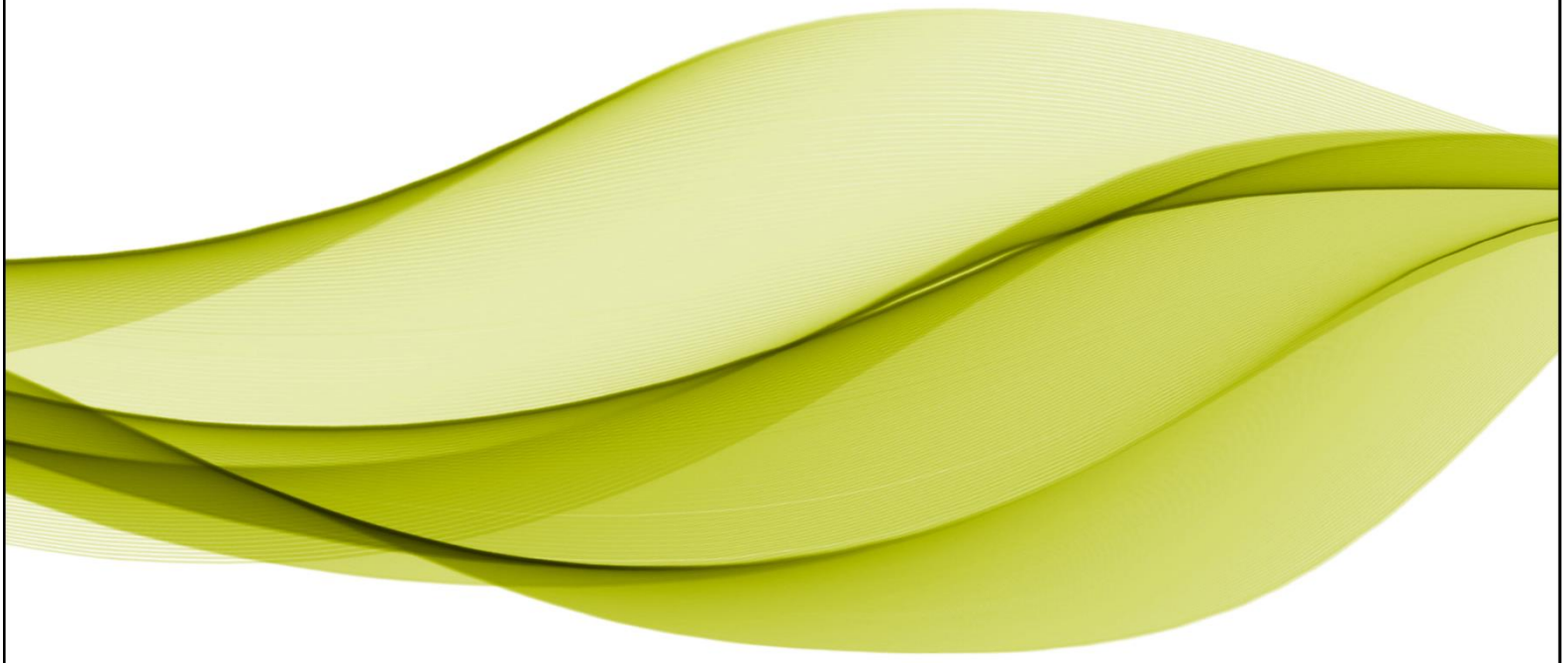
Volume 25, Issue 2 (2021) August

p-ISSN 2356-3664
e-ISSN 2356-3656

Makara Journal of Health Research



Volume 25, Issue 2 (2021) August

Editor's Notes

The World Health Organization declared the COVID-19 outbreak a public health emergency of international concern. The direct and indirect impact of COVID-19 on NCDs emerge. Recently the number of submitted COVID-19 related papers to MJHR has increased. Therefore, we welcome COVID-19 related papers that have impacts on NCDs diagnosis, treatment, prognosis, and management.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 1

8-30-2021

Determination of the Nutritional Habits and Anxiety Levels in Individuals with COVID-19 in Turkey

Hatice Iskender
Department of Nutrition and Dietetics, Faculty of Health Sciences, Artvin Coruh University, Artvin 08000, Turkey, haticeiskender2011@hotmail.com

Eda Dokumacioglu
Department of Nutrition and Dietetics, Faculty of Health Sciences, Artvin Coruh University, Artvin 08000, Turkey, edadokumacioglu@yahoo.com

Osman Yalap
Department of Emergency and Disaster Management, Faculty of Health Sciences, Artvin Coruh University, Artvin 08000, Turkey, osman.yalap@artvin.edu.tr

Recommended Citation
Iskender H, Dokumacioglu E, Yalap O. Determination of the Nutritional Habits and Anxiety Levels in Individuals with COVID-19 in Turkey. Makara J Health Res. 2021;25.

Makara J Health Res. 2021;25(2):69–76
doi: 10.7454/msk.v25i2.1286

Makara Journal of Health Research

Determination of the Nutritional Habits and Anxiety Levels in Individuals with COVID-19 in Turkey

Hatice Iskender[1], Eda Dokumacioglu[1*], Osman Yalap[2]

[1]Department of Nutrition and Dietetics, Faculty of Health Sciences, Artvin Coruh University, Artvin 08000, Turkey

[2]Department of Emergency and Disaster Management, Faculty of Health Sciences, Artvin Coruh University, Artvin 08000, Turkey

Abstract

Background: Coronavirus disease 2019 (COVID-19), which has spread worldwide since December 2019, has infected and claimed the lives of millions of people. This study aimed to investigate the relationship between anxiety levels and nutritional habits of patients with COVID-19.

Methods: This cross-sectional study enrolled patients diagnosed with COVID-19 between February 1, 2021 and May 1, 2021. The study population included a total of 108 individuals with COVID-19 residing in Artvin, Turkey. This study used a self-administered online questionnaire, containing 40 questions from the State and Trait Anxiety Scale.

Results: The state anxiety score was 37.26, and the trait anxiety score was 39.98. A strong, positive, and significant relationship was found between the state and trait anxiety levels of the participants ($r = 0.588$; $p < 0.001$).

