-Meier survival analysis showed the impact of sex (1), gestational age (2), and birth weight (3) on the survival of infants with Critical Congenital Heart Disease at the National Women and Children Health Center in Indonesia, 2020-2022.

The Kaplan-Meier survival curve showed that the survival of infants with CCHD varied according to their characteristics (Figure 1). The Kaplan-Meier curve suggests a disparity in survival duration between males and females. The log-rank test results indicated no significant difference (p-value >0.05). The survival probability of infants born at a gestational age of 23-31 weeks was lower than that of infants born at 32-36 weeks and those delivered at 37 weeks or later. Infants aged beyond 37 weeks constituted the largest group (78.5%).

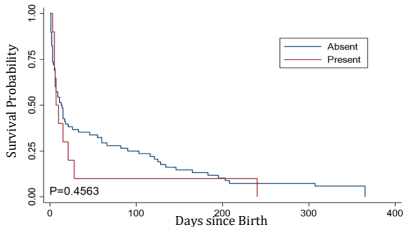
The survival of newborns with CCHD varied according to gestational age. The log-rank test found no significant difference (p-value >0.05). The survival probability based on birth weight showed no significant difference in survival time between infants with a birth weight of ≥2,500 grams and those with a birth weight of <2,500 grams (p-value >0.05).

1. Fetal Growth



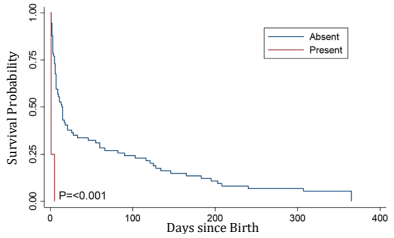
No. at risk	0	100	200	300	400
Normal	0	36	6	3	2
IUGR	1	24	4	0	3

2. Fetal Distress History



No. at risk	0	100	200	300	400
Absent	1	51	10	2	5
Present	0	9	0	1	0

3. Asphyxia

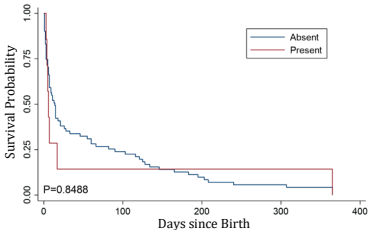


No. at risk	0	100	200	300	400
Absent	0	56	10	3	5
Present	1	4	0	0	0

Figure 2. The Kaplan-Meier survival analysis showed the impact of fetal growth (1), fetal distress history (2), and asphyxia (3) on the survival of infants with Critical Congenital Heart Disease at the National Women and Children Health Center in Indonesia, 2020-2022

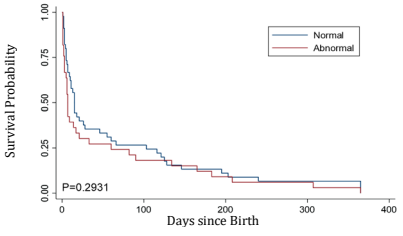
A Kaplan-Meier curve on fetal growth indicates no significant difference in survival time between infants with normal growth and those with Intrauterine Growth Restriction (IUGR) (p-value >0.05). In cases of fetal distress, a disparity in survival duration was observed between infants experiencing fetal distress and those not affected by it. The log-rank test found no significant difference (p-value >0.05). Asphyxia demonstrated a disparity in survival duration between infants born with asphyxia and those without. The log-rank test recorded a significant difference (p-value <0.05) in newborns with asphyxia. Kaplan-Meier curves for other congenital disabilities, oxygen saturation, and length of stay in the NICU indicated no difference in survival time for infants with CCHD. The log-rank test indicated no significant differences in other congenital disabilities, oxygen saturation, and length of stay in the NICU (p-value >0.05).

1. Other Congenital Defect



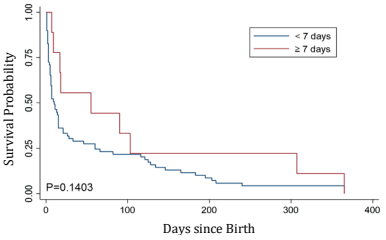
No. at risk	0	100	200	300	400
Absent	1	54	10	3	4
Present	0	6	0	0	1

2. Saturation



No. at risk	0	100	200	300	400
Normal	1	33	7	2	3
Abnormal	0	27	3	1	2

3. Length of Stay in NICU



No. at risk	0	100	200	300	400
<7 days	1	54	9	3	3
≥7 days	0	6	1	0	2

Figure 3. The Kaplan-Meier survival analysis showed the impact of another congenital disability (1), oxygen saturation (2), and length of stay in the Neonatal Intensive Care Unit (3) on the survival of infants with Critical Congenital Heart Disease at the National Women and Children Health Center in Indonesia, 2020-2022.

Discussion

A total of 79 infants diagnosed with CCHD were identified with developmental disorders: DDPC of 48.1% (n=38), DDSC of 35.6% (n=28), CNDD of 6.3% (n=5), and PC of 10.2% (n=8). The majority of diagnoses for live-born infants with CCHD were pulmonary atresia at 25.3% (n=20), followed by HLHS at 24.1% (n=19). The one-year survival probability of newborns with CCHD was 39.2%. The majority of deaths occur before three months of age. This data aligned with a study conducted in Beijing, which revealed that deaths among newborns with CCHD predominantly occur within the first-week post-birth.[11] Previous studies indicated that newborn survival diminished by 70% by 28 days of age.[12,13] A study in developing countries determined that the survival rate for CCHD was 90.4% (95% CI 89–91.8%) at one month and 69.3% (95% CI 67.2–71.4%) at one year.[14]

This study, based on the Kaplan-Meier curve on sex, showed a difference in survival time between males and females. Using the Kaplan-Meier curve concerning sex demonstrated a disparity in survival duration between males and females.[15] Additionally, the log-rank test results indicated no statistically significant difference (p-value >0.05). The survival probability of infants born at a gestational age of 23-31 weeks was lower than that of infants born at 32-36 weeks and those delivered at ≥37 weeks. Infants with a gestational age ≥37 weeks constituted the largest group (78.5%). Infants with a birth weight of >2,500 grams were the highest proportion (62%). Infants born before 39 weeks of gestation have a

greater death and morbidity rate than term infants. Premature newborns with CHD had worse outcomes than full-term infants.[16] According to one study, the one-year survival rate for babies born before 28 weeks was 79.4%, and the one-year survival rate for those born after 37 weeks was 97.1%.[17] The ≥39-week group showed substantial evidence of improved survival, followed by lower evidence at 24–31 and 37–38 weeks, and no evidence at 32–36 weeks, according to another study.[18]

PA-IVS is a critical congenital heart defect characterized by ductal-dependent pulmonary circulation. This study found the highest prevalence of pulmonary atresia with an intact interventricular septum, pulmonary atresia with ventricular septal defect, and its combination with Tetralogy of Fallot was observed among cases of CCHD. The previous study found that 142 of the 491 tested subjects were affected with CCHD.[14] Infants with pulmonary atresia frequently die before one year of age.[19]

HLHS is a form of CCHD disease that causes structural underdevelopment of the left side of the heart, encompassing the mitral valve, left ventricle, aortic valve, ascending aorta, and aortic arch.[20] The mortality rate in this study was highest among newborns diagnosed with HLHS, at 24.1%. Moreover, the majority of infants died before reaching 28 days of age. This finding aligned with the study in Türkiye, which indicated that the death rate escalated to 80% within three months.[13]

In comparison, studies in metropolitan Atlanta discovered that the survival rates of newborns with HLHS into adolescence have markedly improved in recent years.[15–18] This study found that the largest mortality rate occurred in newborns with HLHS within the first week of life. The reason is that these infants did not receive intervention, surgery, or subsequent Norwood treatment in underdeveloped countries such as Indonesia.

Low birth weight significantly increases the risk of mortality in newborns with CCHD.[12,14] Gestational age significantly influences the survival of infants with CCHD.[21] Small for gestational age (SGA) is the primary cause of postnatal mortality in newborns with CCHD.[21] This study discovered that most newborns with CCHD exhibited normal gestational age and birth weight.

The CHD can significantly impact the entire family unit and influence not only the patient's quality of life but also the physical, emotional, and occupational well-being of their loved ones.[22–24] Despite advancements in therapies, numerous patients with CCHD remain uncured and require lifelong management.[22,25,26] Parents of children with CCHD may encounter psychological issues, including anxiety, depression, and hopelessness. They may also encounter stress responses, including acute stress disorder or post-traumatic stress disorder.[23,24,27] In addition to the elevated mortality and morbidity associated with CCHD, surgical procedures and interventions can adversely impact family finances and increase the load on the state.[28–31]

Conclusion

In this study, the survival rate of newborns with CHD is 39.2% after one year of surveillance. The Kaplan-Meier curves reveal disparities in survival time between males and females for gender, gestational age, and asphyxia. More research is needed to determine the risk factors influencing the survival of neonates with IUGR. These findings give evidence for doctors, health workers, researchers, and legislators to enhance services and develop CHD preventive policies.

Abbreviations

WHO: World Health Organization; CHD: Congenital Heart Disease; CCHD: Critical Congenital Heart Disease; NICU: Neonatal Intensive Care Unit; HLHS: Hypoplastic Left Heart Syndrome; DDPC: Duct-Dependent Pulmonary Circulation; DDSC: Duct-Dependent Systemic Circulation; CNDD: Critical Non-Duct-Dependent; PC: Parallel Circulation; IUGR: Intrauterine Growth Restriction.

Ethics Approval and Consent to Participate

The hospital's ethical committee at the Harapan Kita National Women and Children Health Center reviewed and approved the study.

Competing Interest

All the authors declare that there are no conflicts of interest.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article (and its supplementary information files).

Authors' Contribution

All individuals, including SRT, JES, MMD, NS, SN, KAKT, and AA, who meet the criteria for authorship have been listed as authors. It is worth noting that all authors have contributed equally to this work, ensuring transparency and accountability for the content, including participation in the concept and design. Specifically, SRT, NS, SN, and KAKT analyzed and interpreted the data, while JES and MMD contributed valuable insights to the discussion during

the writing process. AA conducted the final revision of the manuscript, which SRT, JES, and MMD acknowledged. Additionally, each author certifies that this or similar material has not been submitted or published in any other publication.

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Adolescent Reproductive Health Promotion for Senior High School Students

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Abstract

Adolescence is a vulnerable period to reproductive health problems, especially regarding issues of sexuality. Healthy adolescent behavior is needed to achieve the SDGs targets by 2030. This study aimed to analyze personal factors such as attitudes, perceptions, and self-efficacy, as well as environmental factors like family, school, friends, community, and social media's role in adolescent reproductive health behavior and health promotion models. This quantitative analysis was conducted using the survey method with 326 respondents at 32 senior high schools, involving 159 male and 167 female adolescents, as samples taken through a multistage random sampling technique. This study used a questionnaire that was pre-tested for validity and reliability. Data were analyzed using path analysis. The results showed that adolescent perceptions, attitudes, self-efficacy, and the role of parents and social media positively influenced reproductive health behavior. The role of parents is the most influential variable among female adolescents. Social media directly affects male adolescents' behavior and indirectly influences female adolescents. This study recommends integrating social media campaigns with parental involvement to enhance reproductive health literacy. Moreover, health interventions should be sex-specific and consider different ways through which social media influence adolescents.

Keywords: efficacy, model, parents, social media, sexuality

Introduction

Adolescence, typically defined as the period between the ages of 10 and 19, is a transitional phase marked by significant physical, psychological, and social changes unique to each individual.[1] Adolescents experience rapid physical, emotional, cognitive, moral, social, and psychological changes that render them vulnerable to reproductive health problems.[1] During this period, there are threats such as death, diseases, and injuries; however, this period is also a critical time for laying a good health foundation.[1]

Adolescents face some threats related to their reproductive health. There are three main threats to adolescents: sexuality, HIV/AIDS, and drug abuse.[1] National data showed that in 2018, an estimated 1,220,900 adolescents in Indonesia were married before aged 18 years.[2] Early marriage is closely related to unwanted pregnancies and risk problems during pregnancy, childbirth, and the postpartum period and can contribute to maternal mortality.[3] Other data have shown that adolescents are at the greatest risk of HIV infection. Almost half of the new HIV cases worldwide are adolescents aged between 15-24 years.[4]

In Indonesia, the percentage of HIV cases among adolescents aged between 15-19 years in 2019 was 2.9% and increased significantly in 2022 was 3.8%.[5,6] Data from the National Narcotics Agency indicate a concerning rise in drug abuse among Indonesian adolescents. In 2019, the national prevalence of drug use among 15-24-year-olds was 2.3%, indicating a significant increase from previous years.[7] The growing issue of drug abuse or addictive substance use among adolescents, which can have detrimental effects on their reproductive health and overall well-being.[7]

Yogyakarta is a densely populated region in Indonesia. Population growth and limited land in urban areas cause the development of dense and slum areas and pose a high risk for sexual health problems. Adolescents living in dense areas were more likely to have a higher risk of risky sexual behavior.[8] A previous study in Yogyakarta showed that 11.6% of adolescents were engaged in high-risk sexual activities, including swiping or attaching genitals, caressing or touching

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sensitive body areas (genital, thighs, or breast), and lip-kissing, and 88.4% engaged in low-risk sexual activities, such as holding hands, hugging, and embracing, as well as brief kissing (lips-cheeks, lips-forehead, or lips-lips).[8]

Females who engage in premarital sex may face the risk of parental disapproval, loss of personal and family reputation, and social ostracism, especially if there is an unwanted pregnancy that can lead to death.[9] The factors influencing reproductive health behavior include personal and environmental factors. Personal factors include perception, knowledge, attitudes, norms, efficacy, and lifestyle, while external factors include negative influences from friends, family, and risky environments.[10] Among the personal factors shown in a previous study, perceived problem severity influences preventive behavior regarding reproductive health.[11] Attitudes have also been shown to influence adolescent health behaviors. Adolescents who have a positive attitude towards reproductive health behave positively in maintaining and improving their level of reproductive health.[12] Self-efficacy also plays a role in shaping promotive behavior.[13]

Environmental factors have been shown to influence adolescents' promotive behavior.[14] Peer relationships and sexual development are closely connected, highlighting the significant impact of various environmental factors on both the choice of social companions and the timing of sexual maturation in adolescents.[15] Consequently, it is essential to explore additional environmental variables that may influence these patterns, such as the quality of parent-child relationships, parenting practices, particularly parental attitudes toward adolescent sexuality, religious beliefs, and characteristics of neighborhoods and schools, among others.[15] The role of family, close friends at home and school, and the wider adolescent community are crucial for adolescents.[11]

Adolescents belonging to Generation Z (born after 1995) have grown up with widespread access to the internet and technology. This constant exposure to and use of internet facilities can present unique challenges to adolescent behavior. About 95% of internet users worldwide who access social media are adolescents for the things they should not access.[16] For example, 24% of adolescents admitted using the internet to interact with strangers, and 14% accessed pornographic content.[17] Social media can provide positive and negative impacts without parental supervision, like a double-edged sword. It has been empirically proven that social media influences adolescent sexual behavior.[18]

Health promotion is the most ethical, effective, efficient, and sustainable approach to achieving good health. Health promotion aims to change behavior towards healthy behavior to achieve optimal health.[19] Healthy behavior may manifest as energy to enhance health through promotional, preventive, and educational initiatives.[20] Health promotion should be adapted to the characteristics of male and female adolescents because they have different brain structures and hormones that influence their behavior.[21]

Health promotion aims to increase knowledge, strengthen attitudes, and create healthy behavior to achieve optimal health.[17] Adolescent reproductive health encompasses a state of physical, mental, and social well-being concerning the reproductive system, its functions, and processes.[21] The expected promotive behavior is that adolescents can carry out personal hygiene behaviors regarding genitals, menstrual health, and the early detection of sexually transmitted diseases. Adolescents are required to engage in preventative behaviors about risky activities and to obtain and comprehend knowledge about adolescent reproductive health as a foundation for their actions. Adolescent reproductive health literacy is characterized by individual initiatives to acquire information regarding reproductive health, serving as a foundation for behaviors enacted through both promotional and preventive measures.[21]

Despite the recognized importance of health promotion in adolescent reproductive health, there remains a significant gap in understanding the sex-based specific factors that influence adolescents' reproductive behaviors and how health promotion models can be tailored to address these differences. Many existing studies have focused on the factors influencing adolescent reproductive health without specifically examining how these factors and their impact might vary between males and females. This lack of sex-based specific understanding could lead to the development of generic health promotion programs that may not adequately address the unique needs and challenges faced by male and female adolescents.

To strengthen the theoretical foundation of this study and address this gap, the field theory and Health Belief Model (HBM) were used as a guiding framework. Lewin's field theory combines individual and social dynamics to explain the processes that drive social change.[22] The HBM suggests that individuals' beliefs about health threats, perceived benefits of taking action, and self-efficacy in performing those actions are key determinants of health behaviors.[23] By applying the field theory and HBM within a sex-based specific context, this study explored how males and females differ in their perceptions of reproductive health threats, their perceived benefits of engaging in healthy behaviors, their self-efficacy in carrying out those behaviors, and the influence of the environment. This nuanced understanding will contribute to

developing more effective, sex-based specific health-promotion interventions.

Method

This study used a quantitative, descriptive-analytical method that applies the survey method approach. Conducted in the Special Region of Yogyakarta Province between April and November 2022, this study involved 326 senior high school students (159 males and 167 females) from 32 selected schools. The sample size was determined using Hair's rule, and the total number of high school students (57,916) was obtained from the Special Region of Yogyakarta Province's Development Planning Board. A multistage random sampling technique was used to select participants in the three stages. Stage 1 involved listings of 69 public senior high schools in the district, including complete urban and rural areas. Stage 2 determined the proportion of senior high schools in each district and chose the school randomly using an online lottery system; thus, 32 senior high schools were selected. Stage 3 comprised a list of students in the selected school and six randomly selected female and male students in each school.

The dependent variable measured in this study was adolescent reproductive health behavior, and the independent variables were personal and environmental factors that influence reproductive health. Data were collected through structured interviews with a questionnaire instrument tested for validity and reliability. Construct validity was assessed using factor analysis based on Kaiser Meyer Olkin (KMO) measures, and Average Variance Extracted (AVE) was also examined with values >0.5, indicating adequate construct validity. Instrument validity was assessed using Corrected Item-Total Correlation (CITC), and values >0.5 were considered acceptable. Reliability was evaluated using Cronbach's alpha, with a threshold of >0.7 deemed acceptable. The questionnaire covered nine key topics corresponding to the study variables and categorized them into personal and environmental factors. Personal factors included adolescents' perceptions of threats to reproductive health, attitudes towards reproductive health, and self-efficacy in facing reproductive health challenges. Environmental factors included the role of parents, schools, friends, community, and social media.

The dependent variable in this study was reproductive health behavior, which included promotive, preventive, and literacy behavior, measured using the summative rating Likert scale of 5 with the following categories: never, rarely, sometimes, often, and very often. The independent variables included: 1) adolescents' perceptions of threats to adolescent reproductive health consisting of perceptions of severity and vulnerability were measured using a 5-point Likert scale with the following categories: not at all dangerous, not dangerous, somewhat dangerous, dangerous, and very dangerous; 2) adolescents' attitudes towards reproductive health were measured using a 5-point Likert scale with the following categories: strongly disagree, disagree, unsure, agree, and strongly agree; 3) adolescents' efficacy in facing the threat of reproductive health problems, which included magnitude, generalizability, and strength of belief was measured using a 5-point Likert scale with the following categories: completely not sure, not sure, doubtful, sure, and completely sure; 4) the role of parents; and 5) and the role of social media was measured using a 5-point Likert scale with the following categories: never, rarely, sometimes, often, and very often. The maximum score was 100 for each variable. Data analysis was conducted using frequency distribution to describe the characteristics of the respondents and path analysis to examine the direct and indirect effects of personal and environmental factors on adolescent reproductive health behavior.

Results

This study involved 326 students, including 159 males and 167 females studying in the 11th grade, with a mean age of 16.3 years (Table 1). Adolescent reproductive health behavior was measured using 23 questions with details of 6 questions to identify promotive behavior, 11 questions to identify preventive behavior, and 6 questions regarding reproductive health literacy behavior. Health behavior encompasses human behavior in maintaining and improving health, based on good knowledge and understanding of behavior in preventing or avoiding disease or cause of disease (preventive), and seeking to improve health (promotive) as a whole in the category often.

This study revealed that the participants' reproductive health behavior was good. However, 14.4% of adolescents were never, rarely, and sometimes engaged in promotive, preventive, and reproductive health literacy behaviors. Several behaviors need to be improved, including breakfast habits; cleaning and drying the genitals using a towel or tissue after defecating; paying attention to or observing fluid discharge from the vagina/penis; avoiding dating; avoiding access to pornography; avoiding smoking; looking for, understanding, and applying information about adolescent reproductive health; can distinguish between information about reproductive health that is true and what information is a hoax; and

discussions with parents/teachers/health workers.

Table 1. Characteristics of Respondents

Variable	Male Adolescents (n=159)		Female Adolescents (n=167)		Total (n=326)	
	F	%	f	%	f	%
Age						
Youngest/Minimum		15		15		15
Oldest/Maximum		19		18		19
Mean		16.4		16.2		16.3
Major						
Science	100	62.9	86	51.5	186	57.1
Social science	59	37.1	81	48.5	140	42.9
Participation in the Student Council						
Yes	33	20.8	40	24	73	22.4
No	126	79.2	127	76	253	77.6
Participation in Other Organizations						
Yes	83	52.2	93	55.7	176	54
No	76	47.8	74	44.3	150	46

Personal factors such as risk perception, attitudes, and self-efficacy reflect individual characteristics that influence behavior. Environmental factors encompassed external influences, such as parental, school, peer, community, and social media exposure. Table 2 presents the mean scores for each variable, offering insights into how these factors contribute to adolescents' reproductive health behaviors.

Table 2. Mean Scores for Personal and Environmental Factors

Variable	Male Adolescents		Female Adolescents	
	Mean	Category	Mean	Category
Perception	80.96	Very dangerous	85.35	Very dangerous
Attitude	76.57	Agree	79.2	Agree
Self-efficacy	76.49	Sure	80.47	Completely sure
Role of parents	61.42	Often	66.07	Often
Role of schools	62.50	Often	64.59	Often
Role of friends	52.13	Sometimes	61.8	Often
Role of community	42.69	Sometimes	47.86	Sometimes
Role of social media	54.09	Sometimes	61.95	Often

Based on the item questionnaire analysis, it was found that females had higher average scores than male adolescents in some questions. The differences regarding the following questions (1) pay attention to or observe the discharge from the vagina/penis; 2) avoid kissing your friend/girlfriend; 3) protect yourself by avoiding sexual relations; 4) avoid access to pornography; 5) avoid smoking; 6) avoid using steam; 7) understand all information obtained about reproductive health; 8) discussion with your parents/teachers/health workers if there is lack of information about reproductive health.

Path analysis examined various factors' direct and indirect effects on adolescent reproductive health behavior. The initial analysis indicated that school, friends, and community roles did not significantly influence the dependent variable. Therefore, these three variables were excluded from the final path analysis model to ensure model fit and parsimony. The resulting model, depicted in Figure 1, focuses on the key personal and environmental factors contributing to adolescent reproductive health behavior. The results of the path analysis of male and female adolescents' reproductive health behaviors are presented in Table 3.

The model of reproductive health behavior was derived from path analysis involving male and female adolescents. The variables mutually influencing reproductive health behavior were the perception of self-vulnerability, attitude, efficacy, and the role of parents and social media. Five variables influenced reproductive health behavior in male adolescents, sorted based on the path coefficient's magnitude: self-efficacy, attitude, role of parents and social media, and perception. For female adolescents, four variables influenced reproductive health behavior, sorted based on the path coefficient's magnitude, including the role of parents, attitude, efficacy, and perception.

Table 3. Reference Value and Obtained Value of Fit Models

Indicator	Reference Value	Scores	
		Males	Females
RMSEA	Close to 0	0.000	0.000
GFI	Close to 1	1.000	1.000
AGFI	Close to 1	1.000	0.998
TLI	≥0.9	1.030	1.038
NFI	≥0.9	1.000	1.000
CMI/DF	<2	0.003	0.041
X^2-Chi-Square	Small	0.003	0.041
Probability	>0.05	0.956	0.840
Normality	-2.58 < cr < 2.58	1.618	2.150

Notes: RMSEA = Rootmean Square Error of Approximation; GFI = Goodfit of Fit Index; AGFI =Adjusted Goodness of Fit Index; TLI = Tucker Lewis Index; NFI = Normed Fix Index; CMIN/DF = Chi-square minimum divided by degrees of freedom.

The difference in the models formed between males and females was the influence of the role of social media. In males, the model shown in Figure 1 shows that the role of social media directly influences behavior. In contrast, the role of social media indirectly influences behavior, but it influences it through self-efficacy in shaping behavior for female adolescents. These models served as a base for developing health promotion to improve adolescent behavior, especially in promotive, preventive, and reproductive health literacy determinations.

Figure 1 shows that these variables structurally influence each other on the reproductive health behavior of both male and female adolescents. The magnitude of the influence can be seen in the value of the path coefficient (p) or Standardized Regression Weights (in AMOS), whose magnitude ranges between 0–1 (a value closer to 0 or zero), indicating that the influence is weaker. In contrast, a value close to 1 (one) is stronger. Path analysis showed the influence of variables, such as-perception, attitude, self-efficacy, the role of parents, and social media, as presented in Table 4.

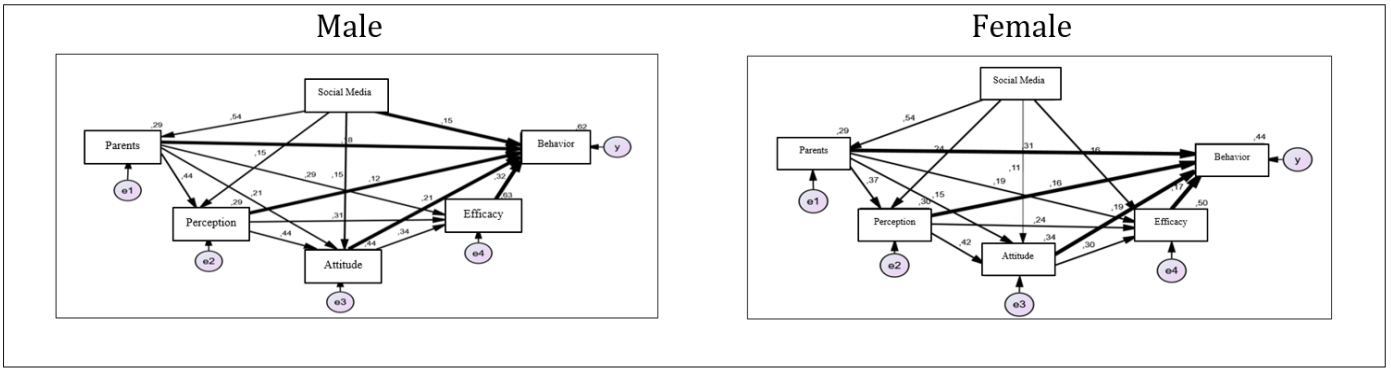

Figure 1. Reproductive Health Behavior Model for Male and Female Adolescents

The model of reproductive health behavior was derived from path analysis between male and female adolescents. Variables mutually influencing reproductive health behavior were the perception of self-vulnerability, attitudes, efficacy, parents' role, and social media's role. Five variables influenced reproductive health behavior in male adolescents, arranged in an orderly manner based on the magnitude of the path coefficient, were self-efficacy (0.318), attitudes (0.209), the role of parents (0.179), the role of social media (0.148), and perception (0.118). In contrast, four variables that influenced reproductive health behavior in female adolescents, ranked by the magnitude of the path coefficient, were the role of parents (0.314), attitudes (0.182), efficacy (0.172), and perception (0.155).