Conclusions: Many individuals who recovered from COVID-19 still suffer and struggle with the residual symptoms of COVID-19 for several months. Symptoms such as fatigue, weakness, pain, and malnutrition may occur even after recovery.

Keywords: anxiety, COVID-19, nutrition habits, pandemic

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic, which has been present for more than a year, has infected and claimed the lives of millions of people.[1] Severe pneumonia, acute respiratory distress syndrome, multiple organ failure, and death may occur in some patients, although some show mild or no symptoms at all.[2,3] Healthy individuals who contacted COVID-19 may have a severe disease course, regardless of age, but its incidence is higher in older adults or those with underlying comorbidities, such as hypertension, cardiovascular disease, diabetes mellitus, chronic lung disease, cancer, chronic kidney disease, and obesity.[4] Chronic infection not only affects the prognosis but also exacerbates existing chronic diseases or causes acute and chronic complications such as septic shock, coagulation disorder, and heart, kidney, and liver damage.[5] In addition, an impairment in the ratio of oxygen to carbon dioxide causes overstimulation of the sympathetic nervous system and, consequently, narrowing of the peripheral vessels and increased left ventricular afterload. Persistent fever lasting for an average of 4 days, hypotension, abdominal pain, diarrhea, nausea, headache, myocarditis, and laboratory findings indicating severe inflammation were observed in nearly all individuals with COVID-19.[6,7]

Such patients should receive biological, psychological, social, and cultural support, and nutrition is among the most important.[8] Although effective preventive or curative methods for COVID-19 are not yet clear, a strong immune system may be protective. Adequate and balanced nutrition is one of the essential strategies to improve and maintain immune system functions.[9] During the COVID-19 pandemic, adopting a healthy lifestyle, eating fruits and vegetables, exercising, maintaining healthy bodyweight, and sleeping adequately are reported to improve the immune system.[10] Physical distancing and social isolation have affected the quality of life, especially eating habits and daily physical activities.[11] The necessity of staying at home for a longer time than normal living conditions increased the risk of consuming less nutritious foods with a longer shelf life and higher contents of salt, sugar, trans fat, and calories.[12] The loss of taste and smell was reported by many people with COVID-19, which either accompanied other symptoms of COVID-19 or presented alone. Optimal nutrition required for a strong immunity may not be achieved because of the loss of taste and smell, which negatively affects the nutritional habits of the individuals' affected.[13]

The COVID-19 pandemic is not only a public health issue but also a social, demographic, and economic crisis and has negative psychosocial effects. The psychological effects of the outbreak are still being discussed, with a gradual relaxation of containment measures against the

***Corresponding author:**
Eda Dokumacioglu
Department of Nutrition and Dietetics, Faculty of Health Sciences, Artvin Coruh University, Artvin, Turkey
E-mail: edadokumacioglu@yahoo.com

pandemic and slow return to normal social living. The number of people experiencing high levels of chronic fear and anxiety has increased as the death toll and distress caused by COVID-19 continue to rise.[14,15] Anxiety causes physical and mental symptoms that vary with each person, presenting emotionally and psychologically. Various opinions are put forward about the transmission and treatment methods of COVID-19, which considerably led to death, deepen uncertainty about the disease, and increase the anxiety level.[16] This study was conducted to evaluate the nutritional habits and anxiety levels of individuals with COVID-19.

METHODS

Ethics committee approval was obtained from Artvin Çoruh University (dated January 1, 2021, no. E.2430), and verbal informed consent was obtained from the participants whose data were collected. Those who refused to participate were excluded from the study. This cross-sectional study, using data collected according to the sampling technique by Urzi and Leo,[17] was conducted to determine whether a significant difference exists between the anxiety levels and nutritional habits of the participants. Patients diagnosed with COVID-19 between February 1, 2021 and May 1, 2021 were included. The number of patients with COVID-19 in Artvin was determined according to the data of the Turkish Ministry of Health, during the period from February 1, 2021 and May 1, 2021. The minimum number of participants to represent the universe was 108.[18,19] A total of 108 people with COVID-19 in Artvin constituted the study population. Volunteers were contacted online and agreed to participate in the study. The state–trait anxiety inventory (STAI) questionnaire was administered to the participants.

Research data were collected online through an easy sampling method to eliminate the risk of COVID-19 transmission. The online questionnaire consisted of 40 questions. The questionnaire was sent through a web link during the period from February 1, 2021 and May 1, 2021. The STAI, which was developed by Spielberg *et al*.[20] and adapted to Turkish by Öner and Le Compte,[21] was used to determine the anxiety levels of the participants. The scale includes two separate measurement tools consisting of a total of 40 items. The "State Anxiety Scale" contains 20 questions that evaluate whether individuals find themselves in a state of anxiety at a certain moment and under certain conditions, while the "Trait Anxiety Scale" contains 20 items that measure how individuals constantly feel during an anxious situation. Both scales have 10 reversed items: a high score indicates a high anxiety level, while a low score indicates a low anxiety level. The State Anxiety Scale is a highly sensitive measure of assessing rapidly changing emotional reactions. The Trait Anxiety Scale measures the continuity of anxiety that a person is susceptible; scores range from 20 (low anxiety) to 80 (high anxiety) points. The Cronbach alpha reliability coefficients of the scales range from 0.94 to 0.96 for the state anxiety scale and from 0.83 to 0.87 for the Trait Anxiety Scale. In addition to the anxiety scales, a sociodemographic characteristics form was administered, involving questions about demographic characteristics (gender, age, marital status, education, etc.) and nutritional habits of the participants.

Data obtained from the sample, including state and trait anxiety levels, were analyzed using the SPSS 20 statistical package program. The average scores of the anxiety-related answers were analyzed to determine whether a significant difference exists between demographic characteristics and eating habits. Independent sample t-test and one-way analysis of variance methods were used in the analysis. Correlation analysis was performed to examine whether a significant difference is present between the eating status and anxiety levels of the participants. Two methods were employed to examine whether a significant difference exists between dependent and independent variables, namely, independent sample t-test, where the dependent variable has a maximum of two categories, and the one-way analysis of variance (ANOVA), where the dependent variable has a minimum of three or more categories. In this context, the t-test was employed in the difference analysis, and one-way ANOVA was used for independent samples.

RESULTS

The demographic characteristics of the participants are presented in Table 1. Women comprised 60.2% of the sample. The age ranged from 36 to 45 years in 36.1% of the participants (largest group), while those aged 18–25 and >46 years made up 16.7% of the participants (smallest group). Moreover, 37.9% and 24% of the participants had a bachelor's degree and postgraduate diploma, respectively. Regarding marital status, 36.1% were married. In addition, 79.6% were nonsmokers, and 91.7% were not alcoholics.

Results of the descriptive analysis related to the eating status of the participants are summarized in Table 2. Overall, 91.7% of the participants were diagnosed with COVD-19 by a healthcare professional, of which 41.7% used the prescribed medicines. Of these patients with COVID-19, 64.8% used herbal products or supplements to strengthen their immunity.

The hospitalization rate was 3.7%, whereas 96.3% stayed at home. The eating habits totally changed in 35.2% of the participants with COVID-19, partially changed in 33.3%, and did not change in 31.5%. Moreover, 51.9% reported eating two meals a day, 39.8% eating three, and 8.3% eating ≥4. Regarding daily water consumption, 18.5% of the participants consumed <1 L, 46.3% drank 1–2 L, 31.5% consumed 2–3 L, and 3.7% drank >3 L per day.

TABLE 1. Demographic characteristics of the study participants (N=108)

Demographic characteristics	N	%
Age		
18–25 years old	18	16.7
26–35 years old	33	30.6
36–45 years old	39	36.1
≥46 years old	18	16.7
Education		
Elementary education	10	9.3
High school	20	18.5
Associate degree	12	11.1
Undergraduate	40	37.9
Postgraduate	26	24.0
Gender		
Female	65	60.2
Male	43	39.8
Marital status		
Married	39	36.1
Single	69	66.9
Smoking		
Yes	22	20.4
No	86	79.6
Alcohol		
Yes	9	8.3
No	99	91.7

Furthermore, 5.6% of the participants had regular physical activity, 18.5% performed physical activity from time to time, and 75.9% did not perform any physical activity at all during the disease period. Bodyweight increased in 9.3% of the participants, decreased in 47.2%, and remained the same in 43.5%.

In this study, the state and trait anxiety scores were 37.26 and 39.98, respectively. A strong positive and significant relationship was determined between the state and trait anxiety levels of the participants ($r = 0.588$; $p < 0.001$).

In Table 3, differences in the scores obtained from the state and trait anxiety scales were examined using the independent sample t-test in terms of the demographic characteristics and nutritional status of the participants. Since the skewness and kurtosis values, which indicate whether the data are normally distributed, are between +2 and −2, the scores were found to have a normal distribution.[22] Accordingly, a significant difference was not found between the state anxiety and trait anxiety levels with respect to the marital status (single or married), alcohol use (yes or no), diagnosis of COVID-19 (by a healthcare professional or not), and drugs provided by the Ministry of Health (drugs were used or not) ($p > 0.05$). However, a significant difference was found between gender distributions and trait anxiety levels, in favor of the male participants. Moreover, a significant difference was found between the variables that COVID-19 diagnosis was made by a healthcare professional and trait anxiety levels in favor of those responding "no".

TABLE 2. COVID-19 diagnosis process and nutritional status of the participants (N = 108)

Diagnosis Questions	N	%
Have you been diagnosed with COVID-19 by healthcare personnel?		
Yes	99	91.7
No	9	8.3
Have you used the medicines given by the ministry of health?		
Yes	45	41.7
No	63	58.3
Have you used herbal products or supplements to strengthen your immunity?		
Yes	70	64.8
No	38	35.2
Have you been hospitalized after being diagnosed with COVID-19?		
No	104	96.3
3–5 days	1	0.9
6–8 days	1	0.9
≥9 days	2	1.9
Did your eating habits change while you were sick with COVID-19?		
Yes	38	35.2
Partially	36	33.3
No	34	31.5
How many meals did you eat in a day when you were sick with COVID-19?		
2 meals	56	51.9
3 meals	43	39.8
≥4 meals	9	8.3
How many liters of water did you consume daily when you were sick with COVID-19?		
<1 liter	20	18.5
1–2 liters	50	46.3
2–3 liters	34	31.5
≥3 liters	4	3.7
How much did you consume tea and coffee daily while sick with COVID-19?		
1 cup	32	29.6
2–3 cups	51	47.2
3–5 cups	12	11.1
≥5 cups	13	12.0
Did you do any physical activity while you were sick with the COVID-19?		
Yes	6	5.6
Partially	20	18.5
No	82	75.9
What was the change in body weight while suffering from COVID-19?		
Increased	10	9.3
Not changed	47	43.5
Decreased	51	47.2

Table 4 shows the results summarizing whether a significant relationship was found between the state and trait anxiety levels of the participants and some demographic characteristics (age, income distribution, and educational status) and nutritional status. Accordingly, no significant difference was found between

the age, income, educational status, smoking status, and daily amount of water consumption and the state and trait anxiety levels. However, significant differences were found between some variables related to the nutritional status and the state and trait anxiety levels of the participants. A significant difference was found between the state anxiety levels of the participants and whether their eating habits changed (yes or no) throughout the disease course. One-way ANOVA was used to determine whether the state anxiety levels were changed with respect to the eating habits of the participants. According to Scheffe's results, indicating which groups displayed a difference, the state anxiety levels of the participants showed a significant difference in favor of those reporting a partial change in eating habits (mean difference = 0.390) when compared with those who reported no change. Significant difference was found between the physical activity of the participants and their state anxiety levels throughout the disease course.