Table 4 shows that the personal factor that has an indirect influence is the perception variable. Apart from directly influencing behavior, it also indirectly influenced attitudes, followed by efficacy and behavior. Environmental factors indicated that the role of parents directly affected the reproductive health behavior of male adolescents, with an influence value of 0.179, and female adolescents, with an influence of 0.314. Apart from having a direct influence, parents' role also had an indirect influence through perceptions, attitudes, and self-efficacy. The influence of social media as an environmental factor differed between male and female adolescents. In male adolescents, social media directly influenced behavior, with a large influence of 0.148, and it also influenced the role of parents, perceptions, attitudes, and efficacy of adolescents. In female adolescents, social media did not have a direct influence on behavior but rather indirectly through parents (0.542), perception (0.245), and efficacy (0.160).

Table 4. Influence of Variables in the Path Analysis Model of Reproductive Health Behavior in Male and Female Adolescents

Influencing Variables	Male			Female		
	Influenced Variables	The Power of Influence	Probability (P)	Influenced Variables	The Power of Influence	Probability (P)
Perception	Behavior	Behavior	0.090*	Behavior	0.155	0.045***
	Efficacy	Efficacy	***	Efficacy	0.243	***
	Attitude	Attitude	***	Attitude	0.419	***
Attitude	Behavior	Behavior	0.003***	Behavior	0.185	0.014***
	Efficacy	Efficacy	***	Efficacy	0.304	***
Self-efficacy	Behavior	Behavior	***	Behavior	0.172	0.033***
Role of parents	Behavior	Behavior	0.009***	Behavior	0.314	***
	Efficacy	Efficacy	***	Efficacy	0.185	0.006***
	Attitude	Attitude	0.006***	Attitude	0.153	0.057*
	Perception	Perception	***	Perception	0.371	***
Role of social media	Behavior	Efficacy	0.013***	Efficacy	0.160	0.019***
	Attitude	Attitude	0.032***	Attitude	0.111	0,152ns
	Perception	Perception	0.058*	Perception	0.245	0.002***
	Parents	Parents	***	Parents	0.542	***

Notes: ***= p-value <0.05; *= p-value = 0.05-0.1; ns: no significant, p-value >0.1

Discussion

This study revealed that perceptions shown to influence efficacy in both male and female adolescents. Perception had the strongest influence on attitude. It is a very important cognitive aspect in humans that allows them to know and understand the world around them.[24] Meanwhile, perceived severity/seriousness is a person's assessment of an illness or health problem, which also determines behavior.[22] A previous study also stated that perceived severity influences preventive behavior regarding reproductive health.[11] The results confirmed a previous study that cognitive aspects influence adolescent literacy behavior in efforts to prevent unwanted pregnancies.[25]

The cognitive aspect of behavior influences adolescent behavior in efforts to increase reproductive health levels or promote behavior.[9] Adolescents with supportive and warm parents are more likely to express conflict and seek guidance and assistance openly.[26] A strong parent-child relationship fosters a sense of belonging, enabling adolescents to internalize social, cultural, and behavioral norms by adapting to accepted patterns. When parents understand and appropriately address their adolescents' needs, they can serve as positive role models. By helping children internalize societal rules and norms, parents can play a crucial role in steering them away from engaging in risky behaviors.[26]

This study also highlighted that social media significantly influenced adolescent reproductive health behavior, with notable differences in its impact on male and female adolescents. For males, social media directly affected behavior; for females, it influenced behavior indirectly through self-efficacy. Enhancing sex-based sensitive strategic communication is essential to optimize social media's role in health interventions and promotion.[27] This involves conducting a thorough context analysis, formulating clear objectives, identifying target audiences, and integrating sex-based considerations into the design of messages and the selection of communication channels.[27]

Adolescent social interactions occur predominantly through digital media. Theoretical frameworks that acknowledge sex differences in interpersonal functioning offer insights into why the impact of digital media on well-being differs between male and female adolescents.[28] Female adolescents are more likely to engage in close, one-on-one friendships, whereas male adolescents are often socialized in groups. Female adolescents prioritize social relationships and popularity during adolescence, and their friendships are generally more intimate. Consequently, female adolescents' moods are more strongly affected by interpersonal events than male adolescents. Overall, social integration appears to be more critical for female adolescents' mental health because of cultural and evolutionary factors. This is based on the psychological impacts of heavy use, such as social comparisons and body image concerns. Interventions targeting female adolescents can promote body positivity campaigns and use influencers to model healthy behaviors and self-acceptance.[29] However, male adolescents could incorporate health messages into gaming platforms or apps or use gamification techniques to make health education more engaging.[28]

This study showed that attitudes influenced efficacy and behavior among male and female adolescents. A previous study indicated that adolescents with a favorable attitude toward reproductive health would likely engage in behaviors that enhance and sustain their reproductive health.[10] This study proved that attitudes influenced reproductive health behavior, especially preventing risky sexual behavior.[10] Confirming the results of previous research, which stated that attitudes are one of the personal factors that influence premarital sexual behavior in school adolescents.[26] A study in

Indonesia has also stated that attitudes influence behavior in improving adolescent health status or promotive behavior.[13] Previous study showed that male adolescents with an agreeable attitude were found to have a higher likelihood of engaging in risky sexual behaviors associated with STIs.[30]

Self-efficacy influenced the reproductive health behavior of male adolescents, with an influence of 0.318. Self-efficacy also influenced adolescent female adolescents' behavior, with an influence value of 0.172. The influence of efficacy on behavior was stronger in male than female adolescents. In this study, self-efficacy was the variable with the strongest direct influence on reproductive health behavior compared to other variables in male adolescents. Self-efficacy is defined as self-confidence, which is the ability to organize and carry out a series of actions necessary to achieve desires and success.[31] Self-efficacy is the self-confidence to perform adequately, achieve goals, and overcome obstacles. Self-efficacy empowers individuals to have confidence in their abilities and to handle challenging or stressful situations effectively.[31] Adolescents who have high self-efficacy can prevent promiscuous sexual behavior.[11]

The impact of parental roles was the most significant factor affecting female adolescents compared to other variables. It also proved to influence self-efficacy and perceptions among male and female adolescents. The role of parents is important in shaping children's behaviors.[32] Parents can foster norms, perceptions, attitudes, and behaviors in adolescents.[11] This study's results aligned with a previous study stating that communication between parents and adolescents influences preventive behavior in reproductive health.[11] Female adolescents carried out more communication about sexuality with their mothers.[33] Adolescents who communicate well with their parents have less access to pornography.[34] Another study also explains that the involvement of parents, combined with collaboration between teachers and adolescents, plays a crucial role in reducing risky sexual behaviors and preventing sexually transmitted infections.[35]

Several analyses related to the role of social media and self-efficacy have been conducted using theoretical exploration. First, physiological factors pertain to examining physical differences, such as differences in the function and structure of the brains of men and women. There are three things related to this physiological factor. First, the structural function of the male brain is more connected with several areas of the brain for carrying out physical actions; for females, it is closely related to various cognitive and emotional functions.[36] The structure of the male brain, the prefrontal cortex, grows slower in adolescent boys than in female adolescents.[36] This condition frequently prompts men the same age as women to act impulsively and recklessly, neglecting to assess the consequences or effects thoughtfully.[36] Men's brains have more activity in the visual processing area than women's, which occurs in processing feelings, attention, and memory. Thus, males are more interested in influencers or social media that offer more visual processes than females.[36]

Second, psychological factors examine the differences in the psychological roles of men and women in responding to certain things. Psychologically, men often emphasize the existence of strong power and agency. At the same time, women, apart from considering themselves, also consider other people's opinions or desires to be greater than their own opinions or desires. Therefore, this influences men's and women's behavior, especially in responding to various things, including social media.[37]

Third, the influence of a culture formed in society and sexual double standards among males and females. This study showed that males responded directly to social media behavior; in contrast, females processed it through efficacy, which could also be caused by the culture that develops in society. Some cultures in society cause men to respond more spontaneously to things and not think or feel the impact as different from that of women.[38] In society, males are often expected to be sexually active and dominant and take the lead in initiating (hetero)sexual activities. In contrast, females are typically viewed as sexually reactive, submissive, and passive. Traditionally, men have also been afforded greater sexual freedom than women have. This double standard leads to unequal treatment when men and women exhibit similar sexual behaviors.[38] For instance, approximately 50% of women experience slut-shaming compared with only 20% of men.[38] These traditional societal expectations regarding sexual behavior contribute to sex differences in risky sexual behaviors, such as men having more sexual partners and women being less likely to request or insist on condom use.[38] In other cases, women receive more negative labels if they leave the house at night than men.[39] The double standards men and women develop in society also influence their behavior. There were differences in behaviors and factors related to adolescent reproductive health between male and female adolescents; thus, health promotion must be developed.

The strengths of this study included its comprehensive analysis of personal and environmental factors, which provided a holistic understanding of adolescent reproductive health behavior. Additionally, the large sample size of 326 respondents from 32 senior high schools enhanced the robustness of the findings. Using pre-tested questionnaires with validated and reliable instruments further strengthens the study's credibility. Another notable strength was the sex-

specific insights that differentiate male and female adolescents, enabling targeted recommendations for health promotion. However, the study was limited by its geographic scope, as it was conducted only in the Special Region of Yogyakarta Province, which restricts the generalizability of its findings to other regions or countries. A potential bias may arise from adolescents underreporting or exaggerating their behaviors owing to social desirability or fear of judgment. Strategies, such as ensuring confidentiality, were implemented to reduce response bias and encourage honest reporting.

Conclusion

This study analyzes reproductive health behavior among male and female adolescents, offering recommendations for health promotion. While most high school students in Yogyakarta demonstrate good reproductive health behavior, some of them still need improvement in promotive and preventive behaviors and health literacy. Personal factors, including perceptions, attitudes, and self-efficacy, influence adolescent behavior, while environmental factors, such as parental roles and social media, play a crucial role. Sex differences reveal that parental involvement is more significant for females, whereas self-efficacy shapes male adolescents' behavior, with social media having both direct and indirect effects. This study emphasizes the need for sex-based specific interventions, integrating social media campaigns with parental involvement and fostering collaboration between parents, schools, and social media platforms to enhance reproductive health education.

Abbreviations

HBM: Health Belief Model.

Ethics Approval and Consent to Participate

This study was approved by the Poltekkes Kemenkes Yogyakarta Ethics Commission (e-KEPK/POLKESYO/0530/VI/2022). Informed consent was obtained from the students and teachers involved in this study.

Competing Interest

The authors declare that no significant competing financial, professional, or personal interests might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Authors' Contribution

NM, SSH, and FTH contributed to the design and implementation of the research. NM did the data analysis; SSH and FTH supervised. NM, SSH, and FTH were involved in manuscript preparation, content, and administration. All the authors discussed the results and contributed to the final manuscript.

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Prevalence of Low Back Pain Among Office Workers During the COVID-19 Pandemic in Various Countries: A Systematic Review

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Abstract

The COVID-19 pandemic has led to the implementation of work from home policies in almost all parts of the world. This policy has increased the onset of musculoskeletal disorders in workers, such as low back pain (LBP). This study aimed to examine the prevalence of LBP among office workers during the COVID-19 pandemic after implementing WFH policies. This study was performed using data from various countries to determine the relationship between LBP and several risk factors, specifically age, sex, physical activity, ergonomic factors, as well as work environment factors such as temperature, humidity, lighting, noise, and work duration. A systematic review was conducted using sub-population studies published from 2020 to 2022. The data was obtained from six electronic databases: ProQuest, ScienceDirect, Embase, Scopus, Ebsco Medline, and Cambridge Core. The prevalence of LBP in office workers was associated with age, ergonomics, and environmental factors: air temperature, humidity, and lighting. There was no specific relationship between sex, physical activity, and working duration when working from home during the COVID-19 pandemic.

Keywords: COVID-19, environment, low back pain, office workers, work from home

Introduction

Low back pain (LBP) refers to pain in the lower back, which is very common in almost everyone at some time.[1] This pain is usually accompanied by hip pain. If the pain persists for 12 weeks or longer, the condition can be classified as chronic and requires immediate treatment.[1] Based on the report from the Global Burden of Diseases (GBD), LBP ranks first as the leading cause of disability in 14 countries and is responsible for around 60.1 million years lived with disability (YLD) in 2015, an increase of 54% since 1990.[2]

During the COVID-19 pandemic, approximately 81% of workers worldwide have to work from home (WFH). However, the working environment at home tends to be inadequate in various aspects, such as the unavailability of ergonomic work equipment.[3] Several studies have associated the incidence of LBP in office workers (desk workers) and the intensity of WFH during the COVID-19 pandemic. A study conducted in Japan showed that the intensity of WFH increased by 31.3% during the COVID-19 pandemic. The incidence of LBP caused by prolonged sitting with poor posture and other environmental factors increased the risk of LBP by 4.1%.[4] However, no similar study has been performed to analyze this issue in Indonesia.

LBP is one of the most common musculoskeletal problems in the world.[5] Generally, the condition is defined as pain localized between the lower edge of the ribs and the buttock.[6] Meanwhile, according to the study by GBD in 2019, LBP is defined as pain on the posterior aspect of the body, extending from the lower margin of the twelfth ribs to the lower gluteal folds, with or without pain in one or both lower limbs, and may last for at least one day.[7]

LBP is classified into three categories based on several clinical characteristics and the duration of symptoms, i.e., acute, sub-acute, and chronic.[8] LBP that lasts less than 4 weeks is considered acute, whereas LBP that persists over a period of 4 to 12 weeks is considered subacute. In comparison, chronic LBP means the condition has persisted for over

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12 weeks.[9] Acute LBP is usually nonspecific, and patients with this condition generally do not seek treatment as they assume that the pain will eventually wear off without medical intervention.[9] On the contrary, chronic LBP has a clear pathological cause to be classified as a disease, not merely a symptom of other illnesses.[10]

Since the condition can be caused by the degeneration of the lumbar spine, LBP is often associated with increasing age. As a result of LBP due to aging, some limitations in social and physical functions, as well as further damage to the musculoskeletal system and more severe pain, may be present.[11] Nowadays, the global prevalence of LBP in adults is approximately 37%, with the highest incidence rates being in older adults and more common for females than males.[2]

Regardless of age, females are more prone to suffer from chronic LBP than males.[12] This notion is based on a previous systematic review study including 40 publications from 28 countries in Africa, Asia, the Middle East, and South America (n = 80,076), stating that LBP was 2.5 times more common in the working population than in the non-working population.[2] Additionally, since females are prone to chronic comorbidities, such as osteoporosis, osteopenia, osteoarthritis, and psychological stress, the risk of having chronic LBP increases.[12] On top of that, female hormones play a vital role in the etiology and pathophysiology of various degenerative musculoskeletal diseases. The incidence rate of LBP, especially in postmenopausal women, has been determined to be higher due to estrogen deficiency, a circumstance that may accelerate the degeneration of the intervertebral discs.[13]

The frequency and intensity of physical activity are risk factors for LBP. Moderate to vigorous physical activity has been known to increase the risk of LBP in various age groups. A population-based study has shown that moderate-intensity physical activity of at least 30 minutes for five days per week or more, for three days per week or more, is significantly associated with an increased risk of LBP.[12] On the contrary, low-intensity physical activity, such as a 30-minute walk five days per week or more and strength training two days per week or more, is associated with a reduced risk of LBP, adjusted for age and body mass index (BMI).[12]

The other modifiable risk factors for LBP are sitting position and the availability of ergonomic chairs at work. A previous study has revealed that desk workers are at risk of experiencing LBP, especially those who sit for more than 2 hours while using a computer without paying attention to the proper sitting posture.[14] Among 44 back-office workers, it was found that among 40 people (90.9% of the sample size) who needed to improve their sitting posture, 20 (45.5%) complained of LBP with moderate pain.[14]

Poor or too bright lighting at work may cause various problems such as eye strain and fatigue, headaches, stress, and even workplace accidents.[15] In the workplace, glare can come from direct light sources such as lamps and computer screens or light reflecting off equipment with shiny surfaces.[15] In the long run, the situation can become a dominant stressor and cause not only eye strain and fatigue but also discomfort in most parts of the body, including the spine.[16] Such discomfort can negatively affect an individual as the body posture continuously tries to adapt to the conditions of the surrounding environment. This, in turn, causes more flexion of the neck and back, increasing the risk of LBP.[16]

Temperature is a degree of hotness or coldness measured in the Fahrenheit or Celsius scale.[17] Meanwhile, humidity is the amount of water vapor in the air. Indoor humidity is measured in terms of relative humidity, which is the humidity of the air compared to the maximum humidity at a certain temperature.[18] A previous study has suggested the relationship between ambient temperature and humidity and the sensitivity and intensity of back pain.[19]

Temperature change can affect the central nervous system, in which the body is forced to adapt to the surrounding environment.[20] As a result of this adaptation, changes in the blood supply from the cardiovascular system to working muscles may occur. Therefore, it is postulated that an uncomfortable ambient temperature can adversely affect the normal state of the lower back muscles through a combination of the nervous and cardiovascular systems.[20] This condition is also associated with bad mood, headaches, and discomfort, which may affect worker performance due to decreased motivation and increased fatigue and stress.[21] Accordingly, temperatures between 22°C and 24°C have been proven to be best for workplaces and have been associated with higher performance for certain jobs.[21]

The International Labor Organization (ILO) has defined working duration as the time people are hired by the employer to do their jobs, excluding their resting periods during which they do not work.[22] Unless otherwise agreed, this period may not exceed 48 hours a week or more than 8 hours a day. Nevertheless, even though the maximum daily work hours can be set and changed as needed, it should not exceed 10 hours.[22] The relationship between working duration and the incidence of LBP in workers is influenced by sedentary work patterns, where workers are required to sit for more than 7 hours per day.[3] Apart from working duration, LBP in workers also occurs due to multiple risk factors, such as

anthropometric factors, ergonomic factors, age, sex, BMI, sitting posture, the distance between the body and the computer, the availability of adjustable back support on the chair, and psychosocial factors.[3]

The ILO, through its Convention No. 177, has defined work from home (WFH) as the work done by people in their homes or other premises of their choice, other than the workplace provided by their employer for remuneration that produces a product or service as specified by the employer, regardless of the party responsible for providing the equipment, materials, or other inputs used in the process.[23] However, this definition does not apply to (i) work done by people with a degree of autonomy or economic independence to be considered self-employed, (ii) work done by people who occasionally perform their work at home instead of their usual workplace, and (iii) unpaid work, such as household chores.[23] Therefore, this study aimed to investigate the prevalence of LBP in office workers during the COVID-19 pandemic after implementing WFH policies in various countries. Specifically, the purpose was to explore the relationship between LBP and several risk factors, such as age, sex, and physical activity, as well as both ergonomic and environmental factors.

Method

This study applied a qualitative approach with a systematic review method to collect the relevant data. The articles to be reviewed were selected according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, which consists of three main stages: identification, screening, and inclusion. Data were collected from six databases: ProQuest, ScienceDirect, Embase, Scopus, Ebsco Medline, and Cambridge Core. These databases were explicitly selected so that the acquired articles and journals could be obtained legally without any charge using Universitas Indonesia access. The keywords used are "Low Back Pain," "Work From Home", "COVID-19", "Environment," and "Cross Sectional." The selection of keywords used in literature searches employed both Boolean and Nesting operators for better accuracy. Boolean operator includes the use of "AND" and "OR," while Nesting is the use of the (+) or (-) sign for each word fragment.

The inclusion criteria were: a) studies containing variables such as desk workers/office workers, WFH, ergonomics, environmental factors, age, sex, physical activity, COVID-19, and the outcome variable of LBP incidence; b) original research articles (not reviews); c) studies employing a cross-sectional or case-control design; d) publications between March 2020 and March 2022; and e) literature written in English and published in Q1, Q2, or Q3 journals. In contrast, the exclusion criteria were: a) the article is not a complete text or full text, or b) the research is a review or gray literature. This study was conducted from April to June 2022 on relevant studies published from March 2020 to March 2022.

Table 1: Keywords Used in Literature Searches in Electronic Database

Variable 1 *Low Back Pain*	*Low back pain* OR *Back Ache*
Variable 1 *Work From Home*	*Work From Home* OR WFH
Variable 1 COVID-19	COVID-19 OR *Coronavirus Disease 2019* OR *2019-NcoV* OR *2019 Novel Coronavirus*
Istilah 4 *Environment*	*Environment factor*
Variable 1 *Cross-Sectional*	

Results

Following the literature search, 836 articles were collected from ScienceDirect, 2,296 from ProQuest, 6 from Scopus, 2 from Ebsco Medline, 10 from Embase, and 5,224 from Cambridge Core. In total, 8,374 articles were obtained using keyword searches from the six databases. These articles were then inputted into the reference manager application (Mendeley Web Importer) and separated using different folders according to the databases for further assessment.

The screening and elimination of duplicate articles resulted in 8,218 articles being rescreened based on the abstract's relevance to this study's topic. From this process, 8,178 articles were excluded as they were found irrelevant to the research topic. The remaining 40 articles obtained from the abstract screening stage were later selected according to the predetermined inclusion and exclusion criteria.

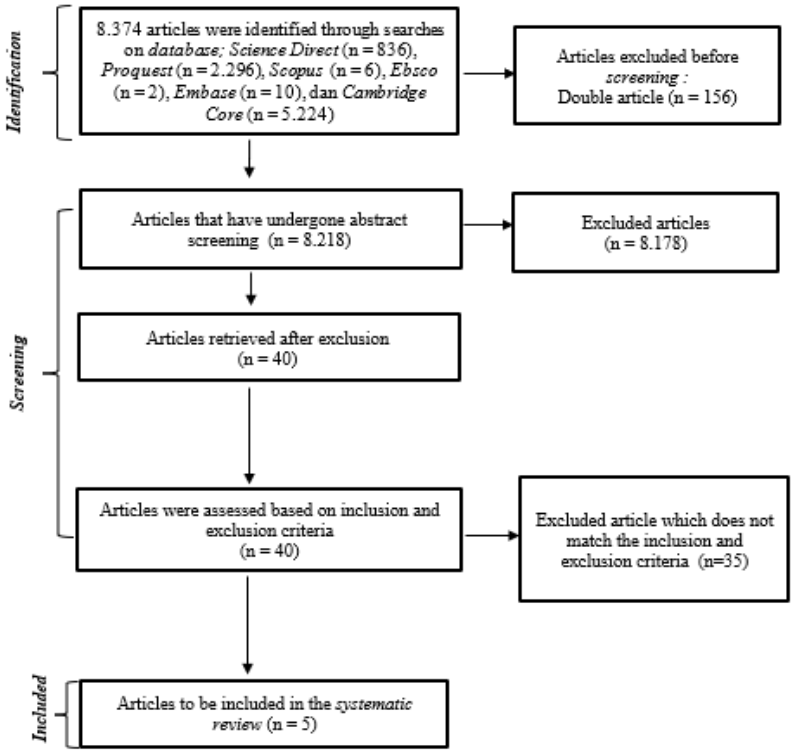

Figure 1: Flow of the Literature Identification Process in Systematic Review with PRISMA Guide

Of all the articles obtained, five articles were included to be reviewed in this study. One was published in 2020 (20%), three were published in 2021 (60%), and one was published in 2022 (20%). One study was carried out in Ohio, the United States (20%), one study was done in Slovakia (20%), one study was conducted in Italy (20%), and two studies were done in Japan (40%); all of them employed a cross-sectional study design (100%), with different research backgrounds and data collection methods. The sample size used varies for each study, ranging from 51 to 12,774.

The characteristics of the respondents differ from one study to another. This can be seen in the variables associated with the incidence of LBP: age, sex, physical activity, the application of ergonomics, environmental factors, and working duration. These distinct variables affected the prevalence of LBP in desk workers during the COVID-19 pandemic following the implementation of WFH policies. Based on the selected articles, the prevalence of LBP in workers due to the implementation of WFH policies during the COVID-19 pandemic also varied widely. Specifically, the prevalence of LBP was 42.82%, 67.68%, 41.2%, 4.1%, and 21%, respectively. Table 2 presents the characteristics of the respondents in each research article reviewed in this study.