TABLE 3. State and Trait Anxiety Inventory average scores according to the demographic characteristics and nutritional status of the participants (N = 108)

Variables	N	State Anxiety			Trait Anxiety		
		Mean	SD	*p*	Mean	SD	*p*
Gender							
Female	65	39.16	0.515	0.254	40.14	0.377	0.048*
Male	43	32.25	0.531		36.17	0.361	
Marital status							
Single	39	33.01	0.544	0.122	37.16	0.399	0.685
Married	69	38.41	0.504		38.01	0.365	
Alcohol							
Yes	9	31.30	0.446	0.190	40.08	0.225	0.167
No	99	35.45	0.546		41.16	0.384	
Have you been diagnosed with COVID-19 by healthcare personnel?							
Yes	99	33.08	0.498	0.006*	34.15	0.347	0.002*
No	9	39.16	0.644		51.02	0.499	
Have you used the medicines given by the ministry of health?							
Yes	45	32.05	0.562	0.091	30.03	0.408	0.174
No	63	37.07	0.484		30.08	0.349	
Have you used herbal products or supplements to strengthen your immunity?							
Yes	70	33.45	0.521	0.485	35.64	0.380	0.384
No	38	44.25	0.528		38.45	0.368	

*$p < 0.05$

TABLE 4. Mean scores of the State and Trait Anxiety Inventory according to the demographic characteristics and nutritional status of the participants (N = 108)

Variables	State Anxiety				Trait Anxiety			
	N	Mean	SD	*p*	N	Mean	SD	*p*
Age								
18–25	18	30.45	0.632	0.106	18	30.05	0.400	0.438
26–35	33	30.26	0.448		33	39.07	0.313	
36–45	39	39.25	0.515		39	42.54	0.451	
≥46	18	40.15	0.499		18	39.07	0.258	
Income distribution								
Income > Expense	32	32.21	0.491	0.275	32	40.19	0.381	0.098
Income = Expense	51	38.25	0.550		51	41.18	0.368	
Income < Expense	25	41.20	0.496		25	52.25	0.365	
Education								
Elementary education	10	32.01	0.373	0.989	10	46.50	0.184	0.188
High school	20	47.54	0.661		20	48.25	0.488	
Associate degree	12	33.05	0.523		12	48.23	0.365	
Undergraduate	40	30.12	0.512		40	48.26	0.370	
Postgraduate	26	33.45	0.503		26	30.03	0.310	
Smoking								
No	86	29.05	0.502	0.062	36	47.25	0.344	0.146
Yes	22	46.20	0.458		72	41.36	0.388	

Table 4. Continues

Variables	State Anxiety				Trait Anxiety			
	N	Mean	SD	*p*	N	Mean	SD	*p*
Did your eating habits change while you were sick with COVID -19?								
Yes	38	39.26	0.468		38	44.12	0.387	
Partially	36	29.38	0.588	0.005*	36	36.50	0.383	0.257
No	34	38.87	0.432		34	38.25	0.350	
How many meals did you eat in a day when you were sick with COVID -19?								
2 meals	56	41.25	0.485		18	40.25	0.400	
3 meals	43	40.86	0.481	0.001*	33	40.57	0.313	0.038*
≥4 meals	9	39.12	0.599		39	40.01	0.451	
How many liters of water did you consume daily when you were sick with COVID -19?								
<1 liter	20	40.01	0.472		32	40.23	0.381	
1–2 liters	50	39.25	0.561	0.755	51	41.02	0.368	0.354
2–3 liters	34	36.14	0.527		25	39.18	0.365	
≥3 liters	4	37.28	0.143		4	38.38	0.359	
How much did you consume tea and coffee daily while sick with COVID -19?								
1 cup	32	40.26	0.506		32	38.46	0.390	
2–3 cups	51	36.49	0.497	0.014*	51	40.24	0.345	0.197
3–5 cups	12	37.25	0.330		12	35.25	0.296	
≥5 cups	13	37.91	0.639		13	36.29	0.486	
Did you do any physical activity while you were sick with the COVID -19?								
Yes	6	36.75	0.629		6	39.00	0.347	
Partially	20	38.56	0.347	0.005*	20	39.45	0.279	0.120
No	82	38.97	0.522		82	40.14	0.382	
What was the change in body weight while suffering from COVID -19?								
Increased	10	39.44	0.431		10	34.25	0.344	0.142
Not changed	47	40.35	0.474	0.020*	47	36.45	0.359	
Decreased	51	40.63	0.550		51	39.01	0.389	

*$p < 0.05$

DISCUSSION

The COVID-19 pandemic causes serious threats to the physical health and lives of people worldwide. It induces malnutrition, panic disorder, anxiety disorder, and various psychological problems such as depression.[23,24] Understanding the subjective experiences of individuals with COVID-19, including how they were affected by the disease and by the quarantine process and how they coped with the fear of death, can facilitate the development of more functional and effective intervention strategies. Hence, in this study, we tried to understand the experience of individuals with COVID-19 during the disease process and to describe the effects of the disease on their eating habits. In addition, anxiety levels of those who recovered from COVID-19 were evaluated in terms of variables used in the state and trait anxiety scales.

Nutrition is considerably important in the fight against COVID-19, as it is in many diseases. Many institutions and organizations published nutritional recommendations to strengthen the immune system against COVID-19.[25] Specific nutritional risk screening tools have not been widely used in clinical practice to identify patients with COVID-19 having a higher risk of malnutrition. The application of nutritional risk screening tools is an important part of the nutritional assessment of patients with severe COVID-19 and the first step in nutritional support therapy.[26] In a study conducted in Italy, individuals have increased consumption of homemade desserts, pizza, bread, cereals, white meat, and hot drinks during the pandemic and decreased consumption of fresh fish, packaged confectionery, and alcohol.[27] In a study conducted in China by Zhao *et al*.[28] 31.2% of the participants stated that they used vitamin C, probiotics, and other nutritional supplements during the pandemic.