Table 2. Characteristics of Respondents

Authors	Prevalence of LBP	Sample Size	Age	Sex	Physical Activity	Application of Ergonomics	Environmental Factors	Working Duration
Gerding *et al.*[16]	n = 361 (42.82%)	834	<30 years (n = 36) 31-40 years (n = 201) 41-50 years (n = 219) 51-60 years (n = 212) 61-70 years (n = 128) 71 years (n = 24)	Male (n= 289) Female (n= 509)	Walking only 1-4 times a day >5 minutes (n = 570)	Always or frequently using a suitable work chair n = 347 (44.6%) Not using a suitable work chair n = 348 (44.7%)	Inadequate lighting (glare) (n = 426)	Working >1 hour without rest (n = 603)
Prieto-González *et al.*[24]	67.68%	782	18–65 years	Female (n = 782)	0 day/week (n = 108) 1-2 days/week (n = 255) 3-4 days/week (n = 263)	Complying with ergonomic recommendations (n = 376) Not complying with ergonomic	N/A	1-9.9 hours/week (n = 194) 10-19.9 hours/week (n = 401)

Authors	Prevalence of LBP	Sample Size	Age	Sex	Physical Activity	Application of Ergonomics	Environmental Factors	Working Duration
					5-6 days/week (n = 87) 7 days/week (n = 69)	recommendations (n = 99)		20-29.9 hours/week (n = 165) 30-39.9 hours/week (n = 20) >40 hours/week (n = 2)
Moretti *et al.*[3]	n = 21 (41.2%)	51	Mean 46.67±11.26	Male (n = 22) Female (n = 29)	N/A	N/A	N/A	<36 hours/week (n = 26 (51%)) 36 hours/week (n = 25 (49%))
Minoura *et al.*[4]	4.1%	4,227	18-29 years (n = 742) 30-44 years (n = 1,681) 45-59 years (n = 1,804)	Male (n = 2,559) Female (n = 1,668)	Doing physical activity outside (n = 1,735) Not doing any physical activity outside (n = 2,492)	N/A	Overall quality of work environment (unspecified).	<35 hours/week (n = 979) 35-39 hours/week (n = 633) 40-44 hours/week (n = 1,431) >45 hours/week (n = 1,184)
Matsugaki *et al.*[25]	n = 2,686 (21%)	Total sample (n = 12,774) *1 seldom work remotely (n = 9,082) *2 work remotely 1 day/week (n = 873) *3 work remotely 2-3 days/week (n = 953) *4 working remotely 4 days/week (n = 2,886)	*1 mean = 47.2 *2 mean = 47.8 *3 mean = 47.9 *4 mean = 48.9	Male; *1 (n = 4,363) *2 (n = 569) *3 (n = 539) *4 (n = 1,077)	Physical activity (2 days/week) *1 (n = 2,415) *2 (n = 352) *3 (n = 406) *4 (n = 637)	N/A	Quality of work environment; *1 good (n = 5,505) not good (n = 3,577) *2 good (n = 670) not good (n = 203) *3 good (n = 722) not good (n = 231) *4 good (n = 1,577) not good (n = 289) Room temperature and humidity	N/A

Discussion

After a thorough assessment of the selected articles, it was found that three out of five articles (60%) stated that age affected the incidence of LBP after the implementation of WFH policies during the COVID-19 pandemic.[3,4,24] Meanwhile, the remaining two articles (40%) did not find a significant impact of age on the incidence of LBP.[16,25] The ILO has explained the relationship between age and the increment of LBP incidence concerning the changes in work patterns over the last decade.[26] As a consequence of technological advances, work demands have substantially increased alongside both pressures and longer working hours. This causes psychosocial and work-related stresses that are consistently associated with various health problems, including musculoskeletal disorders, one of which is LBP.[26]

Two out of five articles (40%) found an influence of sex on the incidence of LBP after the implementation of WFH policies during the COVID-19 pandemic.[3,4] On the other hand, the other three articles (60%) did not indicate a significant effect of sex on the incidence of LBP.[16,24,25] Another study also supports the findings that LBP occurs more frequently in females than males, about 2.5 times more common in the working population.[2] This can be attributed to the more complex psychosocial mechanisms in women, including their pain-coping skills and susceptibility to chemically- or mechanically-

induced pain.[12] In addition, female hormones play a crucial role in the incidence of LBP, as estrogen deficiency has been shown to accelerate the process of intervertebral disc degeneration.[13]

Of the five articles, only one (20%) stated that physical activity has an effect on the incidence of LBP after the implementation of WFH policies during the COVID-19 pandemic,[24] while the remaining four articles (80%) found no significant effect on the topic.[3,4,16,25] Gerding *et al.*'s study did not specifically state the correlation between physical activity and the incidence of LBP but showed a relationship between physical activity and a decrease in static posture and muscle activation in several parts of the body, such as the neck/head, upper back, shoulders, neck, and lower back.[16] Meanwhile, Moretti *et al.*'s study similarly did not discuss the direct relationship between the incidence of LBP and physical activity but linked the pain to a sedentary job pattern.[3] This association is made because some patterns can become a risk factor for LBP, especially when it involves a low activation of the lumbar muscles. When sitting, passive structures such as ligaments and intervertebral discs support the body's weight.[3] Such viscoelasticity of the structures and the deactivation of the lumbar and spinal muscles can, in the long term, trigger deconditioning that causes LBP.[3]

The correlation between the application of ergonomics and the prevalence of LBP was found in most of the articles reviewed in this study. Four out of five articles (80%) revealed the effect of the application of ergonomics on the incidence of LBP after the implementation of WFH policies during the COVID-19 pandemic.[3,16,24,25] In comparison, only one article (20%) did not indicate a significant effect of the use of ergonomics on the incidence of LBP.[4] The relationship between ergonomic factors and the incidence of LBP is in line with the statement of the ILO that environmental and ergonomic factors are associated with an increased risk of musculoskeletal disorders.[27] These ergonomic factors include the availability of a computer desk with an ergonomic chair as well as the computer monitor, keyboard, and mouse adjustable to the needs of workers. Concerning the increase in the prevalence of LBP after the implementation of WFH policies during the pandemic, there were differences in the standards of the office and home environments. For example, inadequate ergonomic equipment and improper work settings can pose health and safety risks due to the adoption of poor posture, which may cause musculoskeletal injuries such as neck pain and LBP.[27]

Three out of five articles (60%) proved that environmental factors affected the incidence of LBP after implementing WFH policies during the COVID-19 pandemic.[4,16,25] Meanwhile, the other two articles (40%) did not find a significant influence of environmental factors on the incidence of LBP.[3,24] The environmental factors associated with the incidence of LBP include lighting, temperature, and humidity. Staying in a room with too bright lighting over an extended period can cause discomfort, eye strain, and fatigue.[15] Based on Occupational Safety and Health (OSH) recommendations, for jobs that require low perception and rough details, such as office work, the optimal lighting in the workplace is a minimum of 100 lux to 200 lux. As for those requiring precision and fine details, such as drawing and assembling certain components, the optimal lighting is around 200 to 500 lux.[15] Glare and the light emitted from computer screens may lead to eye strain and fatigue, affecting sitting posture and eventually causing LBP. To avoid this, the computer monitor needs to be placed in an ideal position, about 10-13 cm below eye level, when sitting upright and about one arm away from the eyes (50-71 cm).[28]

According to the ILO, an unfavorable environment at home due to uncomfortable temperature, humidity, and lighting can increase the risk of musculoskeletal injuries during the WFH period.[27] Such a condition has been known to affect worker performance and productivity. Another study also found that environmental variables are significantly related to the life satisfaction of workers.[21] The magnitude of the effect of air quality on productivity loss varies depending on the type of work.[29] However, in general, the greatest losses occur in jobs that require analytical thinking.[29] The recommended temperature for good indoor air quality is 18°C-30°C, with humidity of 40-60% Rh and a minimum lighting of 60 lux.[29] The ambient air temperature exceeding 30°C must be reduced by increasing air circulation through ventilation.[29] Conversely, if the room temperature is less than 18°C, heaters that use safe and environmentally friendly energy sources are necessary.[29] Meanwhile, ambient humidity can be optimized by using humidifiers, opening windows, increasing the number or area of windows, and increasing air circulation.[29] In Indonesia, the temperature and humidity in the house can be adjusted according to the Indonesian Ministry of Health Regulation Number 1077/MENKES/PER/V/2011 Concerning the Guidelines for Indoor Air Sanitization.[29]

After reviewing the five articles, it was found that two articles (40%) agreed that working duration could influence the incidence of LBP for workers who work at home during the pandemic.[3,24] Meanwhile, the remaining three articles (60%) showed no significant effect of working duration on the incidence of LBP.[4,16,25] Moretti *et al.* stated that there is a correlation between LBP and sedentary work patterns, particularly those that require workers to sit for more than 7 hours per day. This association was also postulated to be directly related to the multiple risk factors for LBP, such as anthropometric factors, ergonomic factors, age, sex, BMI, sitting posture, the distance of the body from the computer, the

availability of adjustable back support on the chair, and psychosocial factors.[3]

This study employed a systematic review method to identify the prevalence of LBP in office workers during the COVID-19 pandemic after implementing WFH policies in various countries. Risk factors were examined, including age, sex, and physical activity. However, this study only used five research articles due to the limited relevant literature. It restricted full-text access to several research articles, making some relevant literature inaccessible.

Conclusion

The prevalence of LBP in office workers is associated with age, ergonomics, and environmental factors of air temperature, humidity, and lighting. There is no specific relationship between the prevalence of LBP in office workers who worked from home during the COVID-19 pandemic and their sex, physical activity, and working duration. Workers are advised to pay attention to the surrounding work environment when working from home. To avoid direct reflection of light, it is highly recommended to install blinds or curtains, use a lampshade or lamp protector, replace clear glass with frosted glass for windows, and rearrange the layout of the work desk if needed. The use of an ergonomic chair and desk to place the computer and other work equipment, such as mouse and keyboards, that can be adjusted to the needs of each worker is also necessary. For workers to maintain proper sitting posture when working, the computer monitor must be placed in an ideal position, which is about 10-13 cm below eye level when sitting upright and about one arm away from the eyes (50-71 cm). Furthermore, policymakers and employers need to educate workers about creating a proper work environment suitable for working from home, supply the necessary equipment for adequate use, and facilitate workers' optimal physical and mental health.

Abbreviations

LBP: low back pain; GBD: Global Burden of Diseases; WFH: work from home; BMI: body mass index; ILO: International Labor Organization; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Ethics Approval and Consent to Participate

The study has been approved by the Ethics Commission for Health Research, Faculty of Public Health, Universitas Indonesia (License Number: Ket-455/UN2.F10.D11/PPM.00.02/2022) obtained from the institution for the research project.

Competing Interest

The authors declare that there are no competing interests.

Availability of Data and Materials

Data and information used as study materials can be obtained from the corresponding author upon reasonable request.

Authors' Contribution

YRI was responsible for creating the ideas, conducting the analysis, preparing the manuscript, performing the formal analysis, conducting the investigation, interpreting the results, and writing the original draft. RAW and PY supervised the study, wrote the review, and edited the text. All authors were involved in conceptualization, methodology, validation resources, data curation, review writing, and editing. All authors have made substantial contributions to the final manuscript for publication.

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Thai Sugar-Sweetened Beverage Tax: Does It Really Help?

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Thai Sugar-Sweetened Beverage Tax: Does It Really Help?

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Abstract

A solution recommended by the World Health Organization to prevent and control noncommunicable diseases is the Sugar-Sweetened Beverage (SSB) tax. This study aimed to evaluate the Thai SSB tax efficiency affecting the change in post-tax individual-level consumption and find causal explanations for the people's consumption behavior after the SSB tax was implemented. This study used a Productivity Model, and stratified random sampling was conducted by selecting 1,200 people. An in-depth interview was conducted to seek causal explanations for post-SSB tax consumption behavior with 15 key informants. The results revealed the SSB tax's efficiency in terms of perception and understanding at 6.75% and in terms of awareness and compliance at 2.83%. Several reasons for the failure of such a policy included no price differences for products with and without sugar, lack of coverage in regulatory enforcement, addiction to sweet tastes, insufficient food literacy, and the dangers of artificial sweeteners. Therefore, a careful and comprehensive review and revision of the tax implementation is necessary. The integration of complementary policy instruments alongside the tax is also required.

Keywords: food policy, noncommunicable diseases, policy evaluation, sugar-sweetened beverages tax

Introduction

Health policy is generally understood as a legitimate and necessary action to strengthen health systems and improve health.[1] Excise tax on sugar-sweetened beverage (SSB) is an effort to address public health problems in many countries,[2] as recommended by the World Health Organization (WHO) to prevent and control noncommunicable diseases (NCDs).[3] The primary component of the SSB tax is a specific excise tax levied based on the beverage's sugar content, meaning that it is progressive; accordingly, beverages with higher sugar concentrations are taxed at a higher rate.

In Thailand, the tax table categorizes sugar content in SSBs based on six levels: <6 g, 6–8 g, >8–10 g, >10–14 g, >14–18 g, and >18 g.[4] The SSB products containing <6 g sugar per 100 mL are exempt from the tax, while those containing ≥6 g sugar per 100 mL are taxed at a higher rate.[4] As the tax rate increases every two years, the Thai Government has imposed an SSB tax at a range of 0.10-5 Baht per liter from October 2019 to September 2021 before further lowering the threshold for higher tax and at a range of 0.30-5 Baht per liter from October 2021 to September 2023, and last, from October 2023 onwards.[4,5] The tax effectiveness depends on consumer response to price changes,[5] that the implementation of SSB tax in Thailand results in an increase in the price of taxed SSBs by 11%.[6]

The SSB tax aimed at reducing SSB consumption by making prices less affordable, encouraging consumers to switch to healthier alternatives with less or no added sugar, and prompting beverage manufacturers to reformulate their products by reducing sugar content or shifting to artificial sweeteners to maintain the desired sweetness level without the sugar and tax burden.[7,8] According to the evidence, domestic sugar consumption should be reduced. However, the domestic sugar sales volume during 2018-2023 did not show a clear downward trend, with sales volume (million tons) of 2.51, 2.48, 2.31, 2.29, 2.45, and 2.57, respectively.[9] At the same time, based on data from the Division of Non-communicable Diseases at the Thai Ministry of Public Health, the diabetes-related mortality rates of Thai people for five years (2017–2021) were 21.96, 21.87, 25.30, 25.05 and 24.55, respectively.[10]

Overall domestic sugar consumption volume and the diabetes-related mortality rate of the Thai population do not appear to be affected by SSB tax implementation since Thailand has various foods and sources of sweetness (white sugar, brown sugar, coconut sugar, palm sugar, honey).[11,12] Sugar consumption is not limited to only consuming sweet beverages.

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As a consequence, people's sweet taste preferences may not decrease, according to the objectives of policy enforcement. This poses a challenge in implementing excise on SSBs, whether it could really improve individual behavior in reducing sugar consumption and help the community have better health degrees.

Although the tax has impacted reducing SSB consumption in Chile, France, Mexico, and the US,[13-15] it does not mean that it can change a sugar consumption behavior beyond the body's needs for an imperfect nutritional knowledge and self-control problems of consumers.[16] Eating behavior and liking for food tastes are accumulated behaviors becoming personality traits similar to food addiction.[17] Changing such behavior takes time and appropriate adjustment to the food environment,[18] and there are many factors associated with inappropriate changes in consumption behaviors other than the SSB tax enforcement.[19] Therefore, this study aimed to evaluate the SSB tax effectiveness in altering the population's sugar consumption patterns using Vedung's Productivity Model,[20] measuring individual behavioral outcomes and investigating underlying reasons that might influence the success or failure of SSB tax in modifying consumption behaviors.

Method

This mixed-method study was conducted from March 2020 to June 2021. For the quantitative approach, a questionnaire was applied to assess perceptions, understanding, awareness, and compliance with the SSB tax to evaluate policy effectiveness. For the qualitative approach, an in-depth interview was implemented to gather detailed insights into the Thais' perspectives and food-selecting behaviors before and after the SSB tax implementation to investigate underlying reasons that might influence the SSB tax's success or failure in modifying inappropriate consumption behaviors.

The sample group was selected using stratified random sampling from the Bangkok Metropolitan Region covering Bangkok, Nakhon Pathom, Nonthaburi, Pathum Thani, Samut Prakan, and Samut Sakhon. This region spans over 7,000 square kilometers and has a population of 10,872,100 people in 2021.[21] As the country's most prosperous economic region, it has the largest number of educational institutions and serves as the center for government administration, business, trade, and finance.[22] Given the region's access to up-to-date news, information, and public healthcare services, it was deemed an appropriate site for the study.

Yamane's sample size formula was taken to calculate the required sample size,[23] yielding 400 individuals. To enhance statistical reliability and verify the homogeneity of data, the sample was collected through three replications of the sample group.[24] Consequently, the final sample size was 1,200 participants aged 15-79 years (see supplementary content). The age range was based on the general population health survey by the Bureau of Non-communicable Diseases, Thai Ministry of Public Health.[25] Questionnaires were distributed to various public locations and communities to recruit respondents. Both printed and digital versions were collected through face-to-face communications. The digitalized questionnaire was administered where possible, using electronic communication devices in areas with a Wi-Fi signal, and the printed questionnaire was used in areas lacking a Wi-Fi signal.

In the qualitative phase, 15 key informants representing the public sector, private sector, and general public were selected using snowball sampling and participated in in-depth interviews. Inclusion criteria for public sector informants required expertise in food, health, health education, health policy, or public policy. Private sector informants were business owners or employees with at least 10 years of experience in food product development, food and beverage (F&B) product development, or food marketing. General public informants were residents aged 15-79 years living in the Bangkok Metropolitan Region for more than 10 years.

The questionnaire was developed as closed-ended questions to explore Thais' perception, understanding, awareness, and compliance concerning the SSB tax. In the first part, a yes or no question was, "Do you know and understand SSB tax policy or not?" The second part comprised two questions on the awareness and compliance of the policy with two images of beverage products before and after the SSB tax implementation: the first question featured images displaying each product's price and Guideline Daily Amounts (GDA) label, and the second question featured images displaying a GDA label and the list of ingredients percentage on each product label. Respondents then chose only one image in each question to evaluate their awareness and compliance with the SSB tax policy. These food choices were determined based on the book "From Basic Nutrition to Sweet, Fatty, and Salty Labels."[26]

For scoring, respondents should choose the correct choice, which was a product with lower total sugar, in both questions to examine the score of awareness and compliance. The questionnaire also gathered the respondents' general demographic data. The questionnaire's validity assessment used an Index of Item-Objective Congruence (IOC). Four experts reviewed and rated the questionnaire, and the appropriateness of each question to its objective was evaluated

to ensure content accuracy, understanding, and clarity of language. All questions demonstrated an IOC value of >0.75. Reliability was determined using Cronbach's alpha coefficient.[27] The questionnaire was pre-tested on at least 30 individuals, separate from the research sample, yielding a Cronbach's alpha value of 0.81.

A semi-structured interview form was designed for the in-depth interview to discuss and solicit opinions on SSB tax, perception and understanding of the policy, food-selecting behavior before and after the SSB tax implementation, and relevant issues. The form's validity assessment used the IOC. Three experts reviewed and rated the form, including an evaluation of content accuracy, understanding, and clarity of language in each question. All the interviewed questions had an IOC value of 1.0.

This study categorized and statistically analyzed the collected data as follows: i) Descriptive statistics were employed to describe the sample's demographic characteristics; ii) Analysis of primary data from three respondent groups applied Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT) to compare all possible pairs of group means, assess multiple comparisons, and detect homogeneity subsets at a 95% confidence level.[28] This analysis aimed to determine whether the three sample groups represented the population and whether any statistically significant differences between the group means; iii) The data from the three sample groups were combined into a single dataset to evaluate the efficiency of the SSB tax policy by applying the Productivity Model (Equation 1) to analyze percentages of perception and understanding (Equation 2), as well as percentages of awareness and compliance (Equation 3).

$$Productivity = Output/Input$$

Equation 1. The Productivity Model of Vedung[20]

$$The\ percentage\ of\ perception\ and\ understanding = \frac{the\ amount\ of\ people\ who\ having\ perceived\ and\ understood\ the\ policy}{Total\ amount\ of\ sample}\ x\ 100$$

Equation 2. The Applied Equation for the Analysis of Perception and Understanding Percentage

$$The\ percentage\ of\ awareness\ and\ compliance = \frac{the\ amount\ of\ people\ who\ had\ awareness\ and\ applied\ the\ policy's\ advantages}{Total\ amount\ of\ sample}\ x\ 100$$

Equation 3. The Applied Equation for the Analysis of Awareness and Compliance Percentage

Audio recordings from the various informants were transcribed for subsequent data analysis and synthesis. The analysis focused on perceptions and understanding of the SSB tax policy, food-selecting behaviors before and after the implementation, and other pertinent issues, including additional recommendations from the key informants. For coding purposes, key informant groups were designated as public sector (G), private sector (C), and general public (P).

Results

Most respondents in the sample group were female than male, by about 7%. The samples were mostly of working age and divided into various jobs, and most had income levels between 10,001–20,000 THB (≈ 296.86–593.67 USD) per month (Table 1). ANOVA revealed no statistically significant differences (p-value >0.05) in the mean percentages of perceived policy efficiency, encompassing both perception and understanding and awareness and compliance, among groups 1, 2, and 3 (Table 2). Furthermore, DMRT indicated a homogeneity across all three groups, as evidenced by their inclusion within a single subset (Table 3). In short, these three sample groups represent the broader population studied.

Data from three sample groups were then aggregated to assess the overall effectiveness of SSB tax policy within the larger sample. Analysis revealed a mean score of perception and understanding of 6.75% and a mean score of awareness and compliance score of 2.83% (Table 4). These low percentages suggested a limited impact of the SSB tax on raising consumer awareness and stimulating behavioral change toward reduced sugar consumption. This observation required further investigation through a qualitative study to explore the underlying reasons for the policy's low effectiveness.

Table 1. Demographic Characteristics of Sample Group (N = 1,200)

Demographic Characteristics		n	Percentage (%)
Sex	Female	642	53.50
	Male	558	46.50
Age	15-20 years (adolescence)	111	9.25
	21-60 years (working age)	900	75.00
	61-79 years (retirement age)	189	15.75
Occupation	Student	222	18.50
	Teacher	19	1.58
	Medical staff	17	1.42
	Bureaucrat	117	9.75
	State enterprise employee	68	5.67
	Private company employee	115	9.58
	Laborer	294	24.50
	Merchant	76	6.33
	Private business owner/freelancer	39	3.25
	Farmer	13	1.08
	Househusband/housewife	213	17.75
	Artist/actor/performer	2	0.17
	Retired/unemployed	5	0.42
Income level (per month)	≤10,000 THB (≈ ≤296.83 USD)	340	28.33
	10,001–20,000 THB (≈ 296.86–593.67 USD)	515	42.92
	20,001–30,000 THB (≈ 593.78–890.50 USD)	171	14.25
	≥30,001 THB (≈ ≥890.51 USD)	174	14.50

Notes: N = the size of the population; n = the sample size; the current exchange rate as of February 5, 2025; 1 USD = 33.6803 THB.

Table 2. ANOVA for Comparison of Mean Differences of the Three Sample Groups

	Source of Variation	ANOVA Tests of REP				
		SS	df	MS	F	p-value
Perception and understanding	REP	0.020	2	0.010	0.159	0.853
	Error	75.512	1197	0.063		
	Total	81.000	1200			
Awareness and change behavior	REP	0.002	2	0.001	0.030	0.970
	Error	33.035	1197	0.028		
	Total	34.000	1200			

Notes: REP = 3 sample groups; SS = sum of squares; Residual MS = mean squared error (residual SS/residual degrees of freedom); F = overall F test for the null hypothesis

Table 3. DMRT for Comparison of Mean Differences of Three Sample Groups

	REP	N	Subset 1
Perception and understanding	1	400	0.0625
	3	400	0.0675
	2	400	0.0725
	p-value		0.6000
Awareness and change behavior	1	400	0.0275
	3	400	0.0275
	2	400	0.0300
	p-value		0.8430

Notes: REP = number of sample groups; N = the size of the population; Subset = subgroups that represent the homogeneity of means

Table 4. The Efficiency of Sugar-Sweetened Beverage Tax Policy (N = 1,200)

Policy	Efficiency Percentage Value	
	Perception and Understanding	Awareness and Compliance
SSB tax	6.75	2.83

Notes: N = the size of the population; SSB = Sugar-Sweetened Beverage

The in-depth information was gathered from 15 key informants regarding potential reasons for the perceived lack of success of the SSB tax policy in Thailand. Five issues emerged from the data are:

No Difference in Prices of Products with and without Sugar

Regarding the policy's impact on consumers, the Thai government anticipated that the price mechanism would indirectly influence consumer behavior. However, the SSB tax practically resulted in an insignificant increase in the price of sugar-sweetened beverages. *"I actually do not believe it can help. Look at liqueur and cigarettes; the tax is up, but customers still can buy… and after the tax on SSBs is applied, the cost of drinks goes up a bit—customers can pay."* (Food product standards specialist, G1). When healthy foods became a popular trend, manufacturers caught some marketing opportunities, leading to an increase in prices. This aligns with several key informants' viewpoints suggesting that the manufacturers promote the "good for health" label to boost the perceived value of their products. Product development specialist (C1) and a coffee business entrepreneur (C2) shared that: *"When it comes to price, will it be expensive if the product is good for health? This is a marketing issue. That is… those who want to take care of their health, they may have to pay a higher price for their good health."* People chose more affordable soft drinks when healthier beverages were expensive. *"Regular soft drinks cost 15 Baht per bottle, but if promotion is available, [the price is] 20 Baht for 2 bottles. It is unlike a sugar-free drink, which [costs] 25-50 Baht per single bottle. No matter how good they are, I cannot afford them. So expensive!" (Bus fare collector, P1).*

Lack of Coverage in Regulatory Enforcement

The current SSB tax in Thailand covers only certain types of drinks, such as industrially produced soft drinks, energy drinks, fruit and vegetable juices, and ready-to-drink coffee or tea, which is a concern for most key informants, given that Thailand has diverse food products, and this complexity poses challenges for effective monitoring. *"Our country has many kinds of food. There are many street foods, markets, corner stores, or café, so we can buy any drink anywhere."* (Marketing and nutrition specialist/C3, a health education specialist/G2, a public health policy specialist/G3, a local public health specialist/G4, and a food and nutrition specialist/G5). Following the SSB tax implementation, the industrial sector has carried out research and development to reformulate products and mitigate tax liabilities. The reformulation often involves substituting sugar with sweeteners while maintaining a comparable level of sweetness for consumers, as a food product standards specialist (G1) and a marketing and nutrition specialist (C3) stated: *"Besides, sugar has been substituted by another, like…sweeteners that customers can accept and the government cannot tax anymore."*

Sweet Taste Addiction

Lifestyle influences the preference for sweet tastes, as it reflects accumulated familiarity with certain foods. As a health education specialist (G2), a public health policy specialist (G3), and a 72-year-old taxi service owner (P2) gave the consistent opinion that: *"If a house always serves sweet side dishes, the children will also be addicted to sweet food because it creates a habit of taste and eating."* The key informants from the public and private sectors had a shared concern about the prevalent preference for sweet taste among Thais, aligned with statements by a bus fare collector (P1), a 72-year-old taxi service owner (P2), and a food vendor in the cafeteria (P4) telling that foods sold in their work areas tasted quite sweet. While a student in grade 12 (P3) expressed great fondness for her regular beverage: *"I am a bubble milk tea lover. I have been drinking it since it was sold in a cart in front of my school. I have been addicted to it much. Oh! It is incredible, it tastes crazy yummy. I am a big fan of bubble milk tea."* Given the prevalent preference for sweet taste among Thais, after the SSB tax was imposed, the industrial sector started using sweeteners to maintain a sweetness level of products comparable to the original formula. This means no change in the population's familiarity and habit of being a sweet taste addict, as a 23-year-old new employee (P5) said: "Between regular soda and sugar-free soda, I can honestly say that I cannot tell the difference between them."

Insufficient Food Literacy

This is another obstacle hindering the success of the SSB tax since most people do not comprehend how to choose healthy food or beverages. A marketing and nutrition specialist (C3) and a pastry company entrepreneur (C4) stated that if people do not understand, they will ignore it. Meanwhile, a food vendor in the cafeteria (P4) stated the incomprehension about food labels. *"GDA label too complicated for most shoppers to understand. I do not know about nutrition and cannot understand what 3% fat, 21% sodium is? Many people are even illiterate."* (Bus fare collector, P1).

Dangers of Artificial Sweeteners

Some key informants provided advice and warnings on the dangers of artificial sweeteners, which are increasingly used by F&B industries to avoid SSB tax. A food product standards specialist (G1), a food and nutrition specialist (G5), a marketing and nutrition specialist (C3), and an organic products entrepreneur (C5) expressed their opinions in the same direction: *"We were worried about sugar, but we might not know whether the sweetener substituting sugar could cause disease as well."* The factors obtained from in-depth interviews should be a strong reason to explain the inefficient SSB tax policy phenomenon in terms of post-SSB tax consumer behavior, whether for this reason there is no change or not.