In our study, 64.8% of the participants used herbal products or supplements to strengthen their immune systems, and 35.2% did not use such products. In their study, Liu *et al*.[29] applied an individualized multidisciplinary approach plan according to the condition of each patient receiving COVID-19 treatment, including antiviral treatment, active infection control, immune support, psychological counseling, and phytotherapy support. The psychological situation during the pandemic and its restrictions greatly affected the nutritional habits of individuals and caused a decrease in their physical activities, leading to deterioration in body functions, fear, and abstinence from physical activities.[30] In the present study, only 5.6% of the participants performed physical activity regularly, whereas 75.9% did not have regular physical activity. Low levels of physical activity during the disease course were reported by Tavakol *et al*.[31] in 206 COVID-19 cases. Many factors were

identified to cause weight loss in patients with COVID-19, such as loss of appetite, loss of taste, fever, inflammation, inactivity, malnutrition, and endocrine dysfunction.[32] In the present study, bodyweight decreased in 47.2% of the participants, whereas it remained unchanged in 43.5%. Only 9.3% stated that they gained weight during the disease period. In the study by Haraj *et al*.[33] weight loss was reported in 61% of their patients with COVID-19, while 39% stated no change in bodyweight. Various drugs, which lacked evidence of their efficiency, have been used in the treatment of COVID-19 worldwide, and they are expected to be beneficial because they manifest effectiveness in other indications or because of the results of in vitro studies. In the present study, 41.7% of the participants used the drugs given by the Ministry of Health during the illness, while 58.3% did not use these drugs. Moreover, 96.3% were not hospitalized during the disease period, while 3.7% were hospitalized. The higher proportion of patients who did not use drugs than those who used drug supplements was attributed to infollution in social media and social environments of the patients about the side effects of drugs. In the present study, majority of the participants did not require hospitalization, so they stayed at home during the disease period.

State anxiety is defined as "a form of anxiety that arises due to environment-related stress, usually due to logical reasons, and explicable for others, and generally depends on the temporary situation experienced by each individual."[34] Trait anxiety, however, is defined as "evaluating a stressful situation as dangerous or threatening, and increasing and perpetuating the frequency and intensity of state anxiety and emotional reactions toward these threats and becoming continuous." The state anxiety level increases with intensive stress and decreases when stress disappears.[35] In the present study, a strong, positive, and significant relationship was found between the state anxiety level and trait anxiety level. A significant difference was found between gender distributions and trait anxiety level, in favor of male participants. By contrast, significant differences were found between the diagnosis of COVID-19 (by a health personnel or not) and the state and trait anxiety levels. In the review of relevant studies, the state and/or trait anxiety scores of women were generally higher than those of men.[36] In a study of healthcare workers during the COVID-19 pandemic, the mean state anxiety levels of women were significantly higher different from those of men. The mean trait anxiety level was not different with regard to gender.[37]

In the present study, no significant difference was found between the state anxiety scores of men and women with COVID-19. However, the mean trait anxiety level was significantly higher in women than in men. People experience high levels of anxiety during viral epidemic or pandemic, leading to alterations in various behavioral patterns, including various habits, with regard to gender. Adaptive response mechanisms to the environmental challenges differ between men and women of various age groups.[38,39] Although many studies have been conducted on the COVID-19 pandemic, various aspects are still unknown. Nutrition and the use of nutritional supplements became popular topics since the beginning of the epidemic in Turkey and worldwide. To date, available data show that advanced age, male gender, poor eating habits, and accompanying diseases are important risk factors for the poor prognosis of COVID-19. Social isolation is unavoidable in the fight against COVID-19, along with staying at home in confinement. Thus, reduced level of physical activity would not be surprising worldwide. In the present study, the majority of the participants used nutritional supplements and significantly reduced their physical activity levels. However, when the state and trait anxiety levels of the participants were evaluated according to gender, women displayed higher levels of anxiety. In addition, changes were observed in the nutritional status of the participants. A significant relationship was found between the changes in eating habits during the disease course and anxiety levels of the participants.

CONCLUSIONS

COVID-19 has affected thousands of people, and those who recovered from it still experience and continue to struggle with symptoms even several months after the recovery. Symptoms such as fatigue, weakness, pains, and malnutrition may occur even after the illness is over. In addition, COVID-19 survivors may be concerned about getting the virus again. Among the study limitations, this study has a small sample size and limited area of research. Further comprehensive studies involving more people living in different regions are warranted.

CONFLICT OF INTEREST

None declared.

FUNDING

None declared.

Received: June 29, 2021 | Accepted: Jul 29, 2021

REFERENCES

1. Ahn DG, Shin HJ, Kim MH, Lee S, Kim HS, Myoung J, *et al*. Current status of epidemiology, diagnosis, therapeutics, and vaccines for novel Coronavirus Disease 2019 (COVID-19). *J Microbiol Biotechnol*. 2020;30:313–24.
2. Huang I, Lim MA, Pranata R. Diabetes mellitus is associated with increased mortality and severity of disease in COVID-19 pneumonia - A systematic review, meta-analysis, and meta-regression. *Diabetes Metab Syndr*. 2020;14:395–403.

3. Stasi C, Fallani S, Voller F, Silvestri C. Treatment for COVID-19: An overview. *Eur J Pharmacol*. 2020;889:173644.
4. Alp Ş, Ünal S. Novel Coronavirus (SARS-CoV-2) pandemic: Overview and current status. *FLORA*. 2020;25:1–10.
5. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, *et al*. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020; 395:497–506.
6. Verdoni L, Mazza A, Gervasoni A, Martelli L, Ruggeri M, Ciuffreda M, *et al*. An outbreak of severe Kawasaki-like disease at the Italian epicentre of the SARS-CoV-2 epidemic: An observational cohort study. *Lancet*. 2020; 395:1771–8.
7. Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, *et al*. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: Estimation and application. *Ann Intern Med*. 2020;172:577–82.
8. Downer S, Berkowitz SA, Harlan TS, Olstad DL, Mozaffarian D. Food is medicine: Actions to integrate food and nutrition into healthcare. *BMJ*. 2020;369:m2482.
9. Jayawardena R, Sooriyaarachchi P, Chourdakis M, Jeewandara C, Ranasinghe P. Enhancing ımmunity in viral ınfections, with special emphasis on Covid-19: A review. *Diabetes Metab Syndr Clin Res Rev*. 2020;14:367–82.
10. Kutlu N, Ekin MM, Alav A, Ceylan Z, Merala R. Research on determining the change in the nutritional habit of ındividuals during the Covid-19 pandemic period. *Int J of Soc Polit Econ Res*. 2021;8:173–87.
11. Martínez-de-Quel Ó, Suárez-Iglesias D, López-Flores M, Pérez CA. Physical activity, dietary habits and sleep quality before and during COVID-19 lockdown: A longitudinal study. *Appetite*. 2021;158:105019.
12. Yüce GE, Muz G. Effect of COVID-19 pandemic on adults' dietary behaviors, physical activity and stress levels. *Cukurova Med J*. 2021;46:283–91.
13. Butlera MJ, Barrientosabcd RM. The impact of nutrition on COVID-19 susceptibility and long-term consequences. *Brain Behav Immun*. 2020;87:53–4.
14. Asmundson GJG, Taylor S. Coronaphobia: Fear and the 2019-nCoV outbreak. *J Anxiety Disord*. 2020;70:102196.
15. Lee SA, Jobe MC, Mathis AA. Mental health characteristics associated with dysfunctional coronavirus anxiety. *Psychol Med*. 2020;16:1–2.
16. Öz Ceviz N, Tektaş N, Basmacı G, Tektaş M. Analysis of variables affecting anxiety levels of university students in the Covid 19 pandemic process. *UEADER*. 2020;3:312–29.
17. Urzı C, De Leo F. Sampling with adhesive tape strips: An easy and rapid method to monitor microbial colonization on monument surfaces. *J Microbiol Methods*. 2001;44:1–11.
18. Sekaran U. *Research methods for managers: A skill-building approach*. 2nd ed. New York: John Wiley; 1992.
19. Yalap O, Baygın E. Interaction of psychological capital and organizational commitment: the role of the mediator of self-compassion. *JOB Rev*. 2020; 2:49–67.
20. Spielberger CD, Gorsuch RC, Luschene RE. *Manual for the state-trait anxiety ınvenntory*. California: Consulting Psychologists Press; 1970.
21. Öner N, Le Compte A. Durumluk–süreklilik kaygı envanteri el kitabı. 22nd ed. İstanbul: Boğaziçi Üniversitesi Yayınevi; 1998.
22. Pallant J. *SPSS survival manual*. Buckingham: Open University Press; 2001.
23. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y. A nationwide survey of psychological distress among Chinese people in the COVİD 19 epidemic: Implications and policy recommendations. *Gen Psychiatr*. 2020;33:e100213.
24. Hatun O, Dicle AN, Demirci İ. Psychological reflections of the coronavirus pandemic and coping with pandemic. *Turk Stud*. 2020;15:531–54.
25. Çulfa S, Yıldırım E, Bayram B. The relationship between obesity and changing nutrition habits in human during COVID-19 pandemic. *Turk J Health Sci*. 2021;6:135–42.
26. Li G, Zhou CL, Ba YM, Wang YM, Song B, Cheng XB, *et al*. Nutritional risk and therapy for severe and critical COVID-19 patients: A multicenter retrospective observational study. *Clin Nutr*. 2021;40:2154–61.
27. Di Renzo L, Gualtieri P, Pivari F, Soldati L, Attinà A, Cinelli G, *et al*. Eating habits and lifestyle changes during COVID-19 lockdown: An Italian survey. *J Transl Med*. 2020;18:229.
28. Zhao A, Li Z, Ke Y, Huo S, Ma Y, Zhang Y, *et al*. Dietary diversity among Chinese Residents during the COVID-19 Outbreak and ıts associated factors. *Nutrients*. 2020;12:1699.
29. Liu C, Wu C, Zheng X, Zeng F, Liu J, Wang P, *et al*. Clinical features and multidisciplinary treatment outcome of COVID-19 pneumonia: A report of three cases. *J Formos Med Assoc*. 2020;119:1702–9.
30. Wang CC, Chao JK, Chang YH, Chou CL, Kao CL. Care for patients with musculoskeletal pain during the COVID-19 pandemic: Physical therapy and rehabilitation suggestions for pain management. *J Chin Med Assoc*. 2020;83:822–4.
31. Tavakol Z, Ghannadi S, Tabesh MR, Halabchi F, Noormohammadpour P, Akbarpour S, *et al*. Relationship between physical activity, healthy lifestyle and COVID-19 disease severity; A cross-sectional study. *Z Gesundh Wiss*. 2021;4:1–9.
32. Anker MS, Landmesser U, von Haehling S, Butler J, Coats AJS, Anker SD. Weight loss, malnutrition, and cachexia in COVID-19: Facts and numbers. *J Cachexia Sarcopenia Muscle*. 2021;12:9–13.
33. Haraj NE, El Aziz S, Chadli A, Dafir A, Mjabber A, Aissaoui O, *et al*. Nutritional status assessment in patients with Covid-19 after discharge from the intensive care unit. *Clin Nutr ESPEN*. 2021;41:423–8.
34. Öntürk Y, İmamoğlu O, Karacabey K. Investıgation of state and trait anxiety of elite taekwondo athletes. *MANAS J Soc Stud*. 2019;8:3764–74.
35. Bingöl H, Çoban B, Bingöl Ş, Gündoğdu C. Determine the anxiety level of national team taekwondo athletes before matches who studied at universities. *Selçuk Uni J Phys Educ Sport Sci*. 2012;14:121–5.
36. Ocaktan ME, Keklik A, Çöl M. Spielberger state- Trait anxiety level in health personnel of Abidinpaşa group directorate's health centers. *J Ankara Uni Faculty Med*. 2002;55:21–8.
37. Sakaoğlu HH, Orbatu D, Emiroglu M, Çakır Ö. Spielberger State and trait anxiety level in healthcare professionals

during the Covid-19 outbreak: A case of tepecik hospital. *J Tepecik Educ Res Hos*. 2020;30:1–9.
38. Semenova O, Apalkova J, Butovskaya M. Sex differences in spatial activity and anxiety levels in the COVID-19 pandemic from evolutionary perspective. *Sustainability*. 2021;13:1110.
39. Bults M, Beaujean DJMA, de Zwart O, Kok G, van Empelen P, van Steenbergen JE, *et al*. Perceived risk, anxiety, and behavioural responses of the general public during the early phase of the Influenza A (H1N1) pandemic in the Netherlands: Results of three consecutive online surveys. *BMC Public Health*. 2020;11:2.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 2