Additional suggestions on policy proposals should be implemented in conjunction with using SSB tax policy. The issue of strengthening health literacy (HL) for people, as a health education specialist (G2) and a local public health specialist (G4) suggested the same: *"We should find ways to strengthen HL of the population. This may be through advertising and public relations through various media platforms."* A public health policy specialist (G3) raised the issue of promoting health knowledge through social media: *"The government should support and supervise the role of new-generation media whose role includes being social influencers to help advocate accurate information and knowledge on NCDs and HL."*

Other opinions on promoting HL came from a food product standards specialist (G1), a health education specialist (G2), a public health policy specialist (G3), a marketing and nutrition specialist (C3), and a pastry company entrepreneur (C4) recommending, *"We should reform the national curricula to include scientific knowledge and HL."* The front-of-package labels (FoPL) were another issue raised by almost all key informants. The Thai FoPL format is complicated to understand, so they chose to ignore reading labels before deciding to buy. *"The Health Star Rating System label is a pattern of FoPL that is easy to understand because it has pictures, even illiterate people can understand."* (Public Health Policy Specialist/G3 and Marketing and Nutrition Specialist/C3). Besides, the issue of creating incentives via financial policy instruments was raised by a product development specialist (C1), a pastry company entrepreneur (C4), and a 23-year-old new employee (P5), suggesting an alternative financial policy instrument that might receive better response from manufacturers and consumers: *"The government should consider implementing the Goods and Service Tax reduction policy on healthy food and beverage, because this positive policy may yield better results of modifying consumer behaviors than a negative policy."*

Discussion

The SSB tax can improve the food environment[29] by affecting people's sugar consumption behavior and reducing the prevalence of NCDs.[7] The briefly analyzed causes of NCDs can be divided into two dimensions: NCDs result from consumer choice and the environment.[30] The tax appears to be the right choice to address the price incentives problem and create an environment limiting food choices. A study evaluating Chile's SSB tax demonstrated a significant decrease of 21.6% in the volume of purchases of the higher-taxed sugary soft drinks each month.[13] A study on the impacts of the French soda tax on prices, purchases, and tastes found a reduction in regular soft drink purchases.[14] In the US, the odds of daily regular soda consumption decreased by 40% within the first two months of tax implementation.[15] A study in Thailand also revealed a significantly greater decrease in the consumption of taxable SSB products compared to non-taxable SSBs.[4]

However, the SSB tax measure still needs further study for any gaps: the tax policy might have been partially effective,[4,13] the tax's impact on prices exhibited uneven pass-through across different beverage categories,[14] and the tax effectiveness in reducing the NCD prevalence remained speculative.[6] This study revealed the efficiency of the Thai SSB tax with a quite low percentage of perception and understanding at 6.75% and awareness and compliance at 2.83%. This is a consequence of the SSB tax being unable to change the food environment, thus giving rise to many paradoxes in practice where the Thai food environment is characterized by diversity and various distribution channels.[12] Moreover, the SSB tax only applies to industrially produced soft drink products, energy drinks, powdered mineral salts, fruit and vegetable juices, and ready-to-drink coffee or tea.[31] It means that other beverages sold by small merchants on the roadside, Sunday markets, floating markets, or cafés, such as bubble milk tea, fruit juice, milkshakes, and coffee, are excluded from the tax. Also, the Thais have insufficient food literacy in selecting which food or beverages will not adversely affect their health.[32] Therefore, consumers can still access and consume high-sugar beverages at levels comparable to pre-tax implementation, indicating no substantial change in the food environment.

The persistent preference for sweet tastes was evident in the post-tax implementation, in which there was a massive growth of the bubble milk tea market[33] and continued growth of the market for sweetened condensed milk (SCM), a main ingredient in beverages excluded in the tax.[34] WHO's new guideline on non-sugar sweeteners (NSS), released on May 15, 2023, recommends against using NSS to control body weight or reduce NCD risks.[35] This recommendation contradicts the apparent trend where the industrial sector increasingly relies on artificial sweeteners in response to the SSB tax policy.

This shift is reflected in the growth of the global sugar substitutes market, estimated at USD 7.01 billion in 2023 and projected to expand at a compound annual growth rate (CAGR) of 5.8% from 2024 to 2030.[36] For these reasons, while the Thai SSB tax policy may demonstrate some effectiveness in reducing SSB product consumption, it might not be a sufficient mechanism for sustainably reducing the NCD prevalence. This is reflected in the persistent rate of diabetes-related mortality among the Thai population.[11]

Given the diverse and dynamic context of the country, the government should carefully and comprehensively review and revise the tax implementation. Further research on the tax implementation process is necessary to ascertain whether its aims and actual outcomes are aligned.[37] Otherwise, the SSB tax may fail to improve public health effectively. It could instead increase household expenditure due to the tax burden while simultaneously creating market opportunities for products labeled as "good for health."

This study was subject to certain limitations, and generalizations based on its findings should be made cautiously. Due to its cross-sectional design, the SSB tax effectiveness in altering the population's sugar consumption patterns was analyzed at a single point. A sampling bias constituted the first limitation, as data were collected solely from urban areas due to time constraints and the COVID-19 pandemic. In quantitative studies, increasing the sample size, often through replication, is a common method employed to mitigate such bias and enhance statistical reliability.[24] A snowball sampling method was employed in the qualitative part of the study. In the context of snowball sampling, saturation is reached when the inclusion of additional participants yields no new information or insights relevant to the research question. At this point, further data collection is deemed redundant, as it is unlikely to alter the findings significantly.[38]

Information bias constituted the second limitation. In the quantitative component, questionnaire validity was assessed using IOC, while reliability was evaluated using Cronbach's alpha coefficient.[25] For the qualitative component, the validity of the semi-structured interview guide was assessed via IOC. Furthermore, information was analyzed through data triangulation, drawing from three distinct key informant groups. Moreover, the purpose and method of analysis were explained to both quantitative respondents and qualitative informants, with assurances given that results

would be presented anonymously from an overall perspective rather than individually. This ensured that individual responses and opinions remain confidential. Consequently, both respondents and informants could be confident that truthful answers would not result in any negative repercussions.

Further analysis utilizing more comprehensive samples from both urban and rural areas is undeniably crucial. Future studies addressing these shortcomings will undoubtedly enhance the precision and validity of findings. Further quantitative studies on influential factors to the success and failure of SSB tax policy, along with qualitative studies exploring complementary policy proposals, are needed to ensure the sustainable effectiveness of such policy in reducing NCD prevalence. These efforts will support the present study's findings and facilitate their practical implementation.

Conclusion

Viewed from the lens of the study findings, the anticipated health benefits of the SSB tax, particularly in reducing NCDs, may be illusory due to the complexities of Thailand's diverse food environment, which hinders effective management and monitoring of post-tax community behavior. Complementary measures are crucial for improving the food environment. First, the government should prioritize food and health literacy by promoting accurate information about NCDs and healthy consumption through various media, including educating and supporting social influencers and reforming national curricula to integrate relevant scientific knowledge. Second, price interventions, such as GST reductions on healthy food and beverages, can incentivize both production and consumer purchasing decisions. Third, the government should reassess the health risks associated with artificial sweeteners compared to sugar. Finally, developing user-friendly FoPL will empower consumers to make informed choices, all of which will support the effectiveness of the SSB tax in reducing NCD prevalence.

Abbreviations

SSBs: Sugar-Sweetened Beverages; WHO: World Health Organization; NCDs: Noncommunicable Diseases; F&B: food and beverages; GDA: Guideline Daily Amounts; IOC: Index of Item-Objective Congruence; ANOVA: Analysis of Variance; DMRT: Duncan's Multiple Range Test; HL: Health Literacy; FoPL: Front-of-Package Labels; SCM: Sweetened Condensed Milk; NSS: Non-Sugar Sweeteners.

Ethics Approval and Consent to Participate

This study was approved by the Committee for Research Ethics (Social Science), Mahidol University, under the project "The proactive policies for tackling risk factor of noncommunicable diseases (NCDs) problems in the dimension of unhealthy diet" code No. MU-SSIRB: 2018/189.1408 approved on August 14, 2018. Informed consent was obtained from all participants included in the study.

Competing Interest

The authors declare no competing financial or personal interests that might have influenced the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

Please contact the corresponding author for any inquiries about the data supporting the findings. Due to data privacy/ethical restrictions, the research team cannot share the data publicly.

Authors' Contribution

Study conception and design: SS and BT; data collection: SS; analysis and interpretation of results: SS and BT; draft manuscript preparation: SS. All authors reviewed the results and approved the final version of the manuscript.

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Socio-Epidemiological Perspectives of Sexual Trauma Experiences and Influential Factors on Sexual Orientation in Men Who Have Sex with Men

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Socio-Epidemiological Perspectives of Sexual Trauma Experiences and Influential Factors on Sexual Orientation in Men Who Have Sex with Men

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Abstract

The complexity of sexuality and sexual trauma experiences, including harassment, unwanted touching, sexual urges, and forced sexual intercourse, should not be underestimated because of the tendency to initiate adverse psychosocial impacts. Sexual harassment can increase mental health risks, which may influence sexual orientation decisions. This quantitative study, using a cross-sectional design, aimed to determine a relationship between sexual trauma experiences and sexual orientation in men who have sex with men (MSM). This study population was MSM living in Palembang and Prabumulih City, with a sample size of 216 respondents. The proportion of respondents with homosexual orientation was 57.1%, and the proportion having sexual trauma experiences was 42.3%. The multiple logistic regression identified a significant relationship between sexual trauma experiences and sexual orientation in MSM with a p-value of 0.02, an adjusted odds ratio of 2.71, and a 95% CI of 1.17-6.26. These results suggested a higher risk of a different sexual orientation among traumatized MSM compared to MSM without one after controlling access to pornographic content and correcting parenting patterns. Sexual trauma has been shown to affect individual sexual orientation; therefore, special attention is needed due to the impact on future life behavior.

Keywords: men who have sex with men, parenting, pornographic content, sexual trauma

Introduction

Humans are born with male and female sexes throughout the world, including in Indonesian society, where religion plays a crucial role in determining sexual orientation. Traditionally, sexual orientation is expected to conform to the rule that males are attracted to females and vice versa. This term is conceptualized as an aspect of the body that develops early in life and remains stable over time.[1] Sexual orientation is a multidimensional construct referring to persistent emotional, romantic, or sexual attraction to another individual.[2]

Building on the term described initially, sexual motivation is the deepest commitment of the body related to emotions that significantly influence the conduct of many ambiguous actions.[3] The complexity of human sexuality should not be underestimated, while the main reason motivating individuals to engage in sex is the high level of satisfaction commonly obtained. From an evolutionary perspective, the motivational nature of sexual experience is best explained as an adaptation to ensure reproductive success.[3]

A person's sex does not guarantee the possession of a preferred sexual orientation, as differences in sexual orientation and the relationship to mental health begin in childhood.[4] This corresponds to the report by Clark *et al.* that sexual orientation differences in psychopathology start at the age of nine.[5] Conceptually, sexual orientation comprises three aspects: identity (how an individual identifies the sexual orientation possessed), behavior (the gender of sexual partners), and attraction (the gender of individuals attracted to).[2]

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The World Health Organization (WHO) is increasingly aware of the health service barriers faced by the lesbian, gay, bisexual, and transgender (LGBT) community, leading to a significant impact on general health and well-being.[6] The latest analysis by the Joint United Nations Programme on HIV/AIDS (UNAIDS) using the Global AIDS Monitoring System until 2019 and less than the last five years in 38 countries shows that the global average proportion of adult men who have sex with men (MSM) was 1.9%, consisting of 1% observed in the past 12 months.[7]

Gay individuals with same-sex sexual orientation are driven by experiences of sexual abuse during childhood.[8] Sexual trauma experiences include abuse, unwanted touching, sexual urges, and forced sexual intercourse, escalating to suicide.[9] Child abuse occurs worldwide with a prevalence of 8-31% for males and 3-17% for females.[10] This causes trauma and many survivors of sexual abuse experience various detrimental psychosocial impacts.[11]

LGBT is a minority group that is not accepted by society, thus having a negative impact on social life.[12] As a result, many hide their sexual orientation from family members and the environment, which becomes a psychological burden.[13,14] LGBT individuals coming out about their sexual identity have reported experiencing negative treatments, which include inappropriate language, stigma, harassment, discrimination, homophobic reactions, condescending attitudes, unfriendliness, and hostility.[15]

Stigma towards sexual minorities contributes to sexual trauma, which impacts health disparities based on sexual orientation in society. Stigma in minorities affects the life journey of individuals in shaping physical and mental health and sexual orientation.[16,17] Sexual trauma requires special attention that can help overcome the trauma and regain emotional and psychological stabilities because its consequences affect future life behavior. Therefore, this study focused on examining socio-epidemiological factors contributing to the formation of male-specific sexual orientation. The aim was to determine the relationship between sexual trauma experiences and sexual orientation. Additionally, the study will support prevention program measures and improve the effectiveness of public health interventions.

Method

This study used a quantitative method with a cross-sectional design to analyze the relationship between sexual trauma experiences and sexual orientation in the male-specific sexual orientation group. The population investigated was all MSM under the reach of a non-profit organization based in Palembang City working on rehabilitation and empowerment of drug addicts; assistance to people with HIV (ODHIV); assistance to child workers and school dropouts to obtain the right to education and health; outreach and assistance to communities at risk of TB, STIs, and HIV; assistance and empowerment of prison inmates; and public health and environmental health. Furthermore, the minimum sample size was 216 respondents, comprising a hidden population selected through purposive sampling, calculated using the two-tail hypothesis test formula with a significance level of 5% and a test power of 80%.[18]

The study instrument was a structured questionnaire that had been tested for validity and reliability. The validity test revealed a strong correlation coefficient (r = 0.62–0.74), while Cronbach's alpha value obtained from the reliability test was 0.831 >0.6. The main independent variable examined was sexual trauma experience, while the dependent variable was sexual orientation. Various potential confounding factors considered were sexual education, access to pornographic content, parenting patterns, and relationships with family.

The operational definition of sexual orientation was the respondents' confessions regarding persistent emotional, romantic, or sexual attraction to other individuals. For subsequent analysis, sexual orientation was particularly categorized into "homosexual" and "bisexual" groups. Sexual trauma was described as the experiences of harassment, unwanted touching, sexual urges, and forced intercourse. This term was further classified into "ever experienced" and "never experienced" categories. Among the potential confounding factors, sexual education was defined as the process of acquiring skills and information related to human sexuality, such as body anatomy, forms of sexual harassment, and reproductive health, with categorization into "never" and "ever" groups. Access to pornographic content deals with watching, obtaining, or encountering explicit material triggering sexual desire, categorized as "never" and "ever." Relationship with family was the emotional, social, and psychological bond shared among parents and siblings, categorized as "disharmonious" and "harmonious." Parenting patterns were described as a form of care in which parents or caregivers provide respondents with "poor" and "good" categories from childhood to adulthood.

Collected data were analyzed univariately to describe the characteristics of respondents and then bivariately to determine the relationship between sexual trauma experiences and sexual orientation using the Chi-square test. To determine whether confounding factors influenced the relationship between these two variables, a multivariate analysis was conducted through multiple logistic regression tests. The entire tests were performed using IBM SPSS Statistics Base

ver. 22 (with license number 7b720dbc0888632240ca) and were all two-tailed with a p-value of <0.05, denoting statistical significance.

Results

A total of 216 MSM respondents aged 17-53 years, with an average of 30.44 years, were divided into homosexual and bisexual groups based on sexual orientation. The results showed 55.6% homosexual and 44.4% bisexual, while respondents exposed to sexual trauma were 41.7%, and those without the experiences were 58.3%. The characteristics presented in Table 1 signify that the majority (53.2%) have completed high school education, 38.4% work with private employees, and 67.1% are married.

According to Table 2, bivariable analysis using the Chi-square test found that sexual trauma experiences (p-value <0.0001), access to pornographic content (p-value <0.0001), parenting patterns (p-value <0.002), and relationship with family (p-value <0.04) were significantly correlated with sexual orientation. Multivariable analysis used a risk factor model comprising sexual trauma experiences as the main independent and sexual orientation as the dependent variable with controlled potential confounding factors. The results showed a significant relationship between sexual trauma experiences and sexual orientation in MSM with a p-value of 0.002, adjusted odds ratio (AOR) of 2.90, and 95% CI of 1.46-5.75. These results implied that MSM exposed to sexual trauma had a 2.90 greater risk of experiencing a different sexual orientation compared to MSM without sexual trauma after controlling access to pornographic content and parenting patterns (Table 3).

Table 1. Frequency Distribution of Respondent Characteristics (n = 216)

Variable	Frequency	Percentage
Age (years)		
Mean-median (Minimum-maximum)	30.44 – 28 (17-53)	
Sexual orientation		
Homosexual	120	55.6
Bisexual	96	44.4
Sexual trauma experience		
Ever experienced	90	41.7
Never experienced	126	58.3
Education level		
Elementary school	4	1.9
Junior high school	20	9.3
Senior high school	115	53.2
Higher education	77	35.6
Occupation		
Civil servant/state-owned enterprise	20	9.3
Private employee	83	38.4
Self-employed	60	27.8
Laborer	24	11.1
Student	29	13.4
Marital status		
Married	145	67.1
Single	71	32.9
Receiving sex education		
Never	103	47.7
Ever	113	52.3
Experience in accessing pornographic content		
Never	75	34.7
Ever	141	65.3
Peer influence		
Yes	145	67.1
No	71	32.9
Parenting patterns		
Poor	151	69.9
Good	65	30.1

Table 2. Relationship between Sexual Trauma Experiences and Sexual Orientation with Potential Confounding

Variable Group	Sexual Orientation				p-value	OR (95% CI)
	Homosexual		Bisexual			
	n	%	n	%		
Sexual trauma experiences						
Never	50	75.8	16	24.2	<0.0001	0.28 (0.14-0.54)
Ever	70	46.7	80	53.3		
Receiving sex education						
Never	64	62.1	39	37.9	0.08	1.67 (0.97-2.87)
Ever	56	49.6	57	50.2		
Experience in accessing pornographic content						
Never	57	76.0	18	24.0	<0.0001	0.26 (0.14-0.48)
Ever	63	44.7	78	55.3		
Parenting patterns						
Poor	73	48.3	78	51.7	0.002	0.36 (0.19-0.67)
Good	47	72.3	18	27.7		
Relationship with family						
Disharmonious	42	46.7	48	53.3	0.04	0.54 (0.31-0.93)
Harmonious	78	61.9	48	38.1		

Notes: OR = odds ratio, CI = confidence interval

Table 3. Final Logistic Regression Model with Risk Factor Model

Variable	Category	B	Sig.	OR (95% CI)
Sexual trauma experience	Ever	1.065	0.002	2.90 (1.46-5.75)
	Never	Reff		
Experience in accessing pornographic content	Ever	1.339	0.001	3.81 (1.98-7.33)
	Never	Reff		
Parenting patterns	Poor	0.957	0.005	2.60 (1.33-5.11)
	Good	Reff		

Notes: OR = odds ratio, CI = confidence interval

Discussion

The results showed that MSM sexual orientations included homosexual and bisexual, while the proportion of homosexual respondents was 57.1%. Furthermore, 42.3% were exposed to sexual trauma, where a significant relationship was found between sexual trauma experiences and sexual orientation with a p-value of 0.02, AOR of 2.71, and 95% CI of 1.173-6.260. These results signified that MSM exposed to sexual trauma were at risk of having a different sexual orientation compared to counterparts lacking the experiences after being controlled for sexual education, parenting patterns, and access to pornographic content.

Exposure to sexual trauma can make someone vulnerable to experiencing different sexual orientations, especially if they have a supportive community. The role of culture can be a positive resource contributing to the safety and well-being of a person experiencing sexual trauma.[19,20] This study's results were consistent with a previous study stating that sexual trauma influences sexual orientation.[21] Attitudes to sexual harassment have implications for interpersonal relationships, mental health, depression, subjective well-being, and sexual orientation.[22,23] Abuse and victimization experienced by minorities in childhood puts them at risk of developing mental disorders, which can increase sexual disparities.[24] These include five dimensions of high-level traits: indifference, deceit, narcissistic privilege, sadism, and revenge.[21]

Being homosexual is not solely an innate characteristic but a complex aspect of individuality shaped by the interplay of genetic factors, uncontrollable environmental influences, past experiences, and individual choices.[25] The experience of interpersonal violence based on sexual identity varies from one individual to another, while sexual violence is experienced by both heterosexual and bisexual females.[25] The respondents had an average age of 30.44 years, but sexual abuse and trauma were experienced at an early age. Another study also reported the same results, that becoming gay was due to

sexual abuse experienced during childhood by close individuals, for example, uncles and female friends.[8]

Violence based on sexual orientation, gender identity, or gender expression occurs in society, and the campus environment.[26] Adverse experiences in childhood have a significant negative impact on subsequent behavior.[27,28] Childhood sexual abuse is a risk factor for children experiencing depression, anxiety, and sexual behavior disorders. Sexual orientation disparities in children are strongly associated with differences in self-reported symptoms.[29] Dark triad traits on sexual attitudes and behaviors are consistently associated with mate selection efforts in males and females.[30] Both sexual behavior and interest terms are described as response choices made by women and men.[31]

The formation of sexual orientation among MSM was influenced by a confounding factor known as parenting patterns. The results showed a significant relationship between parenting patterns and sexual orientation in children, in which 74.4% had poor parenting patterns. These corresponded with Sterret *et al.*'s study stating that children experiencing good relationships and parenting patterns could have increased positive behavior.[32] Improving the mother-child relationship and culturally sensitive psychological therapy can positively improve a child's identity development.[33] Poor parenting tends to support the non-heteronormative sexual orientation of children, and social cognitive theory states that individual personality is developed through imitation.[34] Sexual deviation is not innate but occurs due to the learning process and is also influenced by the family environment.[34]

The learning process is more likely to be obtained at the home, in the workplace, and in the school environment. This study identified sex education as a confounding factor contributing to the formation of MSM sexual orientation. The results showed a significant relationship between sex education and sexual orientation, in which 54.5% of respondents had never received it. Sexual orientation needs optimal consideration when providing counseling services or educational interventions, specifically for the LGBT.[35] Comprehensive health education was capable of increasing knowledge of sexual health and changing behaviors.[36]

Access to pornographic content serves as a sexual reference and initiates sexual arousal while watching porn can affect mental health in young males and is associated with risky sexual behavior.[37,38] This has explicitly affected the attitudes and behavior exhibited among individuals in the MSM sexual minority group. Internet availability promotes access to pornographic content, including sexual discussions and sex-related dating. Additionally, it leads to receiving unwanted sexual requests or becoming victims of online-based harassment with the potential to influence sexual attitudes, knowledge, and behavior.[39,40] This study has the potential to experience information bias since the interview contained several sensitive questions, resulting in respondents not answering honestly. To minimize the information bias, a personal approach was taken by explaining that all information provided was confidential, not disseminated, and only used to support this study.

Conclusion

From a socio-epidemiological perspective, this study identifies that sexual trauma experiences, access to pornographic content, and parenting patterns influence sexual orientation in the MSM. The sexual trauma experiences include harassment, unwanted touching, sexual urges, and forced sexual intercourse. Families and the government should consider these issues to effectively control negative impacts in the future.

Abbreviations

WHO: World Health Organization; LGBT: Lesbian, gay, bisexual, and transgender; MSM: Men who have sex with men; AOR: Adjusted odds ratio; OR: Odds ratio; CI: confidence interval.

Ethics Approval and Consent to Participate

This study received approval with number 197/UN9.FKM/TU.KKE/2024 from the Faculty of Public Health, Sriwijaya University.

Competing Interest

The authors declared no significant competing financial, professional, or personal interests that could affect the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

All data and related materials from this study are available and can be provided by the first author.

Authors' Contribution

RJS contributed greatly to the conceptualization, methodology, data analysis, and writing aspects of this study. MI corrected the draft article, LN and RAS corrected the substance and discussion, and DDS handled the writing method and language adjustment. AM effectively corrected the English language and article substance, and RP conducted the data collection process and analysis.

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Exploring Physician Well-Being: A Bibliometric Analysis of Mental Health

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Exploring Physician Well-Being: A Bibliometric Analysis of Mental Health

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Abstract

This bibliometric study examined the evolving research landscape on physician mental health from 2010 to 2023, analyzing key themes, publication trends, and global contributions. A total of 3,360 articles, including 3,137 original research and 223 reviews, were sourced from Web of Science and Scopus. Findings revealed a significant increase in research output, particularly during the COVID-19 pandemic, with burnout, depression, and anxiety emerging as dominant themes. The US accounted for most publications, while research from low- and middle-income countries remains limited, indicating a substantial global disparity. Thematic analysis highlighted variations in burnout assessment methodologies, underscoring the need for standardized evaluation tools. This study also identified systemic challenges, including excessive workload, hierarchical workplace structures, and inadequate institutional support, as major contributors to physician distress. Technological inefficiencies, particularly in electronic health record systems, exacerbated administrative burdens and physician dissatisfaction. Recommendations include developing standardized mental health assessment frameworks, expanding study in underrepresented regions, and implementing organizational policies to enhance physician well-being. This review provides critical insights for policymakers, healthcare institutions, and researchers, offering a foundation for targeted interventions and evidence-based reforms to improve physician mental health globally.

Keywords: burnout, COVID-19, mental health, physician, well-being

Introduction

The physician profession has long been regarded as one of the most esteemed and fulfilling career paths. However, it is also associated with significant psychological stressors, many of which are unique to the profession, while others are common in high-pressure, highly specialized fields.[1] Mental health disorders, particularly burnout, depression, and anxiety, are widespread among physicians, with approximately 29% exhibiting depressive symptoms, up to 24% experiencing anxiety, and 4-16% suffering from post-traumatic stress disorder.[1] Suicide rates among physicians are disproportionately high, with male physicians in the United States facing a 40% increased risk.[2] In contrast, female physicians are nearly twice as likely to die by suicide compared to their non-physician counterparts.[2]

International data reflects this trend, with 25% of doctors in the United Kingdom reporting depressive symptoms and over 30% of Japanese physicians exhibiting severe burnout.[3] These alarming statistics have intensified the focus on physician well-being, prompting calls for comprehensive systemic reforms. The rising prevalence of mental health issues among physicians has drawn global attention, prompting major healthcare organizations to advocate for urgent reforms in physician training, workplace culture, and mental health support systems.[4] Physicians working in conflict zones face even greater psychological risks, including exposure to trauma, violence, and inadequate mental health resources.[5] Moreover, economic and cultural disparities further influence physician mental health, with doctors in lower-income countries often working under extreme resource constraints, while those in hierarchical work environments may experience higher levels of occupational stress and psychological distress.[6] These concerns extend beyond the altruistic goal of supporting physicians; they emphasize the essential role of physician well-being in maintaining an effective healthcare system.

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Beyond the medical field, mental health disorders are a growing global crisis, affecting over 450 million people worldwide, with projections indicating a sharp increase in disease burden in the coming decades.[7] These issues not only affect physical well-being but also have far-reaching social and economic implications.[8] In response, the 2013-2020 Mental Health Action Plan by the World Health Organization (WHO) outlines key objectives to mitigate mental illness-related morbidity and mortality.[9] These include promoting effective leadership for mental health, providing comprehensive care in community settings, implementing prevention strategies, and strengthening research and information systems. In Malaysia, for instance, mental health problems have risen significantly among adults, as indicated by the National Health and Morbidity Survey.[10] Various factors contribute to this trend, including biological, psychological, socioeconomic, and lifestyle elements.[10] Occupation-related stressors, particularly in high-demand, low-control jobs with inadequate support, are linked to adverse mental and physical health outcomes.[10]

Physicians, who often work in high-stress environments with heavy patient loads and long working hours, are at an increased risk of burnout, anxiety, and depression. A study indicates that physicians experience significantly higher levels of psychological distress compared to the general population, leading to adverse outcomes such as substance abuse and addiction.[11] These issues not only diminish physicians' quality of life and work performance but also compromise patient care and healthcare system efficiency.[12] The unique challenges faced by physicians in maintaining mental health are multidimensional, involving both the demands of their profession and the broader context of a global mental health crisis.[12] This situation underscores the urgent need for comprehensive strategies addressing mental health among physicians, ensuring their well-being and the effectiveness of the healthcare systems they serve.

This study conducted a bibliometric analysis of the study on physician mental health, identifying key trends, thematic evolution, and research gaps. To understand the research landscape, this study examined publication patterns, keyword co-occurrence networks, and country-wise contributions. The findings aimed to highlight underexplored areas and provide insights for future research and healthcare policy development. Ultimately, this bibliometric analysis seeks to contribute to the academic understanding of mental health issues among physicians and to inform strategies for improving mental health support within the medical community.

Method

This bibliometric study systematically examined mental health research on physicians from 2010 to 2023, identifying trends, key contributors, and thematic evolution. The methodology followed a five-stage approach to ensure a comprehensive and structured analysis. Stage 1 involved the definition of search criteria, focusing on keywords encompassing a range of mental health topics ("mental health," "psychological well-being," "stress," "burnout," "depression," "anxiety") and their relevance to medical professionals ("doctors," "physicians," "medical practitioners," "healthcare professionals"). Additional terms related to coping mechanisms and job satisfaction, such as "resilience," "work-life balance," and "job satisfaction," were also incorporated.

Stage 2 entailed the selection of the Web of Science Core Collection and Scopus database, recognized for its extensive repository of scientific literature. This was followed by Stage 3, in which the criteria were adjusted to include only original research and reviews written in English between 2010-2023. This time frame was selected to reflect contemporary research trends and account for the increasing attention to physician mental health following the WHO's 2013-2020 Mental Health Action Plan and the COVID-19 pandemic's impact from 2020 onward. In Stage 4, the data exportation process began. This stage was crucial as it involved extracting the data from the database based on the specified search and filtration criteria. The exported data, which formed the foundation of this bibliometric analysis, included various articles that delved into the mental health aspects of physicians.

The final stage, Stage 5, was dedicated to analyzing and discussing the results. The bibliometric data was collected and analyzed in August 2023, ensuring the inclusion of the most recent publications available at the time of study execution. This comprehensive examination of the data encompasses various bibliometric parameters, including publication trends, authorship, geographical distribution, and thematic focus. The aim was to glean insights into the research landscape surrounding mental health among medical professionals, understand the evolution of topics, and identify key areas of interest and research gaps.

The search strategy for sourcing bibliometric data was meticulously designed to align with the study's objectives. The strategy focused on refining the search to include articles classified as "original research" or "review" published in English. This refined focus allows for a comprehensive examination of the current state of mental health research among

physicians. By downloading a substantial volume of relevant articles in plain text format, this study ensured a rich dataset for in-depth analysis to uncover trends, dominant themes, and potential directions for future studies in this field.

Results

The bibliometric analysis identified 3,360 publications, including 3,137 original research and 223 reviews (Table 1). These studies were disseminated across 1,066 distinct journals and sources, demonstrating the extensive academic engagement with this topic. On average, each article received 8.03 citations, with an annual citation rate of 1.08 per article, underscoring the sustained relevance of research in this field. The mean publication age was 7.47 years, reflecting a substantial accumulation of scholarly work over the past decade. Collectively, these studies cited 27,140 references, highlighting the strong academic foundation underpinning physician mental health research. Furthermore, the dataset included 14,792 KeyWords Plus and 10,344 Author Keywords, illustrating the diverse themes explored within the literature. The authorship analysis indicated contributions from 14,619 researchers, with 268 single-authored articles and 3,112 collaborative works, emphasizing the high degree of research collaboration in this domain. Table 1 provides a detailed summary of these bibliometric indicators.

Table 1. Overview of Bibliographic Data

Description	Results
Timespan	2010-2023
Total articles	3,360
Average years from publication	7.47
Average citations per article	8.03
Average citations per year per article	1.08
Total references	27,140
Article type – original research	3,137
Article type – review	223
Dataset - KeyWords Plus	14,792
Dataset - Author Keywords	10,344
Total authors	14,619
Authors of single-authored articles	268
Authors of multi-authored articles	3,112

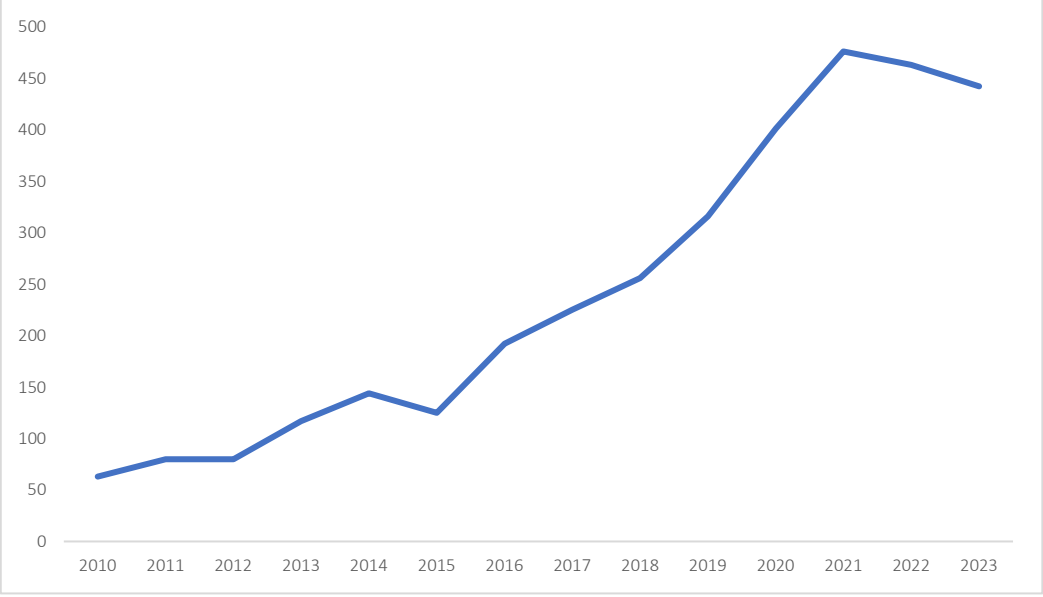

Figure 1. Trends of Total Number of Publications

Figure 1 displays a clear upward trend in the total number of publications on mental health among doctors and physicians from 2010 to 2023. Starting with 63 publications in 2010, there was a notable increase each year, peaking at 476 in 2021. Although there was a slight decrease in 2022 and 2023, with 463 and 442 publications, respectively, the overall trajectory suggests a growing academic focus on this critical area of healthcare research.

Table 2. Global Citation of Mental Health Issues Among Doctors and Physicians

Rank	Country	Total of Citation	Average Citations per Article
1	The United States	51,704	37.09
2	The United Kingdom	7,573	23.89
3	Canada	7,456	33.14
4	China	5,213	30.31
5	Australia	4,887	25.86
6	Italy	4,248	32.43
7	Germany	3,685	22.33
8	The Netherlands	2,823	28.23
9	France	1,751	25.38
10	Spain	1,707	18.76

For the total of citations by country, the United States ranks first by a fairly large margin, amassing 51,704 total citations and an average of 37.09 citations per article, indicating a significant impact on the global research community (Table 2). The United Kingdom and Canada follow with 7,573 and 7,456 total citations, respectively, and average citations per article of 23.89 and 33.14, denoting high engagement with their research outputs. Notably, Italy, with fewer total citations than Australia and China, exhibits a higher average citation rate, suggesting that while the research volume may be lower, the influence per article is substantial. The list concludes with Spain, which, despite its tenth position, reflects a commendable international research contribution.

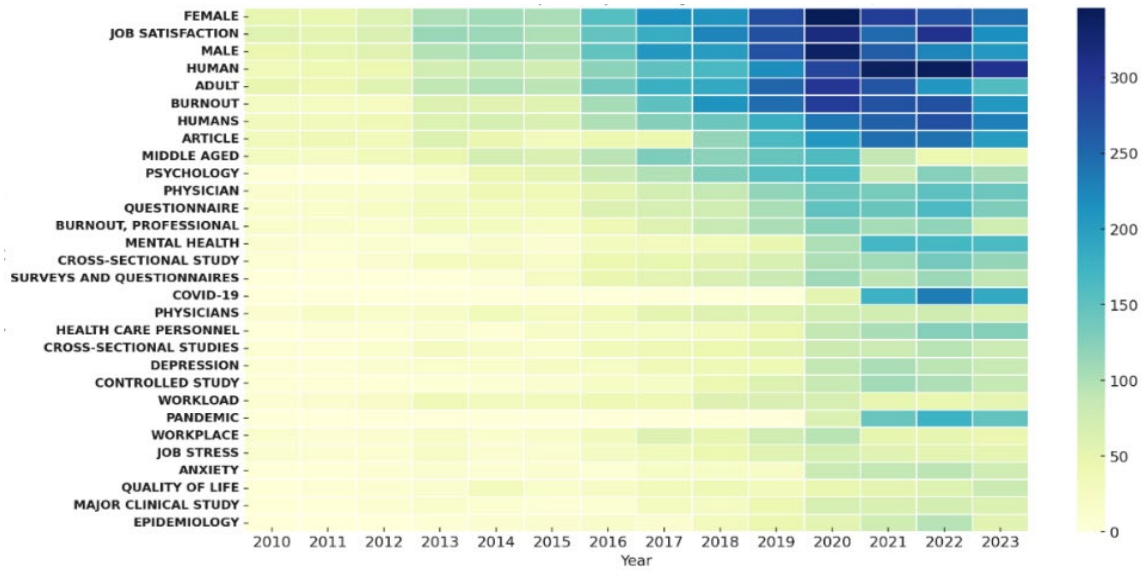

Figure 2. Heatmap of Thematic Evaluation

The Thematic Evolution Map provides a compelling visualization of the shifting landscape of research emphasis in the field of mental health among healthcare workers from 2010 to 2023 (Figure 2). It captures the frequency of the top 30 keywords, with prominence given to terms such as "DEPRESSION," "BURNOUT," and "MENTAL HEALTH," signifying a strong research focus on these critical areas. The heatmap's gradation from light to dark hues corresponds to increased keyword occurrences, indicating growing scholarly attention. Notably, "COVID-19" has emerged sharply in recent years, reflecting the pandemic's significant impact on healthcare research. The term "BURNOUT" shows a sustained presence,

peaking around 2020, aligning with the global health crisis' peak years. "QUALITY OF LIFE" and "JOB STRESS" also feature prominently, underscoring the concern for healthcare professionals' well-being. The map reveals not only the prevalence of topics but also their interconnectedness and evolution, highlighting how global events and societal changes drive scholarly inquiry and discourse.

Table 3. Top 10 Research Keywords

Rank	Author Keywords	Frequency	Rank	KeyWords Plus	Frequency
1	Burnout	312	1	human	3,041
2	Resilience	183	2	Doctor	2,545
3	Stress	107	3	female	1,955
4	Physicians	87	4	questionnaire	1,290
5	Depression	55	5	male	1,210
6	Nurses	45	6	burnout, professional	1,204
7	Wellness	45	7	adult	994
8	Physician	41	8	article	898
9	Anxiety	39	9	survey	847
10	Junior Doctor	38	10	middle aged	764

The table contrasts the top 10 Authors Keywords with KeyWords Plus from bibliometric research, revealing prevalent themes in studies on mental health among medical professionals (Table 3). “Burnout” emerges as the most cited author keyword at 312 occurrences, mirroring its centrality in contemporary discourse. At the same time, “human” leads the KeyWords Plus category with 3,041 mentions, reflecting a broad humanistic focus in related research. Other prominent Author Keywords include “resilience” and “stress,” indicating key research interests in adaptive strategies and psychological pressures, respectively. The presence of “physicians,” “depression,” “nurses,” and “anxiety” underscores the diverse professional scope and psychological states examined. “Doctor,” “female,” and “questionnaire” are significant in KeyWords Plus, highlighting demographic specifics and methodological tools employed in the field. The data collectively underscored the critical emphasis on occupational burnout, sex-based perspectives, and evaluative methodologies in the literature.

Table 4 reflects a bibliometric analysis of the most cited research on mental health among physicians, with a focus on burnout, work-life balance, and systemic factors affecting well-being. Studies from the United States dominated, revealing a significant prevalence of burnout, especially among frontline physicians, compared to other workers. This study underscored the impact of burnout on patient care and healthcare costs, stressing the need for systemic solutions, including leadership involvement and comprehensive organizational strategies.

The rise in physician burnout between 2011 and 2014 was notable, as the wide range of burnout prevalence indicated a complex issue with varying definitions and measurements. The data also highlighted the psychological toll of the COVID-19 pandemic on healthcare providers, both in the United States and China, emphasizing resilience in the face of stress and the need for supportive measures. Issues with electronic health records and the work environment further influence satisfaction and stress-related disorders among physicians, suggesting that both technological and psychosocial workplace reforms are essential for improving mental health outcomes for physicians.

Discussion

This comprehensive bibliometric analysis has shed light on the significant mental health struggles that physicians face, with a specific emphasis on burnout, work-life balance, and the systemic elements affecting their overall health. A review of the 10 most cited articles on physicians' mental health revealed critical research gaps and opportunities for future studies. A key finding was that studies on physicians’ mental health were disproportionately concentrated in high-income countries, particularly the United States. In contrast, studies from low- and middle-income countries (LMICs) remain limited.[23] The limited literature from the LMICs may reflect less awareness, insufficient infrastructure of research, or underreporting of mental health issues among physicians. This raises concerns about whether similar challenges exist in these underrepresented areas but remain undocumented. Furthermore, there was a lack of longitudinal studies examining long-term mental health outcomes or the sustained impact of organizational reforms, making it imperative to conduct studies establishing causal relationships between systemic changes and physician well-being.

Table 4. Characteristics of Top 10 Most Cited Articles

Title	Year	Authors	Citation	Country	Key Points
Burnout and Satisfaction with Work-Life Balance Among US Physicians Relative to the General US Population[13]	2012	Shanafelt TD *et al.*	2,177	The United States	Nearly half of the physicians reported burnout symptoms. Those in primary care access specialties faced the highest burnout risk. Physicians had more burnout and work-life balance dissatisfaction than other workers.
From Triple to Quadruple Aim: Care of the Patient Requires Care of the Provider[14]	2014	Bodenheimer T *et al.*	2,141	The United States	Physician burnout affects patient care and healthcare costs. Staff burnout harms the healthcare system's overall efficacy. Provider work-life improvement is key to healthcare's Triple Aim.
Changes in Burnout and Satisfaction with Work-Life Balance in Physicians and the General US Working Population Between 2011 and 2014[15]	2015	Shanafelt TD *et al.*	1,677	The United States	Physician burnout increased significantly over three years. Physicians' satisfaction with work-life balance worsened. The burnout issue is more pronounced in physicians than in the general working population.
Understanding the Burnout Experience: Recent Research and Its Implications for Psychiatry[16]	2016	Maslach C *et al.*	1,418	The United States	Burnout in psychiatry correlates with negative outcomes for patient care. Burnout is job-specific, distinct, yet related to depression. Social and organizational factors play a role in addressing burnout.
Executive Leadership and Physician Well-being: Nine Organizational Strategies to Promote Engagement and Reduce Burnout[17]	2017	Noseworthy JH *et al.*	967	The United States	Over half of the physicians experience burnout. Burnout is systemic, not just an individual issue. Nine strategies, including leadership and community, are proposed to combat burnout.
Prevalence of Burnout Among Physicians: A Systematic Review[18]	2018	Rotenstein LS *et al.*	963	The United States	Physician burnout prevalence varies widely across studies. Definitions and assessments of burnout are inconsistent. The exact prevalence rate of burnout among physicians is unclear.
The Experiences of Healthcare Providers During the COVID-19 Crisis in China: A Qualitative Study[19]	2020	Liu Q *et al.*	935	China	Providers faced emotional stress and felt powerless. Infection fears and psychological burdens were high among providers. Resilience was shown through self-management and social support.
Psychological Distress, Coping Behaviours, and Preferences for Support Among New York Healthcare Workers During the COVID-19 Pandemic[20]	2020	Shechter A *et al.*	655	The United States	Psychological distress was prevalent among healthcare workers. Sleep issues were common, but a sense of purpose increased. Resilience was noted despite the high levels of stress.
Relationship Between Clerical Burden and Characteristics of the Electronic Environment with Physician Burnout and Professional Satisfaction[21]	2016	Dyrbye LN *et al.*	644	The United States	Electronic Health Records (EHRs) and Computerized Physician Order Entry (COPE) systems are linked to increased physician burnout. Clerical dissatisfaction is associated with EHRs and CPOE. Younger physicians were more satisfied with their electronic environment, but dissatisfaction was common across ages.
Psychosocial Work Environment and Stress-Related Disorders, A Systematic Review[22]	2010	Nieuwenhuijsen K *et al.*	569	The Netherlands	High job demands, low control, and low support are linked to Stress-Related-Disorders (SRDs). Lack of justice at work predicted the incidence of SRDs. Effort-reward imbalance was strongly associated with SRDs.

Another notable gap was the limited focus on specialty-specific challenges, as most studies assess physicians as a homogeneous group without considering the unique stressors associated with fields such as oncology, emergency medicine, and surgery. The increase in burnout, particularly among frontline physicians, who are facing rates higher than

seen in other professions, is concerning.[24] A key finding of this study was the increase in burnout rates among physicians in 2011-2014, followed by a further surge during the COVID-19 pandemic. This trend suggested structural changes in healthcare systems that warrant further investigation. Additionally, this study identified variations in how burnout was defined and measured across studies, highlighting the need for standardized assessment tools to improve comparability and intervention effectiveness.

Burnout among physicians is a critical issue threatening a physician's well-being and healthcare quality. Recognized by the WHO as a state of chronic occupational stress, burnout among medical professionals has reached alarming levels, with reports suggesting a prevalence rate between 27% and 75%.[24] This epidemic of exhaustion is not confined to practicing doctors but has roots traceable to the nascent stages of medical education and grows more acute throughout one's career. Studies indicate that American physicians experience burnout at significantly higher rates than the general population. At the same time, resident physicians in Tunisia and Sudan also report high burnout levels, suggesting a global crisis.[25,26] The implications of this condition are far-reaching and multifaceted, compromising not only the health and well-being of the physicians themselves but also the standard of patient care they are able to provide. The relationship between burnout and an array of negative outcomes, such as medical errors, a hostile attitude to patients, and difficulty in professional interactions, is well-established.[17] On a personal level, it contributes to depression, anxiety, and reduced job performance, highlighting the urgent need for comprehensive interventions.[27] The increasing workload, administrative burdens, and hierarchical workplace structures exacerbate these challenges, making organizational reforms essential.[28]

The COVID-19 pandemic significantly heightened awareness of mental health challenges among physicians, as evidenced by a surge in research publications during this period. Studies conducted during the pandemic highlighted the increased emotional strain, decision-making fatigue, and exposure to trauma faced by physicians, particularly those in emergency and critical care settings.[27,29] This study found that studies on mental health issues among physicians peaked in 2020–2021, reflecting a growing academic focus on burnout, anxiety, and depression among frontline healthcare workers. The exigencies of working in such an environment, as characterized by excessive protective gear, dehydration, lack of rest, and the constant threat of illness, have led to a marked increase in burnout symptoms.[30] Studies conducted during the pandemic reveal that physicians have reported heightened levels of burnout compared to pre-pandemic times.[31] During the pandemic, physicians encountered additional stressors exacerbating their burnout, including concerns about transmitting the virus to their families, increased childcare responsibilities due to extended work hours and school closures, apprehension regarding their organization's support for their personal and familial needs in the event of infection, and limited access to timely information and communication.[32] These findings underscored the need for urgent attention to the mental health crises precipitated by such global health emergencies. Despite the odds, they also pointed to the resilience exhibited by doctors, emphasizing the human capacity to adapt and endure even in the most trying circumstances.

The technological landscape within which doctors operate has also come under scrutiny, with electronic health records (EHRs) drawing particular concern.[33] While these systems were envisioned as tools to streamline patient care and foster shared decision-making, the reality has been less than ideal. Many physicians found themselves mired in increased administrative work, with EHRs contributing to the time burden rather than alleviating it.[30] Issues of poor user-friendliness, unreliable systems, and outdated hardware compound the problem, detracting from patient interaction and contributing to physician dissatisfaction. Furthermore, frequent interruptions from phone calls and other technological disruptions have been linked to significant adverse effects, such as medication errors.[34] The discord between the intended benefits of healthcare technology and the actual experience of doctors reflects a disconnect in innovation that fails to align with the practical needs of its users.[35] Co-creation, the collaborative development of technology involving its end-users from inception, emerges as a crucial strategy for bridging this gap and ensuring that technological advancements support rather than hinder healthcare delivery.

At the organizational level, factors such as work-life balance, job autonomy, and institutional support play a critical role in physician well-being. A previous study suggested that perceived organizational support is a key determinant of job satisfaction, professional performance, and employee retention.[36] However, a study on mental health support systems within healthcare institutions remains limited, particularly during crises.[37] The COVID-19 pandemic has highlighted the importance of organizational support in safeguarding mental health, encompassing the provision of protective equipment, psychological support, and involvement in decision-making processes. The dearth of empirical data on the impact of such support measures on healthcare workers' mental health, particularly concerning post-traumatic and depressive symptoms or perceived stress, calls for a concerted research effort.[38]

Conclusion

This bibliometric analysis identifies critical gaps in physician mental health research, including the need for longitudinal studies, specialty-specific research, and expanded global coverage. The COVID-19 pandemic has intensified mental health challenges among physicians, necessitating targeted interventions for high-risk medical fields. Additionally, technological inefficiencies and workplace structures contribute significantly to burnout, underscoring the need for organizational reforms. Addressing these issues through standardized mental health assessments, stronger institutional policies, and evidence-based interventions will be essential for improving physician well-being and healthcare system sustainability. Specialty-specific studies are also crucial for addressing unique challenges faced by different medical fields.

Abbreviations

WHO: World Health Organization; LMCIs: low- and middle-income countries; EHRs: electronic health records.

Ethics Approval and Consent to Participate

This bibliometric analysis did not involve primary research with human or animal subjects, hence obviating the need for an ethics approval or consent process. The investigation was conducted solely on the basis of previously published data, adhering to all relevant ethical standards for secondary data analysis.

Competing Interest

The authors declare no competing interest in the preparation, analysis, or presentation of this study. This statement affirms that there have been no personal or financial relationships or affiliations that could have inappropriately influenced the work presented in this study.

Availability of Data and Materials

The data supporting the conclusions of this study are derived entirely from publicly accessible sources. These sources include established academic databases such as ISI Web of Knowledge, PubMed, Scopus, Ovid Medline, and Google Scholar. A supplementary file, offering additional insights and specifics about the utilized datasets, is available for public scrutiny, ensuring transparency and replicability of the research findings.

Authors' Contribution

The contributions to this research paper were equally multifaceted and collaborative.

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Determinants of Adolescent Resilience Levels in Surabaya City, East Java Province, Indonesia

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Determinants of Adolescent Resilience Levels in Surabaya City, East Java Province, Indonesia

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Abstract

Assessing adolescent resilience may provide valuable insights into adult resilience. This study aimed to analyze the relationship between determinants and adolescent resilience in Surabaya City. The participants of this cross-sectional study were 277 adolescents aged 12–19 years who were in senior high school. The outcome was the resilience levels. This study's findings indicated relationships between resilience levels and stress experience (p-value = 0.01), access to mental health information (p-value = 0.00), life satisfaction (p-value = 0.00), family harmony (p-value = 0.03), presence of adults to share (p-value = 0.04), feeling safe at home, school, and community (p-value = 0.00), perception of ideal body image (p-value = 0.03), and suicidal urges (p-value = 0.00). The multivariate analysis showed that a variable related to resilience was satisfaction with life (p-value = 0.04, 95% CI 1.07–24.22). Adolescents dissatisfied with their lives had a 5.09-fold greater risk of developing into established categories of resilience. Therefore, intervention efforts are necessary to increase adolescents' resilience levels.

Keywords: adolescent, level, resilience, stress, prevention

Introduction

Global data on mental health, according to the 2021 World Health Organization report, indicate that one in seven adolescents aged 10–19 years experience mental health issues, which mainly include depression and anxiety; suicide cases are the fourth leading cause in the 15–19 age group.[1] In younger adolescents (11–16 years old), the prevalence of mental health problems was the same among male and female adolescents. However, in older adolescents (17–19 years old), mental health issues are more common in female adolescents, with almost 1 in 4 female adolescents (23.9%) experiencing mental health issues, compared to 1 in 10 male adolescents (10.3%).[2] Self-harm and suicide attempts are six times more prevalent among adolescents aged 11–19 years[3] with mental health issues (32.8%) than among those without (5.1%).[4] Fifty percent of mental health issues occur by the age of 14 and 75% by the age of 24.2. Approximately 10% of those aged 5–16 years have a clinically diagnosable mental health issue, yet 70% of them have not received appropriate interventions at a fairly early age.[4,5]

The national prevalence of depression in Indonesia was 1.4% in 2023, with the young adult group aged 15–24 years occupying the highest prevalence of depression at 2%.[2] The 2022 Indonesian adolescent mental health survey found that 5.5% of adolescents aged 10–17 years had mental disorders.[2] Of these, 1% had depression, 3.7% had anxiety, 0.9% had post-traumatic stress disorder, and 0.5% had attention-deficit/hyperactivity disorder. Depression is a mental disorder prone to occur in adolescents. Data also show that 6.1% of the Indonesian population aged 15 years and older have mental disorders, including those in Surabaya City, with an 18.8% prevalence of those suffering from depression, anxiety, and other mental disorders.[2]

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Primary health care (PHC) is spread across 31 subdistricts in Surabaya City, each of which has a psychologist. These PHCs provide mental health care through outpatient care, with a visit rate of 33.22%, which is accessible to adolescents. Common mental health issues include drug-related, psychotic, and neurotic issues.[6] From the results of previous studies, junior and senior high school students in Surabaya City experienced emotional disorders at a rate of 60.17%, with symptoms of loneliness at 44.54%, anxiety at 40.75%, and suicidal attempts at 7.33%.[2,5,7]

Failure to address adolescent mental health issues will ultimately impact adulthood, negatively affecting physical and mental health and limiting the potential to live a good life in adulthood.[1] Adolescent health entails not only physical but also mental health. The adolescent health status in the global health indicators includes adolescent birth rates as an indicator of global fertility. Mental health is included among the 100 global health indicators.[8]

Adolescents are vulnerable to mental disorders, and their success or failure in addressing these issues depends on the risks and protective factors involved. The interaction between risks and protective factors affects resilience.[9] A person's resilience lies in adapting well to adversity, threats, tragedies, traumas, and even severe stressors.[10] Resilience in adolescents is similar to that in adults. Examining resilience during adolescence may provide valuable insights into adult resilience.