8-30-2021

Preventive Behaviors, Barriers, and Drivers of the COVID-19 Pandemic in Malaysia: A Cross-sectional Survey

Normaliza Ab Malik
Faculty of Dentistry, Universiti Sains Islam Malaysia, Kuala Lumpur 55100, Malaysia,
liza_arie2004@yahoo.com

Rusyda Helma Mohd
Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia, Selangor 43600, Malaysia,
rusyda_h@ukm.edu.my

Nor Ba'yah Abdul Kadir
Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia, Selangor 43600, Malaysia,
aknbayah@ukm.edu.my

Makara J Health Res. 2021;25(2):77–86
doi: 10.7454/msk.v25i2.1265

Makara Journal of Health Research

Preventive Behaviors, Barriers, and Drivers of the COVID-19 Pandemic in Malaysia: A Cross-sectional Survey

Normaliza Ab Malik[1*], Rusyda Helma Mohd[2], Nor Ba'yah Abdul Kadir[2]

[1]Faculty of Dentistry, Universiti Sains Islam Malaysia, Kuala Lumpur 55100, Malaysia

[2]Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia, Selangor 43600, Malaysia

Abstract

Background: Coronavirus disease 2019 (COVID-19) is a public health concern worldwide. This study aimed to assess the preventive behaviors, barriers, and drivers, including the knowledge and self-efficacy of COVID-19 in Malaysia.

Methods: A cross-sectional study was conducted during the COVID-19 outbreak by using a self-administered questionnaire. The instrument used was adopted from the World Health Organization resources. Descriptive statistics were used to describe the categorical data. Chi-square and independent t-test were performed to evaluate the associations between the variables and preventive behaviors.

Results: A total of 465 (97.3%) respondents were recorded. The mean age was 34.3 ± 11.8 years old. A high percentage of the respondents (99.4%) were aware of the COVID-19 outbreak, and their knowledge mean score was 18.74 (Standard Deviation [SD]: 2.51). The mean scores of self-efficacy, barriers, and drivers were 11.07 (SD: 1.72), 5.20 (SD: 2.81), and 39.71 (SD: 5.17), respectively. Barriers (Odds Ratio [OR]: 1.10; 95% Confidence Interval [CI]: 1.01, 1.21; $p < 0.05$) and drivers (OR: 1.12; 95% CI: 1.07, 1.17; $p < 0.001$) were found to be predictors for social distancing practices.

Conclusions: Knowledge and self-efficacy were found to be at good levels, whereas self-efficacy, barriers, and drivers were revealed to be the predictive factors in determining the preventive behaviors. Adherence to preventive measures was largely affected by the behavioral drivers.

Keywords: coronavirus, COVID-19, cross-sectional studies, disease outbreaks, self-efficacy

INTRODUCTION

A pneumonia disease outbreak, which was first identified in the city of Wuhan, Hubei Province of China in December 2019, has become a global concern since early 2020. The novel coronavirus disease has brought the attention of the World Health Organization (WHO) due to an exponentially increasing number of people being infected, involving many countries worldwide. The disease was declared a pandemic on March 11, 2020 by WHO.[1] To date, the number of reported cases has exceeded over 132 million with almost three million deaths globally.[2]

The disease has raised threats to the health system worldwide due to unknown treatments and fast transmission patterns with an ever-growing number of infected cases and mortality rates daily.[3] People of all ages can be infected, and the infection can be transmitted from an asymptomatic person during the incubation period.[4,5] The elderly and those with comorbidities are more vulnerable to COVID-19 infection than others. The symptoms vary, and severe cases may result in deaths. Therefore, WHO has emphasized the transparent delivery of information from the higher authorities to the public about the preparedness, readiness, and response measures to increase awareness and public health knowledge for reducing the spread of the novel coronavirus.[6] In general, appropriate preventive measures, such as health programs, health education, and awareness, have led to good health behavior practices.[7,8] Thus, knowledge and preventive behavior toward the COVID-19 infection are two of the important areas to reduce anxiety and increase preparedness among communities.

Early recognition of symptoms and provisions of preventive measures help increase recovery and prevent conditions from deteriorating.[9] Risk assessment and preparedness measures are critical in curbing the transmission of the novel coronavirus.[6] Hence, various preventive measures, such as quarantine, travel restriction, strict movement control, and COVID-19 center establishment, have been implemented worldwide and at the national level to contain and mitigate the disease.[10] The preparedness measures at individual levels are those related to the self-preventive behaviors to reduce the risk of transmission, such as frequent hand washing, wearing a face mask, and social distancing.[11] Implementing preventive measures at a

***Corresponding author:**
Normaliza Ab Malik
Faculty of Dentistry, Universiti Sains Islam Malaysia,
Kuala Lumpur, Malaysia
E-mail: liza_arie2004@yahoo.com

correct time has shown to have major impacts on health outcomes.[12] Meanwhile, incorrect information or messages may trigger an alarm to the public and increase panic, distress, fear, and anxiety level.[13] Transparent communication and adequate knowledge provided by the government to the community are critical to increase awareness and self-efficacy among the public for adopting preventive behaviors in curbing the spread of the virus and thus protecting themselves against it.[14] Governments take various approaches to slow down the spread of the infection, such as close down workplaces and schools, prevent massive gatherings, and impose quarantine restrictions.[15] Information dissemination using official media, newspaper, television, radio or airing at public stations, such as bus stations, varies among countries. Studies have shown that these means of information delivery are effective in engaging the public to adopt the required preventive behaviors, provided the information is appropriate.[16,17] The means of communication and information are also a critical function for the psychological well-being of individuals to go through this pandemic.[18]