Highly resilient adolescents are less likely to have mental health issues.[11] Resilience levels consist of individual, group (family and peer group), and community levels. At the individual level, the focus is on assessing the extent to which individuals have the resources to manage adversity and emotional, social, and physiological recoveries after trauma. Individual resilience is influenced by family, peer group, and community characteristics. A resilience concept for problem-solving at the individual level is more appropriate for research because it has a greater likelihood of increasing resilience at that level.[12]

This study determined the extent of the resilience of adolescents in Surabaya City, thus preventing the emergence of mental health issues in adolescents on a widespread basis. This study is necessary to reduce cases of adolescent mental health problems in general in Indonesia, specifically in Surabaya City, by observing the determinants. In addition, this study provided basic evidence for developing appropriate interventions to improve the resilience of city adolescents. Therefore, this study aimed to analyze the determinants of adolescent resilience levels in Surabaya City.

Method

This quantitative study used a cross-sectional design conducted from June to August 2023 in Surabaya City, East Java Province, Indonesia. Data were collected through an online questionnaire using Google Forms on June 1–15, 2023, among Surabaya adolescents. The dependent variable was resilience level, and the independent variables were stress experience, access to mental health information, life satisfaction, family harmony, presence of adults to share, feeling safe at home, school, and community, perception of ideal body image, and suicidal urges. The questionnaire consisted of 20 items categorized as "yes," "no," and "sometimes." This instrument was modified from the Adolescent and Young Adult Health Questionnaire (11–20 Years).[13]

The outcome measured in this study was the resilience level. The instrument used to assess resilience was the Nicholson–McBride Resilience Questionnaire (NMRQ). The questionnaire consisted of 12 items that assessed an individual's condition using a Likert scale of 1–5. Score 1 indicated strong disagreement, whereas score 5 indicated strong agreement. The total score can be classified into four categories: developing level with a score of 0–37; established level with a score of 38–43; strong level with a score of 44–48; and exceptional level with a score of 49–60.

The sample size was determined using the Lemeshow formula with $\alpha = 0.05$ and β-power 90%,[14] and the study population consisted of adolescents from Surabaya City. The minimum number of participants was 277 adolescents aged 12–19 years in senior and vocational high schools in Surabaya City. The samples were obtained using the random sampling technique: school data were obtained from the Surabaya City Education Office by observing area-based school information (the West, East, South, North, and Central Surabaya). Each of the five areas was represented by a randomly selected school. The respondents came from those five representative schools. A random selection was made from all the students at each selected school to select the respondents.

A Google Forms link outlining information on the research and consent form to be a respondent was delivered to the selected students via their teachers in charge of student affairs at each selected school. For minor participants aged 12–16 years, informed consent was required from their parents. The participants aged 17 years and older were allowed

to provide informed consent. The respondent response rate was 60%.

This study performed bivariate statistical analysis using a Chi-square test to examine the relationships between several factors: stress experience, access to mental health information, life satisfaction, family harmony, presence of adults to share, feeling safe at home, school, and community, perception of ideal body image, and suicidal urges. For the multivariate analysis, binary logistic regression was employed to classify resilience levels into two categories: "developing-established" (coding as 1) and "strong-exceptional" (coding as 0). The binary logistic regression model demonstrated a robust fit, as indicated by the non-significant Hosmer–Lemeshow test and overall percentage classification table. The significance level was set at $\alpha = 0.05$ for all statistical tests. The risk ratio (RR) was also calculated to assess the risk or condition associated with adolescent resilience levels with a 95% Confidence Interval (CI). All statistical analyses were performed using the free version of the STATA software.

Results

A total of 277 respondents comprised 70.8% female and 29.2% male adolescents. Regarding education levels, more than half of the respondents (81.9%) were in senior high school, while the remaining 18.1% were in junior high school. In terms of grades, most respondents were in grade 11 at 36.8%, followed by grade 12 at 22.7%, and grade 10 at 21.7% at the senior high school level. The remaining respondents were junior high school students in grade 7 (9.7%), grade 8 (8.7%), and grade 9 (0.4%). The area distribution covers East Surabaya at 29.6%, West Surabaya at 25.3%, South Surabaya at 24.2%, North Surabaya at 11.2%, and Central Surabaya at 9.7%.

A total of 26% of the adolescents suffered from several mental health issues, including stress, anxiety, eating disorders, body image concerns, depression, suicidal urges, and suicidal behavior. Additionally, 78% had experienced mild, moderate, or severe stress. A total of 63% of adolescents had access to mental health information. Information is obtained from websites, smartphone applications, PHCs, and other media, such as educational materials from college students and printed media, including posters, brochures, or leaflets. The highest resilience level was in the developing category, at 58.1%. These findings highlighted the need for further resilience development, as resilience remains relatively low. The demographic characteristics of adolescents in Surabaya are presented in Table 1.

According to Table 2, based on the bivariate analysis, a significant relationship (p-value ≤0.05) was found between resilience level and the determinants, including stress experiences, life satisfaction, family harmony, presence of adults to share, feeling safe at home, school, and community, perception of ideal body image, suicidal urges, and access to mental health information. Statistical analyses showed that the adolescent resilience level had a significant relationship (p-value <0.05) with stress experience, access to mental health information, life satisfaction, family harmony, the presence of adults to share, feeling safe at home, school, and community, perceptions of an ideal body image, and suicidal urges. Several of these determinants also indicated risk factors for adolescent resilience. Adolescents experiencing stress had a 1.16 times greater risk of developing established resilience levels; therefore, the success of interventions aimed at improving resilience may rely on strategies to prevent stressors or detect symptoms of stress.

Adolescents with no access to mental health information were 14% less likely to develop established resilience levels; hence, easier access to information among adolescents may lead to stronger to exceptional resilience levels. Adolescents who were sometimes satisfied and dissatisfied with their lives had a 1.2 to 1.3 times (95% CI) greater risk of developing established resilience levels. Adolescents who did not have the presence of an adult to share with had a 1.1 times greater risk of developing established resilience levels; therefore, the presence of an adult to confide in is needed to improve their resilience. Adolescents who did not feel safe at home, school, and the community had a 1.2-fold greater risk of developing established resilience levels. Therefore, fostering a sense of safety at home, school, and in the community is necessary to promote better resilience.

Adolescents with suicidal urges had a 1.2 times greater risk of developing established resilience levels. However, based on the 95% CI, adolescents' perception of their body image was not significantly related to developing an established level of resilience; thus, in this case, the perception of an ideal body image was not a risk factor for developing an established level of resilience. These findings suggested that adolescents' perception of an ideal body image was not a determinant of the success of their resilience efforts.

Table 1. Demographic Characteristics of Respondents (N = 277)

Characteristic	n	%
Sex		
Male	81	29.2
Female	196	70.8
Education Level		
Junior High School	50	18.1
Senior High School	227	81.9
Grade		
7	27	9.7
8	24	8.7
9	1	0.4
10	60	21.7
11	102	36.8
12	62	22.7
Age		
12–15 years	53	19.1
16–19 years	224	80.9
Area		
East Surabaya	82	29.6
West Surabaya	70	25.3
North Surabaya	31	11.2
Center Surabaya	27	9.7
South Surabaya	67	24.2
Experiences of mental health difficulties		
Yes	73	26.4
No	99	35.7
Do not know	105	37.9
Experiencing stress		
Yes	216	78
No	61	22
Accessing mental health information		
Yes	167	60.3
No	110	39.7
Source of information		
Primary Health Care	17	10.2
Website	73	43.7
Smartphone applications	60	35.9
Printed media	3	1.8
Others	14	8.4
Resilience level		
Developing	161	58.1
Established	75	27.1
Strong	34	12.3
Exceptional	7	2.5

The bivariate analysis (Table 2) revealed eight significant variables. However, after multivariate analysis was conducted to control for the influences of other variables, the relationship observed in the bivariate analysis was likely influenced by other variables outside the variables studied or confounding variables. The binary logistic regression analysis indicated a robust fit for the model, as evidenced by a non-significant Hosmer–Lemeshow test (p-value = 0.958). Furthermore, the model demonstrated substantial predictive accuracy, with 84.8% of cases correctly classified, as reflected in the overall percentage of the classification table. From the results of the multivariate analysis, only one variable had a statistically significant relationship with the level of resilience: the "life satisfaction" variable, with a significance value of p-value = 0.04 and an adjusted RR of 5.09 (95% CI 1.07–24.22). Therefore, adolescents who were dissatisfied with their lives had a 5.09-fold greater risk of developing an established resilience level.

Table 2. Relationship between Determinant Factors and Resilience Levels Among Adolescents in Surabaya City (N = 277)

Category	Resilience Level						Crude RR (95% CI)	p-value	Adj RR (95% CI)	p-value
	Developing-Established		Strong- Exceptional		Total					
	n	%	n	%	n	%				
Stress experience										
Yes	190	87.9	26	12.0	216	100.0	1.16 (1.00–1.36)	0.01*	0.92 (0.36–2.30)	0.84
No	46	75.4	15	24.6	61	100.0	ref			
Accessing mental health information										
Yes	146	87.4	21	12.6	167	100.0	ref			
No	90	81.8	20	18.2	110	100.0	0.86 (0.77–0.97)	0.00*	0.75 (0.35–1.60)	0.45
Life satisfaction										
Yes	24	68.5	11	31.4	35	100.0	ref			
No	58	95.1	3	4.9	61	100.0	1.38 (1.10–1.75)	0.00*	5.09 (1.07–24.22)	0.04*
Sometimes	154	85.1	27	14.9	181	100.0	1.24 (0.98–1.57)	0.01*	1.71 (0.64–4.59)	0.29
Family harmony										
Yes	111	80.4	27	19.6	138	100.0	ref			
No	17	89.5	2	10.5	19	100.0	1.11 (0.93–1.32)	0.34	0.87 (0.07–9.83)	0.91
Sometimes	108	90.0	12	10.0	120	100.0	1.12 (1.01–1.24)	0.03*	1.50 (0.59–3.76)	0.40
Presence of adults to share										
Yes	90	79.6	23	20.4	113	100.0	ref			
No	94	89.5	11	10.5	105	100.0	1.12 (1.00–1.26)	0.04*	1.25 (0.50–3.14)	0.63
Sometimes	52	88.1	7	11.9	59	100.0	1.11 (0.97–1.26)	0.16	1.70 (0.65–4.44)	0.28
Feeling safe at home, school, and community										
Yes	78	75.0	26	25.0	104	100.0	ref			
No	15	93.8	1	6.2	16	100.0	1.25 (1.05–1.48)	0.33	1.82 (0.17–18.97)	0.62
Sometimes	143	91.1	14	8.9	157	100.0	1.21 (1.08–1.37)	0.00*	2.17 (0.90–5.22)	0.08
Perception of ideal body image (weight and height)										
Yes	61	80.3	15	19.7	76	100.0	ref			
No	151	89.9	17	10.1	168	100.0	1.12 (0.99–1.26)	0.03*	1.60 (0.70–3.60)	0.27
Sometimes	24	72.7	9	27.3	33	100.0	0.90 (0.71–1.15)	0.38	0.55 (0.19–1.55)	0.26
Suicidal urges										
Yes	80	94.1	5	5.9	85	100.0	1.20 (1.08–1.34)	0.00*	1.79 (0.55–5.76)	0.33
No	97	78.2	27	21.8	124	100.0	ref			
Sometimes	59	86.8	9	13.2	21	100.0	1.11 (0.97–1.27)	0.15	0.81 (0.30–2.11)	0.66

Notes: Crude RR = crude risk ratio, Adj RR = adjusted risk ratio, *= significant value (<0.05)

Discussion

The demographic characteristics of adolescents in this study were predominantly female, aged 16–19 years. Older age and lower economic status have a greater impact on emotional pressure among female adolescents, who have lower perceptions of mental health. However, female adolescents exhibited higher prosocial behavior scores, acting as a buffer against mental health issues.[15] Sex is a strong and significant explanatory factor in the perception of self-health in adolescents. Females demonstrated a significantly higher perception of self-health.[16]

However, the results of several studies on resilience indicated that stress records are a determining factor in the success of resilience-increasing efforts.[17-20] There is an interaction between resilience, stress, and well-being. Resilience and low stress levels can predict better well-being.[17] Stress felt is a high-risk factor for resilience (p-value <0.001).[18] Resilience serves as a strong indicator of adolescents' vulnerability to stress or depression. Improving resilience against psychological pressure in adolescents is essential for improving their well-being.[19] There is a positive relationship between daily stress, anxiety, and resilience.[20]

In the context of COVID-19, clear and accessible information has played a crucial role in developing adolescents' resilience to face the pandemic. The raising of awareness has led to improved prevention and protection.[21] One of the determinants in improving resilience is information access that comprehensively promotes resilience.[22] Another important factor influencing the resilience level based on the results was life satisfaction. In terms of contentment with current life, the analysis results revealed that being content with the life one faces is a related factor in the success of efforts to increase resilience, with a significance level of 0.0029. A low degree of life contentment is predicted to lead to prominent symptoms of depression and anxiety.[23] Furthermore, the findings of a study across 81 cities in Turkiye, using SEM analysis, indicated a relationship between resilience, contentment, and hope. Resilience was found to directly and indirectly affect individual subjective contentment.[24] A high level of resilience affects life satisfaction (p-value = <0.001). This indicates that when individuals possess high resilience, they are satisfied with their current lives.[25]

A good support system can improve adolescent resilience and life satisfaction.[26] In addition, family function significantly predicts satisfaction with life.[27] The effective ways to increase life satisfaction, which affects the adolescent resilience level, are establishing life goals, having positive emotions, and receiving social support from family, friends, and the school environment.[28] Adolescents with life goals and positive emotions feel satisfied with their lives.[29] The contributing factors to life satisfaction in adolescents are social support from family, friends, and the school environment.[30]

Another factor related to the level of resilience is the harmonious family, in which family harmony is a determinant of the success of resilience-increasing efforts, with a significance level of 0.015. Adolescents whose families have high resilience also exhibit a higher resilience level.[31] A harmonious family is a function of the family as a place to grow.[32] The family function significantly predicts resilience, with each family member's contribution and the quality of the family unit affecting resilience levels. A resilient family demonstrates a strong focus on family harmony, communication, finances, and family-focused events.[27]

In addition, an influential factor in the level of resilience is the presence of adults with whom to share the issues, which was revealed to be a determinant factor in the success of resilience-increasing efforts. Communication with empathy (p-value <0.005) is an alternative to boost resilience.[33] The closeness of adolescents with adults significantly impacts resilience levels. Adolescents who maintain a high level of closeness with their parents, compared to those with a low level, have a higher resilience level.[34] Sharing inherent trauma is a form of treatment to ensure physical safety at the individual level.[35]

Another influential factor in the resilience assessment was feeling safe at home, school, and community. The results indicated that the feeling of safety was the most prominent determinant of adolescent resilience, with a significance of 0.003. Social support from family, peers, and the community enables us to increase the individual resilience level.[25] Enhancing individual capacity generally creates community resilience and vice versa; a resilient community contributes to the development of resilient individuals who are capable of facing crises. This is also in line with the social capital approach.[36]

Undeniably, apart from the aforementioned, the perception of an ideal body image is also related to resilience. Perception of the body causes the emergence of symptoms of depression and anxiety disorders.[37] Findings suggested that illness perception, body image, and personality were determinants of resilience. Last, suicidal urges are also a factor that determines the level of adolescent resilience. Suicidal behaviors notably occurred in groups with lower resilience levels (p-value <0.001). The resilience level showed a significant protective effect on longitudinal life planning (OR 0.25, p-value

= 0.003).[18] Psychological resilience is a potential factor in suicidal attempts.[38] Individuals who lose resilience face high risks of committing suicide.[39]

In Surabaya City, several programs managed by the health and non-health sectors can indirectly improve adolescent resilience, although they have not specifically targeted mental health. The first program is the Anti-Juvenile Delinquency Cadre program, led by the Surabaya City Youth and Sports Office, which aims to reduce the number of juvenile delinquency cases in the city. Second, the adolescent integrated health care program and health ambassadors, led by the Surabaya City Health Office, aim to empower adolescents in the health sector by creating peer educators.[40]

The adolescent resilience levels assessed in this study will enable further studies to determine appropriate interventions based on resilience levels. The limitation of this study was that the determinants and resilience levels were measured in the same period, making it difficult to assess causal relationships. In addition, the level of resilience observed was at the individual level, excluding family resilience, although family and community factors are related to the level of resilience. The programs implemented are still partial and not comprehensive; therefore, a more comprehensive program is needed with integration and contribution from relevant sectors or the expansion of programs to various youth groups.

Conclusion

Life satisfaction has the strongest relationship with resilience. The higher the life satisfaction of adolescents, the higher their level of resilience. Adolescent life satisfaction can be achieved in several ways, including having life goals, positive emotions, and social support from family, friends, and school. Therefore, efforts to improve adolescents' individual abilities to set life goals for the future, manage emotions to foster positive emotions, and increase social support are needed. To develop mental health programs for adolescents, relevant stakeholders should consider adolescents' personal skills, such as emotional regulation and life goal planning, as well as the influence of parents, families, and social environments (schools and communities), as these factors are significantly related to the condition of adolescent resilience to mental health issues. Other researchers interested in studying adolescent health should focus on the influence of family on resilience.

Abbreviations

PHC: primary health care; RR: risk ratio; CI: confidence interval.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Faculty of Dentistry, Airlangga University, with approval number 1189/HRECC.FODM/X/2023. Informed consent requires parents' consent as guardians because teenagers are not yet old enough.

Competing Interest

The authors declare that they have no competing interests.

Availability of Data and Materials

The primary author can provide all data and materials from this study.

Authors' Contribution

RDR designed the research. FST and DS provided advice and reviewed the manuscript. RDR, MDI, and AR wrote and proofread the manuscript and did the data analysis. The authors read and approved the final manuscript.

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Five-Year Journey of Technical Assistance in Health Governance Reforms: A Case Report

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Five-Year Journey of Technical Assistance in Health Governance Reforms: A Case Report

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Abstract

Many districts and cities in Indonesia continue to have Public Health Development Index scores below the national average, highlighting the need for improved health governance. This study assessed the five-year impact (2019–2023) of a mentoring program for 149 District Health Offices in preparing annual work plans, focusing on stagnation or performance declines. Using a qualitative approach, the study analyzed annual work plan scores before and after technical assistance, conducted focus group discussions, and carried out in-depth interviews to identify challenges. Key barriers included data management issues, weak advocacy, knowledge transfer gaps, and poor cross-sectoral coordination, which hindered decision-making and program sustainability. Findings suggested that structured technical assistance enhanced data-driven planning and intersectoral collaboration at the district level. Strengthening governance frameworks through capacity-building programs and integrating mentorship models into national health strategies can improve regional health performance.

Keywords: annual work plan, health governance, District Health Offices, technical assistance

Introduction

Effective governance in health systems is critical to achieving sustainable health outcomes, particularly through evidence-based planning and program alignment.[1,2] In Indonesia, Law Number 59 of 2024, Concerning the National Long-Term Development Plan for 2005–2025, establishes governance transformation as a core mission for achieving sustainable national development.[3] The law underscores the importance of harmonizing governance reforms with high-quality planning processes, highlighting the necessity of ensuring coherence among planning documents, including the National Long-Term Development Plan/*Rencana Pembangunan Jangka Panjang Nasional* (RPJPN), National Medium-Term Development Plan/*Rencana Pembangunan Jangka Menengah Nasional* (RPJMN), Strategic Plan/*Rencana Strategis* (Renstra), and Annual Work Plan (AWP).

This alignment is crucial for integrating local and national priorities to enhance policy coherence and improve implementation effectiveness. However, despite existing policy mandates, no prior study has systematically evaluated the effectiveness of planning harmonization at the district levels of Health Offices in Indonesia. This study addressed this gap by examining the impact of a technical assistance program aimed at improving the preparation of the AWP as a planning document aligned with the Health Strategic Plan, the Regional Long-Term Development Plan, and other relevant strategic planning frameworks.

The AWP plays an important role in tracking progress toward priority health indicators. However, significant obstacles have consistently challenged its implementation, particularly at the city/district levels. To address these issues, the Indonesian Ministry of Health, through the Bureau of Planning and Budgeting, with support from the World Bank and the National Budget, implemented a technical assistance program from 2019 to 2023. This initiative aimed to enhance the capacity of District Health Offices to independently develop high-quality AWPs, align local activities with national priorities, and ultimately strengthen health governance across Indonesia.

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A total of 149 Health Offices across Indonesia participated in this initiative, each receiving guidance from university-affiliated technical assistance teams. To initiate the first phase of intervention in 2019, a baseline indicator was established using data from the 2018 Public Health Development Index, revealing that 54% of regions scored below the national average on key health indicators. This finding underscored persistent challenges in the content, structure, and timeliness of AWP submissions.[4] In addition, insufficient capacity among the planning team was identified as a major constraint in developing the AWP. Many planners lack the necessary knowledge and technical skills and have not received adequate training.[5]

These limitations have hindered the alignment of local health plans with national priorities, thereby reducing the overall effectiveness of health governance and limiting the achievement of desired health outcomes. Ensuring the synchronization of these planning documents is essential for establishing effective, evidence-based health governance that can drive long-term improvements across Indonesia. This case report examined the performance of District Health Offices that experienced stagnation or declines in their AWP scores to identify barriers, draw lessons from these challenges, and offer recommendations to support sustainable improvements in health governance.

Method

This case report employed a qualitative approach to assess the AWP of District Health Offices from 2019 to 2023. Data collection was conducted between July and August 2024 at designated District Health Offices. The evaluation began with an analysis of AWP scores provided by the Indonesian Ministry of Health, comparing performance before and after the technical assistance program.[6] Based on score trends, District Health Offices were categorized into three groups: improved, stagnant, and declining.

The District Health Offices were categorized as improved when they demonstrated an increase in their AWP scores after receiving technical assistance, indicating enhancements in the quality of planning, alignment with national priorities, and overall governance capacity. Meanwhile, stagnant District Health Offices showed no change in their AWP scores before and after technical assistance, suggesting that despite intervention, planning quality and performance indicators remained unchanged, possibly due to limited technical capacity, inadequate resource allocation, or institutional constraints. Last, declining District Health Offices experienced a decrease in their AWP scores after technical assistance, reflecting a deterioration in planning effectiveness, coordination, or compliance with the evaluation criteria. This decline can be attributed to organizational instability, policy shifts, or systemic barriers that prevent the effective implementation of the AWP.

By classifying District Health Offices into these categories, this study provided insights into the impact of technical assistance on local health governance, helping to identify factors that influence progress, stagnation, or regression in health planning performance. To further explore the factors contributing to these trends, Focus Group Discussions (FGDs) and in-depth interviews were conducted with selected District Health Offices. Additionally, key informants from the Indonesian Ministry of Health, the Ministry of Home Affairs, the Ministry of National Development Planning, and university mentors were interviewed to ensure the validity and triangulation of the findings. AWP quality was assessed using the 2022 AWP Evaluation Guidelines and an evaluation instrument developed by the Ministry of Health.[6] This instrument measured five key dimensions: report structure completeness, data completeness, problem prioritization, activity prioritization, and budget allocation. Each aspect was scored on a scale from 0 to 5, with a maximum score of 25 points. The final scores were then categorized into five performance levels (Table 1).

Table 1. Score Categorization of Annual Work Plan Assessment

Range score	Category
0–5	Very bad
5.1–10	Bad
10.1–15	Moderate
15.1–20	Good
20.1–25	Very Good

The interview participants included District Health Officers who participated in the technical assistance program, while FGDs involved representatives from each division. The study areas were selected using purposive sampling based on a comparison of AWP quality before and after technical assistance. A total of four areas were chosen, focusing on District Health Offices categorized as declining or stagnant. The qualitative data analysis was conducted using a thematic approach. All collected data were transcribed verbatim, systematically organized into a matrix, and analyzed to identify emerging patterns and themes. A thematic framework was then developed to guide data interpretation and ensure a structured and comprehensive analysis. Triangulation was applied by integrating in-depth interviews, FGDs, and data from multiple institutions to ensure cross-verification and reduce bias. This multi-source approach provided a comprehensive understanding of the factors influencing AWP quality and strengthened the credibility of the findings.

Results

Table 2 provides an overview of the performance changes among the selected District Health Offices before and after technical assistance, focusing on their scores and final categories. District Health Office A (Bengkulu Province) experienced a decline in its score from 25 (Very Good) to 20 (Good), resulting in a final category of decline. Similarly, District Health Office B (North Kalimantan Province) saw its score drop from 19 (Good) to 13 (Moderate), also categorized as Declining. However, District Health Office C (West Kalimantan Province) stagnated, maintaining a score of 5 (Very Bad) before and after technical assistance. Last, District Health Office D (East Nusa Tenggara Province) showed a slight improvement in its score from 9 (Bad) to 10 (Bad) but remained in the stagnant category.

Table 2. Characteristics of District Health Offices

Code of the District Health Office	Province	Score before technical assistance	Category	Score after technical assistance	Category	Final Category
A	Bengkulu	25	Very Good	20	Good	Declining
B	North Kalimantan	19	Good	13	Moderate	Declining
C	West Kalimantan	5	Very Bad	5	Very Bad	Stagnant
D	East Nusa Tenggara	9	Bad	10	Bad	Stagnant

Table 3 provides a structured overview of the key challenges and thematic issues contributing to stagnation or decline in the quality of AWPs across four District Health Offices. Each of them faced a unique combination of systemic barriers, as reflected in their categorization as either declining or stagnating AWP performance. The challenges were grouped into three broad themes: persistent data management issues, cross-sectoral coordination and advocacy gaps, and human resource challenges. This grouping emerged as thematic issues identified through FGDs and in-depth interviews with District Health Office representatives, university mentors, and key informants from relevant ministries. These insights highlighted the interconnected nature of challenges and their impact on the effectiveness of AWP preparation and implementation.

Table 3. Key Challenges and Root Causes of Renja Performance in District Health Offices Experiencing Stagnation or Decline in Annual Working Plan Quality

Province	Final Category	Thematic Issue	
		Key Challenges	Root Causes
Bengkulu	Declining	Persistent data management issues hindered the planning process	• Delayed and incomplete data submission • Fragmented data systems
North Kalimantan	Declining	• Persistent data management issues • Cross-sectoral coordination gaps • Advocacy	• Delayed data • Advocacy skill gaps • Weak interagency collaboration (coordination and communication)
West Kalimantan	Stagnant	Human resource challenges	• Staff turnover • Conflicting schedules • Limited retention of organizational knowledge and experience due to frequent staff turnover
East Nusa Tenggara	Stagnant	• Cross-sectoral coordination gaps • Advocacy • Human resource challenges	• Advocacy skill gaps • Insufficient leadership guidance, commitment, or engagement in supporting initiatives and decision-making • Excessive staff workload and competing responsibilities

Persistent Data Management Issues

Most District Health Offices identified data completeness as a major challenge when preparing their AWP. The primary source of data is the Primary Health Care (PHC), which periodically submits reports to the District Health Offices for verification. However, limited infrastructure, such as network constraints and limited electricity, at the PHCs often impedes data submission, causing delays in data readiness and complicating the verification process. As noted by one of District Health Office A representative:

> "*Sometimes, the problems are not just in the planner team, but also the validity of the data. We are having difficulty checking the data from the PHC because most of the report submissions are delayed due to problems in using the computer or IT network. We have set a deadline, but in the end, it did not go well*."

The issue extends beyond PHC, as internal data management within District Health Offices is also problematic. According to the university mentors, the data sent by the PHCs were often managed independently by different departments of District Health Offices. As a result, the planner team had to manually retrieve the required data from each section, while staff members were often preoccupied with other responsibilities:

> *"...one of the difficulties regarding data in local government is the availability of the data itself..."*
> *"The data were kept only by one person* (program manager)*, whereas we need the data immediately... at the beginning, we were quite struggling with the data availability."*

To address these issues, planners often had to engage directly with the staff responsible for the data or rely on secondary data sources, such as the Health Profile or the Indonesia Health Survey, to fill in gaps in information:

> *"For the required data, we have to meet the sections directly...to overcome the internal problems, well the right approach is always meet them in person."* (University Mentors)
> *"Well, in the end, we used* (health) *profile data, SKI* (Indonesia Health Survey)*, and other secondary data that were available, and then we asked the staff again."* (University Mentors)

Cross-Sectoral Coordination and Advocacy Gaps

Advocacy plays a crucial role in securing the resources and budgets needed to implement AWP effectively. However, findings from this technical assistance revealed that most District Health Offices felt that cross-sectoral advocacy was not adequately addressed during the program. In practice, the planner teams responsible for drafting the AWP and all proposed programs often faced challenges in gaining recognition and support from their superiors and other stakeholders. Participants noted a significant gap in the training on advocacy skills:

> *"... soft skills on how to advocate, it does not seem to be taught in the technical assistance on how the results of our plan can be advocated to the other stakeholders, well that does not seem to be explained back then, only up to the making of AWP."* (District Health Office C representative)
> "*...also this cross-sectoral sometimes is more subjective. We* (the planner team) *are not considered important to them. Meanwhile, we are the ones who understand how the proposed activities should be run. It always clashes with the superior officer when we are trying to explain. Those are the things that were not addressed* (during the technical assistance)*...*" (District Health Office D representative)

These findings were echoed by key informants from the Indonesian Ministry of Health, who attributed these challenges to the limited exposure of District Health Offices to cross-sectoral information and practices:

> *"Actually, sometimes it* (advocacy) *was not carried out not because* (they) *do not want to, but* (they) *did not know how. That is why we invite them* (to join this technical assistance)*, hoping they will know and understand, so without us asking, they already did it."* (The Indonesian Ministry of Health representative)

Human Resources Challenges

Human resources have emerged as a critical challenge in the implementation of technical assistance. The planner team, a central component of the program, often faced difficulties balancing the mentoring sessions with their daily responsibilities. Participants frequently reported conflicts between the sessions and other tasks, such as attending meetings or completing administrative duties. These challenges were exacerbated by a lack of understanding by superiors, who often underestimated the importance of technical assistance activities. Consequently, staff were sometimes required to leave sessions prematurely or were replaced by other personnel who lacked the necessary continuity and context.

> *"...Yes, the conflicting schedules. Because we are just staff, Ma'am, so, when we come before our superiors, he thinks we are available, so we are ready for more work. Even though we are still in training, like that. So, the superiors at that time did not know, so maybe they thought it was just another Zoom meeting. But for us, it is very important, especially for me, it is a very new thing, very valuable."* (District Health Office B representative)
>
> *"...we are also working at the same time...so there are times when we could not focus because we were doing other tasks."* (District Health Office C representative)

The university mentors also observed inconsistencies in participant attendance, further undermining the continuity of the technical assistance:

> *"It was always different staff, the participants that present today already different than yesterday."* (University Mentors)

Sustainability posed an even greater challenge, particularly after technical assistance ended. Frequent staff turnover, a common occurrence among civil servants because of job rotations or promotions, often leads to the loss of institutional knowledge. The trained personnel were reassigned, leaving their replacements without the same level of expertise or understanding. This cycle frequently resulted in a regression of the progress made during the technical assistance:

> "*... that's the difficulty during the technical assistance, eventually, the trainee has to leave the AWP (drafting team). Now the ones who compiled it at that time were not, not the colleagues who participated in the technical assistance. That's why it was only good at the beginning, after a few years it went back to zero again.*" (District Health Office C representative)

This issue was also highlighted by the Indonesian Ministry of Health, which noted that staff turnover, coupled with hesitancy to implement changes, often delayed the progress of health governance transformations:

> *"Only that the execution in local government faced several challenges. It could be staff replacement or the existing staff isn't courageous enough to implement the new transformation because those changes depend on the head of local government and also covering other offices, not just the health office. Consequently, it delayed the implementation in the local regions."*

Discussion

This study's findings provided critical insights into the systemic challenges District Health Offices faced in improving the quality of their AWPs. These challenges, identified through thematic analysis, highlighted persistent issues that require urgent attention to enhance health governance. This discussion focuses on three key areas: data bottlenecks and fragmentation, advocacy and coordination gaps, and human resource instability, offering actionable strategies to address each issue.

Effective health planning requires timely and accurate data. However, data bottlenecks and fragmentation have emerged as significant barriers across District Health Offices, stemming from delays in data submission by PHCs and the use of fragmented data systems within District Health Offices. The lack of a centralized system forced planners to manually retrieve data from different sections, further complicating the process. A previous study also highlighted the primary challenge in data availability as the lack of integration within health information systems, which results in fragmented data.[7]

This issue not only delayed AWP preparation but also compromised the overall quality of health planning. Accurate and complete data enable health planners to assess the severity and scope of problems, allocate resources strategically, and implement programs that address real community needs. Without robust data, prioritization becomes subjective and prone to inaccuracies, leading to interventions that may not align with actual conditions in the field.[8] To resolve these challenges, there is a pressing need to invest in digital infrastructure, streamline data workflows, and provide training for data management at the PHC and District Health Office levels.

Currently, the Indonesian Government has made efforts to integrate data through relevant policies aimed at addressing data and information fragmentation. Unfortunately, challenges persist in the field, particularly at the PHC level, such as insufficient human resources and the failure of vendors or third parties to fully adopt standardized metadata protocols. These issues are often attributed to inadequate health information system infrastructure, limited access to information systems in remote areas, and a shortage of skilled personnel due to insufficient training.[7]

The involvement of stakeholders and cross-sectoral collaboration is crucial for future assistance efforts, particularly with agencies such as the Development Planning Board and other regional government organizations. Strengthening

advocacy materials with the mentoring team is essential. One key strategy is to optimize Regional Development Coordination Meetings, essential for aligning national priorities with regional health objectives.[9] Enhancing the execution of these meetings and ensuring the active participation of relevant stakeholders can foster stronger collaboration across sectors.

Additionally, the involvement of the Development Planning Board at the city/district and provincial levels is crucial for integrated planning and resource allocation.[10] This engagement not only facilitates coordination but also reinforces the role of provincial governments as national governance representatives. This involvement strengthens the role of the provincial government as a representative of the national government.[11] According to another study, advocacy plays a key role in integrating evidence into the policymaking process, contributing to a paradigm shift as well as improved focus and resource allocation, which are essential for supporting and strengthening policies.[12] These findings are particularly relevant in the context of drafting the Health Office's Work Plan, in which advocacy is a vital strategy to ensure that evidence-based decisions are effectively implemented. Finally, provincial governments must take an active role in bridging the gap between District Health Offices and other sectors. Their oversight can help streamline coordination processes and ensure that health priorities are effectively integrated into broader regional planning efforts.

One of the key challenges encountered in technical assistance programs was related to human resources. Common issues included the planning team being occupied with multiple responsibilities, frequent job rotations, and staff promotions, which could disrupt continuity and hinder the effective implementation of the program. The heavy workload of the planning team often prevented participants from fully engaging in the mentoring process. A previous study suggested that on-the-job training for planning teams is one approach to addressing this issue.[13] Another human resource-related challenge was job rotation. A previous study indicated that while job rotation can enhance employee performance, it may also lead to a decline in work motivation.[14] Therefore, its implementation should be cautiously approached and accompanied by adequate training to ensure its effectiveness.[14]

To address the identified human resource challenges, it is essential to implement targeted and sustainable solutions. Establishing knowledge management systems is a critical first step because these systems can preserve institutional memory by documenting processes, key learnings, and outputs from technical assistance. This will ensure that new staff can quickly access and adapt to their roles seamlessly.[15] Additionally, the development of self-learning modules, such as online courses or comprehensive guides, can provide continuous training opportunities for health officials. These modules should address practical needs and include real-world case studies to enhance their relevance and applicability.

Promoting continuous learning opportunities is also important, particularly in light of the frequent job rotations among civil servants. Integrating ongoing training and capacity-building programs into civil service systems can help bridge knowledge gaps and maintain the quality of health governance over time. Furthermore, strengthening leadership awareness is crucial for creating a supportive environment for planning teams.[16] By engaging local government leaders and emphasizing the long-term benefits of technical assistance, the importance of staff participation and sustained learning can be better recognized and prioritized. Collectively, these recommendations aim to mitigate the impact of staff turnover, enhance capacity retention, and support sustainable improvements in health planning and governance.

This study had several limitations in obtaining comprehensive information from the District Health Offices. Several members of the planning teams who participated in the technical assistance were rotated to other offices, making them unavailable to participate in the focus group discussions. To minimize this limitation, additional data were collected through interviews with key informants, including university mentors, current District Health Office staff, and representatives from the Indonesian Ministry of Health. This approach provided broader perspectives and supplementary insights to address information gaps while ensuring a more comprehensive analysis of the challenges faced by District Health Offices.

Future research should examine the impact of improved AWP quality on health outcomes, including service delivery, resource allocation, and system efficiency. Evaluating regional influences such as infrastructure and governance can help tailor technical assistance to diverse contexts. Additionally, assessing the scalability and effectiveness of digital platforms such as Aplikasi Sehat Indonesia (ASIK) and SatuSehat is essential for optimizing health planning and data integration. Longitudinal studies are needed to determine these improvements' sustainability and identify factors influencing long-term health governance success.

Conclusion

District Health Offices experiencing stagnation or declines in the quality of their AWPs face several common challenges, including inadequate data management, limited advocacy skills, weak cross-sectoral coordination, and the impact of job rotations on knowledge retention. To address these issues, several key recommendations should be implemented. Strengthening technical assistance in data management and advocacy is crucial for health offices to develop plans that respond to community needs. Additionally, enhancing coordination with the Development Planning Board and providing support for synchronization forums can help improve AWP development and implementation. Self-learning modules containing advocacy materials will further support the capacity of health offices to prepare high-quality documents, enabling them to achieve more effective public health development goals. Finally, promoting continuous learning opportunities is essential, given the frequent job rotations among civil servants, by integrating ongoing training and capacity-building programs into civil service systems to ensure sustainable knowledge transfer and skill development.

Abbreviations

AWP: Annual Work Plan; FGDs: Focus Group Discussions; PHC: primary health care.

Ethics Approval and Consent to Participate

This study was reviewed by the Health Research Ethics Committee of the National Research and Innovation Agency (Number: 190/KE.03/SK/10/2024).

Competing Interest

The authors declare that there is no competing interest to disclose.

Availability of Data and Materials

All of the materials in this study are available upon reasonable request.

Authors' Contribution

PY, IT, and AD conceptualized the study. PY drafted the original manuscript. PY, IM, M, LK, FAB, TSD, AS, HRP, RM, RK, and NAR collected, analyzed, and interpreted the data and critically reviewed the draft. IT supervised the study and assisted in data interpretation. AD provided material for the study. IM and LK provided material support and reviewed and edited the draft.

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Help-Seeking Behavior and Related Mental Health Promotion Programs in Southeast Asian Youth: A Systematic Literature Review

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Help-Seeking Behavior and Related Mental Health Promotion Programs in Southeast Asian Youth: A Systematic Literature Review

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Abstract

Mental health issues are a prominent burden among adolescents and young adults in Southeast Asia, compounded by reluctance to seek help and low treatment rates. This mixed-method systematic review analyzed help-seeking profiles (preference, facilitators, and barriers) and evaluated implemented help-seeking programs. Data were sourced from electronic databases, hand-searched local databases, conference proceedings, and grey literature. Study selection followed PRISMA 2020 guidelines, focusing on 1) adolescents (10–19 years) and young adults (18–26 years) in Southeast Asia who were not receiving mental health care, 2) assessing help-seeking behavior, and 3) evaluating programs to increase help-seeking. A total of 16 articles were identified. Help-seeking behavior in Southeast Asian youth was shaped by mental health literacy and stigma (including attitudes from family, peers, and the wider community). Program effectiveness was mixed, with improvement often lacking significant differences from control groups or failing to persist at follow-up. These findings emphasized the need for more community-level and upstream policy interventions alongside individual-level interventions to improve mental health literacy and stigma. Developing interventions requires methodological improvements in help-seeking research, and ultimately, accessible and trustworthy mental health services are crucial to sustaining progress.

Keywords: adolescents, help-seeking, mental health, Southeast Asia, young adults

Introduction

The 2022 World Mental Health Report by the World Health Organization (WHO) revealed that nearly one billion people worldwide live with mental health conditions. This prevalence has remained steady at 13% since the first report in 2001.[1] Furthermore, by 2030, direct costs of care, economic productivity losses, and increased social costs due to mental health conditions are predicted to reach USD 6 trillion globally, surpassing the costs of diabetes, chronic respiratory diseases, and cancer combined.[2] The COVID-19 pandemic exacerbated mental health conditions, particularly for younger individuals who are more vulnerable and disproportionately affected by social and economic impacts, placing them at higher risk for adverse mental health outcomes.[1] In the first half of 2021, the United Nations Children's Fund (UNICEF) reported that a median of 19% of individuals aged 15–24 years across 21 countries felt depressed or disinterested in activities.[3] The proportion of years lived with disability due to mental disorders, such as depression and anxiety, is highest globally among those aged 15–29 years (23.7–25.6%), compared to less than 10% in younger children (0–4 years) and older adults (≥60 years).[1]

In 2024, the Southeast Asia (SEA) accounts for approximately 8.52% of the global population.[4] Adolescents (10–19 years) represent a significant demographic in the region, as the WHO-SEA's 2024 Declaration on Adolescent-Responsive Health Systems highlights that approximately 360 million adolescents constitute 27% of the global adolescent population, the largest share for any region.[5] Within the SEA, the mental health burden among adolescents and young adults is also prominent. A 2021 systematic review of university students in six SEA countries (Cambodia, Laos, Malaysia, Myanmar, Thailand, and Vietnam) reported median point prevalences of 42.4% for anxiety, 29.4% for depression, 16.4% for stress, and 13.9% for eating disorders, with suicidality present in 7–8% of students.[6] Despite the high prevalence of these issues, treatment rates remain low, and reluctance to seek professional help is widespread.[6] Similarly, the 2023 Indonesian Health Survey revealed that depression is most prevalent among young people (15–24 years), yet only 10.4% receive treatment.[7]

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Despite efforts to raise awareness about mental health issues, significant gaps remain in improving mental health help-seeking behavior.[8] Mental health is yet to be prioritized in many SEA countries,[8] and interventions must consider the region's unique cultural norms and resource limitations.[9] A major barrier to intervention development is the scarcity of reliable data, stemming from inadequate systematic data collection processes and proficient data collection authorities.[9] Given these challenges and the lack of literature review on this topic, a systematic evaluation of mental health help-seeking behavior among adolescents and young adults in the SEA is essential. This systematic literature review (SLR) aimed to assess published evidence on help-seeking behaviors, including assessing preferences, barriers and facilitators, and the effectiveness of mental health promotion programs implemented for the SEA youth.

Method

A mixed-method SLR was selected to comprehensively capture the diverse components and outcomes associated with help-seeking behaviors and interventions. This SLR employed the Population, Intervention, Comparison, and Outcome (PICO) framework to construct the final research question and eligibility criteria. The target population included adolescents (10–19 years) and young adults (18–26 years),[10,11] who were not receiving mental health care. Studies focusing solely on adults without a specific sub-analysis for adolescents or young adults, as well as those involving children under 10 years old, were excluded. Any mental health help-seeking screening, assessment, program, or intervention aimed at improving help-seeking behavior was reviewed without requiring a specific comparator. Eligible outcomes encompassed mental health help-seeking, including facilitators, barriers, and preferences, as well as attitudes or behaviors related to seeking mental health support.

Studies focused on health-seeking behaviors outside of mental health (e.g., physical health or academic help) were excluded. All study designs were eligible, and only articles published in English or Indonesian language were considered. Studies conducted within Southeast Asian countries (Indonesia, Singapore, Malaysia, Thailand, Vietnam, Laos, Myanmar, Cambodia, Brunei Darussalam, the Philippines, and Timor-Leste) were included. Only original research articles, including brief reports, were included. Review articles, theoretical articles, study protocols, as well as editorials, opinion pieces, and perspective articles were excluded. There were no restrictions on the publication date.

Systematic searches through major electronic databases and manual hand-searching of local databases, conference proceedings, and grey literature were conducted in October 2024. Four electronic databases (MEDLINE, EMBASE, PsycINFO, and PsycEXTRA) were searched using keywords encompassed five main themes: 1) mental-health promotion programs, 2) help-seeking profiles, 3) help-seeking behavior, 4) adolescents and young adults, and 5) Southeast Asia. Supplementary Material 2 lists all keywords used, and Supplementary Material 3 details the manual hand-searching sources. Search results were exported to EndNote 21 (institutional license provided by the London School of Hygiene and Tropical Medicine), where duplicates were removed before screening. The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) 2020 flow diagram for systematic reviews, including searches of databases, registers, and other sources.[12]

Data were systematically extracted into a pre-specified grid, tailored to accommodate variations based on the aim of each study (either on help-seeking behavior profile or program) and design. For help-seeking behavior profile studies, extracted data included publication year, participant characteristics (country, setting, age range, sampling method, and sample size), study methods (study design, data collection, and analysis), and outcomes (mental health scales used and results for quantitative studies, or themes and concepts for qualitative studies). For help-seeking behavior program studies, data extraction included publication year, participant characteristics, study methods, intervention, comparison in the control group (if applicable), and outcome (measured behavior, mental health scales used, assessment time points, and results). Different Joanna Briggs Institute (JBI) critical appraisal tools were used based on study design: 1) randomized controlled trial (RCT), 2) quasi-experimental, 3) cross-sectional, and 4) qualitative.[13] Scoring and grading followed a previous SLR.[14]

The data synthesis process was organized by study aims, categorizing them as describing the overall help-seeking behavior profile or evaluating help-seeking interventions. Within these categories, the synthesis was further detailed as follows: 1) Profile (mental health scales used, facilitators and barriers to help-seeking, and preferences for support), and 2) Program (intervention delivery and effectiveness). Quantitative data were narratively analyzed following the Synthesis Without Meta-analysis (SWiM) guidelines.[15] Qualitative data were inductively analyzed through thematic synthesis, following the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) reporting

guideline.[16] Themes were manually extracted from the "results" and "conclusions" sections to form overarching concepts without computer software. Data reporting followed the PRISMA 2020 checklist.[12]

Results

Database searches initially yielded 511 results, of which 106 duplicates were removed (Figure 1). Title and abstract screening excluded 367 articles, leaving 33 for full-text review. Manual hand-searching identified 13 studies, 12 of which were retrieved and reviewed. At full-text stage, 24 articles (Supplementary Material 4) were excluded for reasons listed in Figure 1. This review included 16 studies (11 from database searches and five from manual hand-searching).

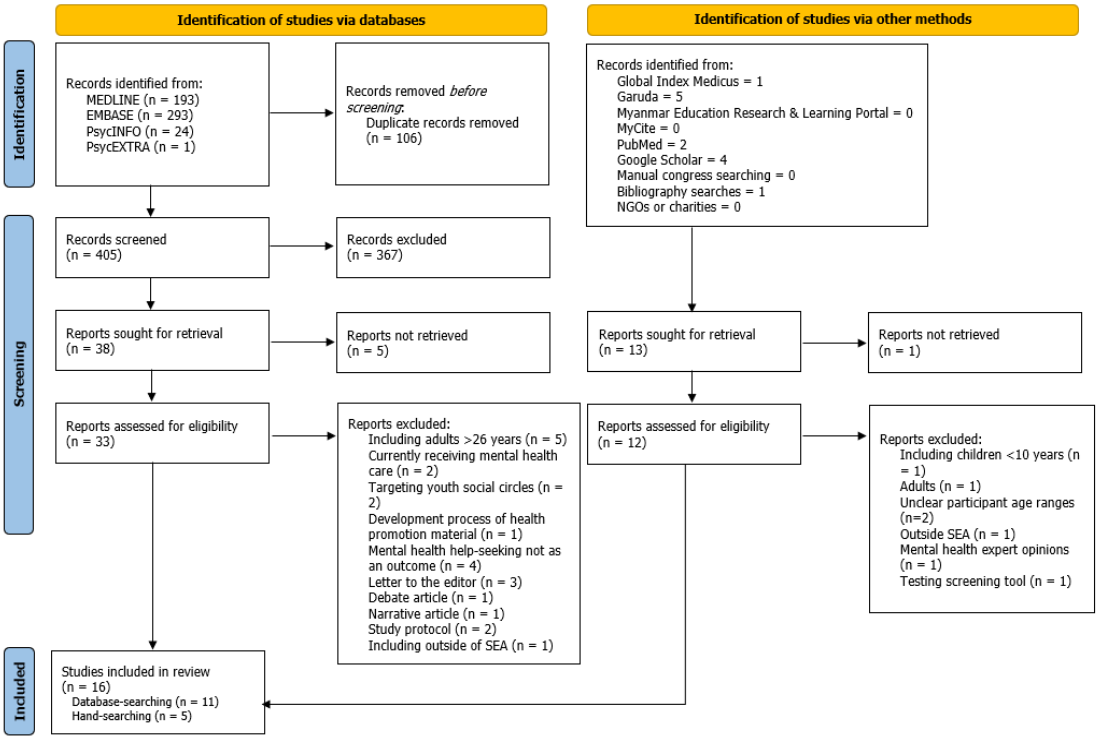

Figure 1. PRISMA 2020 Flow Diagram

The majority (68.8%) of included studies were published from 2020 onwards. Five studies originated from Malaysia, five from Indonesia, four from Vietnam, and two from Singapore. Most studies (81.3%) were conducted in educational facilities (schools or universities). More than half of the studies (56.3%) were conducted in adolescents aged 10–19 years. The remaining seven (43.8%) included both adolescents and young adults, with the broadest age range being 13–25 years. Twelve studies (two qualitative and 10 cross-sectional) assessed help-seeking behavior profiles (Table 1), while four studies (two RCTs, one quasi-experimental, and one cross-sectional) evaluated interventions aimed to facilitate or increase help-seeking behavior (Table 2). Critical appraisal results showed seven high-quality studies (43.8%), two medium-quality (12.5%), and seven low-quality studies (43.8%).

Table 1. Summary of Study Characteristics (Profile)

Author (Year)	Country	Study Design	Participants' Characteristic	Sample Size	Data Collection Method	Help-seeking Profile	Critical Appraisal Grading
Goh DH *et al.* (2007)[17]	Singapore	Cross-sectional	12–18 years secondary school students	448	Custom questionnaire	Attitude	Low
Aida J *et al.* (2010)[18]	Malaysia	Cross-sectional	15–17 years secondary school students	205	Custom questionnaires	• Preferences • Barriers	Low
Muthupalaniappen L *et al.* (2012)[19]	Malaysia	Cross-sectional	13–17 years government school students	131	Custom questionnaires	• Preferences • Barriers	Low

Author (Year)	Country	Study Design	Participants' Characteristic	Sample Size	Data Collection Method	Help-seeking Profile	Critical Appraisal Grading
Thai QCN *et al.* (2018)[20]	Vietnam	Cross-sectional	19–26 years college students	350	Custom questionnaires	• MHL • Preferences	Low
Ibrahmi N *et al.* (2019)[21]	Malaysia	Cross-sectional	13–25 years secondary school and college students	202	• GHSQ • MHSAS • SSOH	• Facilitators • Barriers	High
Prawira B *et al.* (2020)[22]	Indonesia	Cross-sectional	18–24 years college students	284	• SOSS • GHSQ	• Facilitators • Preferences	High
Berry C *et al.* (2020)[23]	Malaysia	Qualitative	16–23 years in a non-governmental education and mental health social enterprise and partner organizations	9	Semi-structured interview	• MHL • Preferences • Facilitators • Barriers	High
Thai TT *et al.* (2020)[24]	Vietnam	Cross-sectional	15–18 years high school students	1,114	• MHLS • GHSQ	• MHL • Preferences • Attitude	Medium
Brooks H *et al.* (2022)[25]	Indonesia	Qualitative	11–15 years from primary care and child and adolescent mental health services	19	Semi-structured interview	• MHL • Preferences • Facilitators • Barriers	High
Siswanti DN *et al.* (2022)[26]	Indonesia	Cross-sectional	17–22 years in Makassar City	177	• MHKQ • Custom questionnaire	• Preferences • Facilitators	Low
Syakarofath NA *et al.* (2023)[27]	Indonesia	Cross-sectional	14–19 years high school students	300	• MHSAS • MHSIS	• Attitude • Intention • Preferences	Low
Lesmana MHS *et al.* (2024)[28]	Indonesia	Cross-sectional	16–19 years old public high school students	760	• GHSQ • MHLS	• Facilitators • Barriers • MHL	High

Notes: GHSQ = General Help-Seeking Questionnaire, MHSAS = Mental Help-Seeking Attitudes Scale, SSOH = Self-Stigma of Seeking Help, SOSS = Stigma of Suicide Scale, MHLS = Mental Health Literacy Scales, MHKQ = Mental Health Knowledge Questionnaire, MHSIS = Mental Help-seeking Intention Scale.

Table 2. Summary of Study Characteristics (Program)

Author (Year)	Country	Study Design	Participant's Characteristic	Sample Size	Intervention	Data Collection Method	Help-seeking Outcome	Critical Appraisal Grading
Ibrahim N *et al.* (2020)[29]	Malaysia	Quasi-experimental	12–17 years boarding school students	101	One-time depression literacy intervention	• MHSAS • SSOH	• Attitude • Self-stigma towards professional mental health services	High
Nguyen DT *et al.* (2021)[30]	Vietnam	Cross-sectional	16–20 years secondary school students	643	A website delivering health and mental health information	Custom questionnaires	• Website visit activities • User evaluation	Low
Tay JL (2022)[31]	Singapore	RCT	18–24 years university students	175	Four online mental health sessions	Custom questionnaires	• Attitude • Intention	Medium
Tran TD *et al.* (2023)[32]	Vietnam	RCT	15–16 years public high school students	1,084	Six 90-minute whole-class sessions	CSES	Social support seeking	High

Notes: MHSAS: Mental Help-seeking Attitudes Scale; SSOH: Self-stigma of Seeking Help; CSES: Coping Self-efficacy Scale.

Mental Health and Help-Seeking Measurements in Southeast Asian Youth

The General Help-Seeking Questionnaire (GHSQ) was used in four studies.[21,22,24,28] The Mental Health Literacy Scales (MHLS) were used in two studies,[24,28] in which both observed low levels of mental health literacy (MHL). An adequate MHL of 26.3% was found only in one study.[20] MHL emerged as a concept in two included qualitative studies, where both authors interpreted low levels of MHL.[23,25] MHL was shaped by personal experiences in their living environment, reflected as heavily dependent on family members and technology to access information,[25] and exposure to new perspectives and cultural environments.[23] The Mental Help-Seeking Attitudes Scale (MHSAS) was used in two studies.[21,27] The Mental

Health Knowledge Questionnaire (MHKQ) and the Mental Help-Seeking Intention Scale (MHSIS) were each used in one study.[26, 27] Two studies assessed mental health-related stigma using the Self-Stigma of Seeking Help (SSOH) and the Stigma of Suicide Scale (SOSS).[21,22]

Facilitators for Help-Seeking in Southeast Asian Youth

Mental health literacy and school climate significantly correlated with help-seeking behavior (both p-value <0.001) in one study,[28] with another study also found that mental health literacy significantly influenced adolescents' attitudes to seeking psychological help (p-value = 0.02).[26] Mental help-seeking was positively correlated with a general help-seeking attitude (p-value = 0.027). At the same time, self-stigma of seeking help was the sole predictor of mental help-seeking attitude across different academic levels (secondary school and university) (p-value <0.05).[21] One study found suicide stigma positively associated with both non-formal (p-value <0.001) and formal (p-value ≤0.001) help-seeking intentions.[22] Several themes appeared under the facilitators' code in the two included qualitative studies, including participants' knowledge,[23,25] support from their environment,[25] and positive past help-seeking experience.[25]

Barriers for Help-Seeking in Southeast Asian Youth

Four studies highlighted barriers to help-seeking, including the negative correlation with mental health literacy and perceived stigma (p-value <0.001),[28] particularly between mental help-seeking attitude and self-stigma of seeking help (p-value <0.001) in university students.[21] Various self-stigma on mental health issues were presented in two studies as barriers to accessing mental health care in primary services.[18,19] Concerns over others' perceptions, including those of friends, family, teachers, and the wider community, were also apparent. There were additional healthcare access barriers, including limited awareness of available services and logistical challenges (time constraints, transportation difficulties, and service costs). Both qualitative studies also presented negative attitudes and stigmatizing social narratives as the main barriers to seeking help.[23,25] Additionally, one study highlighted participants' views of building relationships with therapists as a challenging endeavor,[23] and another showed a lack of confidence in sharing their story.[25]

Preferences for Sources of Mental Health Support in Southeast Asian Youth

Informal sources were preferred for help-seeking, with friends and family members consistently ranked among the top three preferences in six studies.[18-20,24,26,27] Two qualitative studies stated that participants mainly relied on family and friends,[25] perceiving informal help-seeking from these intimate, established relationships as more acceptable.[23] Additionally, participants in both studies demonstrated a lower preference for religious or spiritual activities as sources of help.[23,25] In three cross-sectional studies,[20,26,27] professional or formal sources of help (counselors, psychologists, or psychiatrists) were also recognized among the top preferences. Despite this, two qualitative studies revealed contrasting views: participants exhibited skepticism towards professional help while simultaneously recognizing its potential benefits and usefulness.[23,25] Two studies also mentioned self-reliance in mental health problem-solving.[20,26]

Mental Health Promotion Programs Targeting Help-Seeking Behavior in Southeast Asian Youth

Four different programs were captured in this review. Among the included RCTs, one trial from Vietnam delivered six weeks of in-person class sessions on depressive symptoms and mental well-being,[32] while the other from Singapore involved four online sessions providing mental health knowledge.[31] Assessment tools included the Coping Self-efficacy Scale (CSES)[32] and custom questionnaires.[31] Follow-up periods varied, with one trial conducting a six-month follow-up,[32] and the other a two-month follow-up.[31]

In the six-week in-person program, the intervention group showed a higher social support-seeking component of the CSES score and a smaller decline in scores during the six-month follow-up. However, the differences with the control group were not statistically significant at any time point (p-value = 0.068 at baseline, p-value = 0.23 at post-intervention, and p-value = 0.26 at 6-month follow-up).[32] The online program found no significant differences in help-seeking intentions between the intervention and control group at baseline (p-value = 0.51), post-intervention (p-value = 0.11), or follow-up (p-value = 0.24). However, within the intervention group, there was an improvement in help-seeking over time, with notable differences between baseline and post-intervention (p-value = 0.001) and follow-up (p-value = 0.03).[31] Both RCTs had low dropout rates and applied intention-to-treat analysis.

One quasi-experimental study from Malaysia focused on adolescents with significant depression symptoms, comparing an intervention group to a control group with a cumulative drop-out rate of 12.1% at a three-month follow-

up.[29] Following a one-time depression literacy intervention, including small group activities, an explanatory talk, and an animated video, the intervention group saw significantly increased MHSAS scores after intervention (p-value <0.001) and at follow-up (p-value = 0.034). In contrast, the SSOH score showed a significant decrease at post-intervention (p-value = 0.001), though not maintained at follow-up (p-value = 0.242). When controlling for pretest scores, the intervention group maintained significantly higher MHSAS scores (p-value = 0.004) and lower SSOH scores (p-value <0.001) at the three-month follow-up. A cross-sectional study from Vietnam assessed the use of a health and mental health information website.[30] Two weeks after its launch, 17.7% of its visitors used the website for help-seeking, with significantly higher use in regular than specialized school students (p-value = 0.003). A one-year follow-up of website traffic showed that sections focused on emotions and feelings, alongside depression-related items, were the website's second and third most visited areas. The website also received positive Likert-scale feedback from users regarding its usefulness, topical relevance and suitability, accessibility, future usage, and recommendation intentions.

Discussion

This SLR analyzed the profiles of help-seeking behavior and related mental health interventions in SEA adolescents and young adults. This SLR identified a limited-sized evidence base of 16 mixed-quality studies. The majority of studies indicated that MHL in this demographic was generally low. Despite a keen interest in improving mental health understanding and acknowledging the potential benefits of seeking professional help, skepticism and a lack of trust in professional mental health services persisted. SEA youth relied on self-help and preferred informal sources, mostly family and friends, for seeking help and mental health information. The primary barriers to help-seeking were the perceived stigma of society and negative societal attitudes, with additional barriers related to accessing and utilizing mental health services. All the interventions reviewed in this paper aimed to improve help-seeking behavior by providing mental health-related knowledge, utilizing direct contact, or an online medium in educational facilities. Primary outcomes were assessed using self-reported questionnaires. This review identified mixed efficacy. While improvements in help-seeking were observed within intervention groups, some studies did not observe statistically significant differences compared to control groups, or if they existed, were not maintained at follow-up.

The findings from this review reflected two key areas to address when improving help-seeking behavior among SEA youth: individual aspects and environmental influences. First, on the individual aspect, the MHL assessed by three cross-sectional and two qualitative studies among SEA adolescents and young adults was generally low. In the cross-sectional studies, self-reported questionnaires used to measure MHL were adapted from two questionnaires originally developed outside of SEA and for the general population, including the most commonly used MHLS. The MHLS currently stands as the most reliable, validated, and comprehensive MHL instrument and has been adapted for various cultures and languages; however, reviews on its adaptations' measurement properties are still scarce, with a systematic review currently underway.[33] This highlights the need for future research to develop a methodologically rigorous and context-relevant MHL scale tailored to SEA youth.

Furthermore, MHL was identified as a significant factor correlating to help-seeking behavior in two studies. A positive correlation between MHL and help-seeking behavior was also supported by a 2023 systematic review.[34] In addition to its direct influence on help-seeking, MHL influences other individual-level aspects, such as self-stigma and preference for sources of help. For example, a study from Singapore emphasized the importance of improving MHL and the recognition of mental health conditions, as these were associated with reduced personal and perceived stigma and an increased likelihood of seeking professional help.[35] Based on these findings, this review suggests that improving MHL could address various individual barriers, including youth perceptions of professional help, scepticism, self-stigma, and preference for sources of help.

Second, exploring youth preferences and opinions leads to the other key area to address: youth's environmental influences, including informal sources of help and perceived negative stigma and attitude. Favorable preferences towards informal help sources were reported by eight studies consisting of five low- and one medium-quality cross-sectional studies and two high-quality qualitative studies. Out of these six cross-sectional studies, only two measured outcomes in valid and reliable ways,[20,24] and four others let participants select more than one answer. Given these considerations, concluding a clear preference for youth's sources of help may be challenging, as most studies reported these preferences in a descriptive way and did not provide additional supporting statistical analysis. However, a favorable preference towards informal sources of help was also supported by two high-quality qualitative studies, and allowing multiple answers captured the complexity of SEA youth's thoughts and experiences related to help-seeking in reality. This

complexity calls for careful consideration when designing surveys or other data collection methods for future quantitative studies. It highlights the strength of employing qualitative methods to capture this data type.

Findings from this review showcase that efforts to improve help-seeking in SEA youth need to be supported by improvement in their environment. This finding is supported by a large-scale cross-national study on the mental health of children and adolescents across 13 Asian and European countries with varying income levels, which found that support from informal sources, particularly family members, friends, and educators, is particularly vital in lower-income settings.[36] Additionally, despite the general understanding of religion's role in SEA's sociocultural context, SEA youth show a lesser preference for religious or spiritual activities when seeking mental health help.[23,25] This contrasts with a previous cross-sectional survey finding from a multi-ethnic Asian adult population in Singapore that found religious affiliation was associated with enhanced positive mental health components,[37] highlighting the need to cater to the unique differences across various population groups.

Four mixed-quality studies presented interventions to improve help-seeking behavior in SEA youth, with mixed efficacy overall. The lower quality in the two studies was mainly attributed to methodological issues affecting results and interpretation, such as insufficient reporting on the reliability and validity of exposure and outcome measurements. Similarly, the authors also reflected limitations related to measurement scales and self-reported tools in all intervention studies.[29-32] There is a need for improvements in methodological tools and standards in youth help-seeking study,[38] as reliance on self-reported questionnaires introduces various biases. A need for larger-scale trials was also identified, as interventions analyzed in this review came from only three SEA countries, and two studies incorporated participants from only one school or university setting.

Additionally, the need for more studies includes developing original help-seeking interventions that are relevant and tailored to the context of youth and their environment in SEA. One included study shared an interesting reflection on adapting a program from its original version to accommodate participants in their study setting.[32] It included an upscaling of participant group sizes to more than double the size in the original program, and researchers faced challenges in the delivery of the program. This may also have affected the quality and effectiveness of the intervention.

Similar mixed results in effectiveness were also seen in one systematic review on interventions to increase help-seeking for mental health care in low- and middle-income countries; however, a clear trend of favorable results is seen in interventions incorporating multiple components of raising general population's awareness and promoting help-seeking among the population in need of mental health care.[39] Reflecting on the two areas mentioned in the previous section, all interventions analyzed in this review primarily focused on the individual aspect, specifically targeting individual's mental health literacy and self-stigma through educational facilities. Mental health education through educational facilities allows interventions to reach the overall student and teacher community, potentially addressing peer stigma. However, it is important to ensure that young people outside of educational settings are not overlooked.[38]

Future studies are needed on more diverse and dynamic youth environments, as well as interventions on wider determinants of youth's mental health. Given that larger facilitators and barriers often involve social groups outside of youth individually, a review study on interventions targeting family and wider community or upstream policy interventions will be crucial to support evidence on individual-level interventions. Ultimately, this review also reflected the constraints of time, transport, and service costs faced by SEA youth to access mental health services. A preliminary scoping review in 2023 on mental health services access and utilization across SEA identified several barriers related to mental health services, including inadequate training of health professionals, quality of service, and poor distribution of resources.[40] The same study highlighted enablers, including outreach services, accessibility, and affordability.

This paper is the first SLR focusing on help-seeking behavior among SEA adolescents and young adults. By using a mixed-method approach, this study provided a comprehensive and interconnected analysis of the help-seeking profiles and the programs implemented to date, highlighting the existing gaps in the current evidence base. This SLR, however, had several limitations. First, it excluded individuals who, at the time of the included studies, were already receiving mental health care. Future studies should include this population to capture broader insights and experiences of what successfully prompted them to seek help. Second, this review included studies published in English and Indonesian languages only. Expanding language inclusion through collaboration with multilingual SEA researchers or using professional translation services could enhance the number of studies analyzed in future reviews. Third, most included studies were considered low-quality, underscoring the scarcity of evidence and highlighting the pressing need for more robust evidence in this topic and area. Future systematic reviews should be conducted once a stronger body of research with improved methodologies becomes available on this topic.

Conclusion

This review examines the mental health help-seeking behavior profile and implemented interventions in SEA youth. SEA youth hold significant potential as a facilitator to empower help-seeking both individually and within their communities. To maximize their potential, it is crucial to enhance the mental health literacy of youth and the wider community, particularly by actively addressing self- and perceived community stigma associated with seeking help and mental illness. Additionally, designing accessible and relevant mental health services is essential to complement improvements in literacy and stigma, thereby facilitating help-seeking behavior in this population. Ultimately, developing help-seeking interventions needs to be supported by developing objective and robust tools to record or assess help-seeking behavior.

Abbreviations

WHO: World Health Organization; SEA: Southeast Asia; SLR: Systematic Literature Review; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analysis; RCT: Randomised Controlled Trial; MHLS: Mental Health Literacy Scales; MHL: Mental Health Literacy; MHSAS: Mental Help-seeking Attitudes Scale; MHKQ: Mental Health Knowledge Questionnaire; MHSIS: Mental Help-seeking Intention Scale; SSOH: Self-stigma of Seeking Help; SOSS: Stigma of Suicide Scale; CSES: Coping Self-efficacy Scale.

Ethics Approval and Consent to Participate

Not applicable.

Competing Interest

The authors declared no conflict of interest.

Availability of Data and Materials

Materials were accessed through the London School of Hygiene and Tropical Medicine's library database or publicly available through sources listed in the supplementary files.

Authors' Contribution

GO conceptualized the study, performed data collection and analysis, and prepared the manuscript. JD and KC reviewed the study protocol, performed data collection and analysis, and reviewed the draft of the manuscript. All authors have read and approved the published version of the manuscript.

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Public Health Entrepreneurship in Indonesia: What is Next?

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Abstract

Public health has been demanded to search for ways to improve well-being by tackling societal and ecological factors that influence health through cooperative strategies and partnerships across various fields. More interdisciplinary, interprofessional, and action-oriented approaches toward sustainable public health programs are recommended to be made. Therefore, public health entrepreneurship is an indispensable approach to creating new interventions that address future public health problems. The Indonesian Ministry of Health conceptualized five public health entrepreneurship skills as standard competence for public health personnel. In addition, the Association of Indonesian Public Health Higher Education Institutions has identified several study materials and learning outcomes for undergraduate public health personnel. To enrich the currently available approaches, a similar concept of entrepreneurship training, including three-course areas: systems of laws and regulations, advertising and public outreach, and financial oversight, consumer insights, and assessment, is presented. The Public Health Entrepreneurship and Intrapreneurship Framework is also presented in this study. Researchers, government, private sectors, experienced entrepreneurs and intrapreneurs, and other stakeholders should collaborate to formulate the best entrepreneurship curriculum for Indonesia. This curriculum can initially be piloted, evaluated, and finally adopted by public health educational institutions in the country.

Keywords: curriculum, public health education, public health entrepreneurship

The landscape for public health is changing. For several decades, data have shown that the leading health problems and causes of death result mostly from lifestyle and behavior choices that are strongly impacted by social and environmental conditions. Changes in population dynamics, governance, policies, climate conditions, and rapid technological advancement have called for a reassessment of health strategies. More health experts are beginning to understand that to address health outcomes. They must also address social and ecological determinates via collaborative multiscale solutions. As a result, there is a growing demand for integrative, cross-disciplinary, and anticipatory approaches to creating sustainable solutions to health challenges. In this context, the concept of public health entrepreneurship (PHE) has emerged as a promising new approach to designing new solutions, tools, and services to solve today's health challenges.[1–3]

The PHE is the application of an entrepreneurial mindset to enhance public health initiatives through innovative methods. It includes initiatives and programs focused on advancing health, preventing illness, and enhancing community well-being.[4] PHE is a subset of social entrepreneurship as it applies business-oriented solutions to resolve health challenges faced by a population.[5,6] Entrepreneurship, as a term itself, is an organizational scientific term that encompasses a futuristic approach, creativity, and a free-flow thought process that originated in business management-related individuals and theories. Furthermore, entrepreneurial principles are increasingly used in healthcare research. Fundamentals like entrepreneurial skills and mindsets are important as they help prepare the next generation of public health leaders for any possible scenario. This does not mean that public health must be managed like a business but rather that certain entrepreneurial skills, techniques, and approaches are used to advance public health practice.[2]

PHE needs to be included in the public health education curriculum to prepare the public health workforce better. This competency needs to be included as part of the public health personnel profile based on their roles, functions, tasks, and responsibilities, which are Manager, Innovator, Researcher, Apprentice, Communicator, Leader, Educator (MIRACLE) plus Consultant, and Entrepreneur.[4,7]

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In 2024, The Indonesian Ministry of Health published the Decree of Minister of Health Number HK.01.07/MENKES/1337/2024 on public health personnel competence standards. This decree includes PHE as one of the skills public health personnel should have. The levels of PHE skills according to Bloom's taxonomy and the Indonesian National Qualifications Framework are listed in Table 1.[4]

Table 1. Levels of Public Health Entrepreneurship Skills according to the Decree of the Minister of Health[4]

Skills	Bloom Taxonomy	Level 6 (Undergraduate)	Level 7 (Profession)	Level 8 (Postgraduate)	Level 9 (Doctoral)
Develop ideas and take advantage of entrepreneurial opportunities to produce added value for improving the health status of the community.	C	C3	C4	C5	C6
	A	A3	A3	A4	A4
Analyze the economic feasibility of entrepreneurial activities and make appropriate decisions to improve public health status.	P	P2	P3	P4	P5
	C	C3	C4	C5	C6
Marketing ideas, ideas, goods and services resulting from entrepreneurial activities to enhance community well-being	A	A3	A3	A4	A4
	P	P2	P3	P4	P5
	C	C3	C4	C5	C6
	A	A3	A3	A4	A4
Managing resources to increase entrepreneurship to enhance community well-being	P	P2	P3	P4	P5
	C	C3	C4	C5	C6
	A	A3	A3	A4	A4
Mastering technical and strategic skills to maximize profits and benefits of entrepreneurship and organizational development to enhance community well-being	P	P2	P3	P4	P5
	C	C3	C4	C5	C6
	A	A3	A3	A4	A4
	P	P2	P3	P4	P5

Notes: C = Cognitive, A = Affective, P = Psychomotor, C1 = Remembering, C2 = Understanding, C3 = Applying, C4 = Analyzing, C5 = Evaluating, C6 = Creating, A1 = Receiving, A2 = Responding, A3 = Valuing, A4 = Organizing, A5 = Internalizing, P1 = Imitating, P2 = Manipulating, P3 = Precision, P4 = Articulating, P5 = Naturalization

The Association of Indonesian Public Health Higher Education Institutions has also prepared national curriculum guidelines for public health undergraduate and postgraduate programs, including PHE. Based on the curriculum review, the entrepreneurial competency profile of public health graduates for each level is as follows: (a) undergraduate: piloting entrepreneurial activities, designing and piloting acceptable and effective public health programs; (b) postgraduate: designing entrepreneurial activities; develop or evaluate creative and innovative programs according to local conditions; (c) doctoral: creating entrepreneurial activity, develop or evaluate creative and innovative programs according to local conditions.[7,8] The study materials and indicators of entrepreneurial learning outcomes for undergraduate programs are shown in Table 2. Proposed study materials for postgraduate and doctoral programs are not yet available.

Table 2. Study Materials and Indicators of Entrepreneurship Learning Outcomes for the Undergraduate Program by The Association of Indonesian Public Health Higher Education Institutions

Study Materials	Sub-Materials	Indicators of Learning Outcomes	Depth
Theory and concept of entrepreneurship	Main concepts related to entrepreneurship and building an entrepreneurial spirit	Explains entrepreneurship theory, current entrepreneurship issues and trends, how to develop an entrepreneurial spirit, techniques for choosing and developing entrepreneurship, and business management and survival strategies.	C2
Steps for developing entrepreneurship in public health	1. Business idea development	Analyzes entrepreneurship potentials and opportunities in public health fields and formulating business ideas	C4
	2. Market survey	Planning market survey	C4
	3. Business feasibility appraisal	Analyzes the feasibility of public health entrepreneurship	C4
	4. Business feasibility appraisal	Formulating business feasibility	C4
	5. Business plan development	Developing business plan	C4
	6. Business apprenticeship	Practicing business apprenticeship	P2

Notes: C2 = understanding, C4 = analyzing, P2 = manipulating

Hernández *et al.*[9] presented another proposal for shaping the curriculum in PHE. They emphasized expanding the skill sets of future practitioners in building health businesses that tackle both medical and societal problems in an appropriately market-oriented way. They proposed education surrounding three main areas: (1) systems of laws and regulations, (2) strategies in advertising and public outreach, and (3) financial oversight, consumer insights, and assessment. A suggested curriculum is shown in Table 3. This educational framework could take many forms: (1) as a concentration in existing graduate programs in public health or business administration, (2) as a certificate program of core courses in such fields as public health, business, and relevant areas such as law, engineering, and public administration, or (3) as an entirely new master's program with interdisciplinary courses in a public health department, ideally developed with practitioner-entrepreneurs and faculty from the business school and allied fields.[9]

Table 3. Sample Curriculum for Public Health Entrepreneurship Training[9]

Course Areas	Fields of Study: Skills Acquired with Applicability to Public Health
Systems of laws and regulations	
Ethics	Develop an understanding of both individual and societal advantages of public health entrepreneurship while critically evaluating the ethical implications of generating profit from health promotion versus illness-related industries.
Legal and tax structures for business	Gain knowledge of different legal and tax frameworks for corporate and nonprofit entities, and assess the advantages and constraints of each structure, including LLCs, S Corporations, B Corporations, 501(c)(3) organizations, and benefit corporations.
Partnerships	Foster partnerships between for-profit and nonprofit entities. Utilize beneficial aspects of legal and tax frameworks to minimize risks and liabilities.
Contracts	Clearly define the responsibilities and potential legal obligations between both parties.
Intellectual property	Develop a thorough understanding of legal safeguards that enable public health entrepreneurs to innovate while achieving financial success.
Basics of litigation	Gain knowledge of the legal rights and protection associated with personal and community investments.
Advertising and public outreach	
Brand strategies	Analyze the marketing strategies behind health-focused and unhealthy products while examining the competitive brand landscape.
Behaviors	Recognize patterns of human behavior related to health and design products and services that align with behavioral tendencies and social influences.
Public health conceptual frameworks	Grasp theoretical models that connect health to larger systemic factors influencing disease outcomes and design public health initiatives that apply research and theory to intervene in disease progression.
Digital marketing and social media	Implement strategic approaches to advertising and public engagement by leveraging data-driven promotional techniques, including online marketing, social media outreach, and behavioral analysis of consumer decision-making.
Campaigns	Gain insight into the strategic design and execution of impactful promotional initiatives aimed at engaging defined consumer groups, enhancing brand visibility, and driving revenue growth.
Financial oversight, consumer insights, and assessment	
Finance	Develop a foundational understanding of financial principles and effective approaches for securing initial funding and investor support.
Research and evaluation	Gain expertise in analyzing market landscapes through comprehensive research and developing targeted health promotion strategies. Acquire proficiency in both conventional business performance indicators, such as financial statements, and public health evaluation tools, like community needs assessments, to assess success based on economic viability, social influence, and health outcomes.

After a thorough literature review and thematic analysis, Chahine[6] identified five central components of PHE. In addition to entrepreneurship, the author also considers intrapreneurship, an act of fostering an entrepreneurial mindset and skillset in an existing organization. These were the fundamental pillars on which the educational programs in both PHE and intrapreneurship (PHEI) are organized. This study presents a framework for this perspective in Table 4, which has been assessed through a course at Yale University.[6]

Table 4. Public Health Entrepreneurship and Intrapreneurship Framework[6]

Design thinking	A flexible and evolving approach to innovation that prioritizes the needs of the customer, demanding a fundamental transformation in public health's mindset to effectively navigate uncertainty and setbacks.
Resource mobilization	Harnessing talent and assets to speed up the advancement of new solutions, utilizing mixed funding strategies to experiment with and expand promising concepts.
Financial viability	Developing strategies for income generation or expense reduction to ensure long-term financial stability.
Cross-disciplinary	Bridging gaps between specialized areas of public health and integrating collaboration across diverse fields, fostering engagement among private enterprises, government agencies, and nonprofit organizations.
Systems strengthening	Integrating established frameworks into the development and execution of new innovations to avoid duplicating structures and ensure seamless implementation.

Each of the above curriculum models has its unique emphasis and approach to PHE training. The models of the Indonesian Ministry of Health and the Association of Indonesian Public Health Higher Education Institutions emphasize the business and financial aspects. The curriculum proposed by Hernandez *et al.* emphasizes the same but devotes a large part to the related legal aspects.[9] The framework of Chahine focuses more on entrepreneurial skills that can be applied to the management of any public health program.[6] This framework also includes intrapreneurship and holds that entrepreneurial innovations must align with existing systems. These models may give insights into the best way to formulate the most appropriate curriculum for Indonesia. To the authors knowledge, several universities have

included PHE in their courses. However, this course has not yet been applied by all public health educational institutions in the country.

Public health practitioners are facing increasingly complex challenges. For instance, global health issues such as pandemics, emerging pathogens, antimicrobial resistance, noncommunicable diseases, climate change, disparities in access to health services, social determinants, the digital health revolution, and humanitarian crises require innovative and sustainable solutions.[10,11] Improved and broadened public health practices beyond traditional functions and programs are needed. Cross-sectional collaboration and collective actions are becoming essential in achieving desirable health outcomes.[12]

A program aimed at nurturing the next generation of public health entrepreneurs will help to raise student ambitions, speed up career progression, and discover new ways to promote better health and innovation in public health education. It is anticipated that these graduates will have a mindset of possibility, a path to go independent, and the power to govern and innovate solutions. This will help elevate PHE and improve its reach and purpose in its domain.[9]

Public health educational institutions should consider entrepreneurship training compulsory and crucially needed in their curricula. Additionally, the academicians, researchers, communities, government, private sectors, experienced entrepreneurs and intrapreneurs, and other stakeholders should also collaborate in formulating the best curriculum and ecosystem appropriate for PHE in Indonesia. This curriculum can initially be piloted through short courses and then evaluated for its efficacy. Afterwards, the recommended PHE educational model can be disseminated through a national seminar and adopted by public health educational institutions for the betterment of Indonesia.

Abbreviations
PHE: public health entrepreneurship.

Ethics Approval and Consent to Participate
Not applicable.

Competing Interest
The authors confirm that they have no conflicts of interest to disclose.

Availability of Data and Materials
Not applicable.

Authors' Contribution
HP conceived the idea, structured the manuscript, conducted a thorough review, and provided final approval; RD contributed valuable insights, thoroughly reviewed the manuscript, and granted final approval; and KS collected the material and rewrote and organized the final manuscript.

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