Perceived self-efficacy is a concept introduced by Bandura in 1977, and it is related to a person's belief in his or her competency and ability to cope or influence events that may affect his or her life.[19] A person's belief about his or her capabilities has been proven to have a direct impact on what he or she is capable to do and produce desired actions.[20,21] It is a foundation of motivation, performance achievement, and emotional well-being.[22] Studies have also revealed that self-efficacy plays an important role in health behavior.[23–25] As a result, high self-efficacy increases one's engagement in preventive behavior. Behavioral change has been the main primary target in improving preventive behaviors among communities and the public at individual levels. Barriers and drivers to health care also play important roles in engaging them to adopt health behaviors.[26] Studies have indicated that barriers to health care have impacts on health outcomes, such as cost and transportation,[27,28] whereas drivers help increase health outcomes; for example, improving access to healthcare systems through social influences.[29,30]

Therefore, this study aimed to assess the levels of preventive measures, barriers, and drivers, including the knowledge and perceived self-efficacy among the Malaysian community during the pandemic and to gain insights into their practice of preventive behaviors against the novel coronavirus.

METHODS

This research was a national cross-sectional study conducted during the movement control order period from May 2020 to August 2020 in Malaysia. The study had been approved by the Ethical Research Committee of the Universiti Kebangsaan Malaysia (reference no: PPI/111/8/JEP-2020-27) and had complied with the STROBE guideline. An online self-administered questionnaire via a Google form was used. It was distributed using convenient sampling through email among private and government agencies or associations and through social media platforms among known individuals. The population comprised people residing in Malaysia with Malaysian nationalities. Three inclusion criteria were considered for this study, namely, participants must be above 18 years old, literate, and have an Internet access. The sample size was 1,000, determined using the WHO guidelines, which recommended it for meaningful findings of studies based on large population sizes.

The survey was conducted using tools adapted and extracted from WHO resources, Guidance and Protocol[31]. The questionnaire comprised items related to sociodemographic information, knowledge, self-efficacy, barriers, drivers, and preventive behaviors. It involved two languages: English and Malay. Forward and backward translations were performed to ensure semantically equivalent versions. The sociodemographic section included questions related to age, gender, level of education, healthcare profession, chronic illness, and state of residence. The knowledge section comprised six main domains: knowledge level (two items), group at risk of severe illness (eight items), symptoms of COVID-19 infection (nine items), treatment of COVID-19 infection (one item–related to availability of drug and vaccine), transmission of the COVID-19 infection (two items), and infection statements (two items–the incubation period and immune system). The perceived self-efficacy section consisted of two items: how well the person knows about ways to protect themselves and whether avoiding the infection is easy. The preparedness questions were measured using three main domains: preventive measures, barriers, and drivers. The preventive measures were divided into two categories: i) the possible preventive measures; "Which of the following are effective measures to prevent the spread and infection of the novel coronavirus?" (23 items) and ii) the taken preventive measures (i.e., the preventive behaviors); "Which of the following measures have you taken to prevent infection from the novel coronavirus?" (23 items). The barriers and drivers comprised 10 items in total.

Knowledge was assessed on the basis of scores. The correct answer was assigned a score of 1, and the items were summed up with total scores ranging from 5 to 22. A higher total score is indicative of greater knowledge about COVID-19. The items on preventive measures were assessed on the basis of the answers given, namely, "yes, no, do not know, or do not apply." The items on perceived self-efficacy were rated using a seven-point

Likert scale from 1 = not at all to very much so ("I know how to protect myself from coronavirus") to 7 = extremely difficult to extreme ("for me avoiding an infection with the novel coronavirus in the current situation is …. ."). The scores for this domain could range from 2 to 14 with higher scores reflecting higher perceived-self-efficacy. The items on barriers and drivers were rated using a seven-point Likert scale from 1 = strongly disagree to 7 = strongly agree. The scores could range from 2 to 14 for the barriers and from 7 to 47 for the drivers. The lower scores of barriers and the higher scores of drivers indicated better preventive measures.

Data were analyzed using the Statistical Package for the Social Sciences version 21.0. A descriptive analysis was performed for all sections by using percentages. Chi-square and t-test were conducted to determine the association of participants' background, knowledge, self-efficacy, and preparedness with the preventive behaviors. Multiple logistic regression analyses were performed to determine key factors associated with the preventive behaviors, such as hand washing, wearing a face mask, and social distancing. Adjusted odds ratios (ORs) were used to interpret variables of preventive practices. Univariate analysis was conducted to determine the relationships of knowledge, self-efficacy, barriers, and drivers with the significant variables in the final model.

RESULTS

Participant characteristics

A total of 478 respondents received the questionnaire via the online Google form, approximately 48% of the targeted sample size. However, given that 2.7% of the responses were incomplete, only data from 465 participants were included for the analysis. No duplication of the data was observed. The respondents' mean ages were 34.3 ± 11.8 years old. More than half of them were female (65.6%), and 93.5% were not health professionals. Approximately three quarters (77%) of the respondents had bachelor's degrees and higher. Most of them (91%) claimed that they had no chronic illnesses. The respondents were from all states in Malaysia, and almost half of them were from the central region of Malaysia (47.3%), the highest percentage being from the state of Selangor (25.4%). The details are presented in Table 1.

Knowledge

Most participants (99.4%) were aware of the COVID-19 outbreak. A high percentage of the respondents claimed that their knowledge level of the novel coronavirus and ways to prevent its spread were above moderate; 88.0% and 93.3%, respectively. The mean scores of their knowledge were 18.74 (SD: 2.51) based on the summation of the following items; people at risk of severe illness, symptoms, treatment, transmission, and infection of COVID-19 (Table 2).

Self-efficacy

The mean score of their perceived self-efficacy was 11.07 (SD: 1.72). The mean of each item is presented in Table 2.

TABLE 1. Demographic profile of the respondents

Variables	Frequency (N)	Percentage (%)
Age		
18–25 years old	184	39.6
26–35 years old	69	14.8
36–45 years old	69	14.8
46–55 years old	102	21.9
>55 years old	16	3.4
Total	440	94.6
Gender		
Male	160	34.4
Female	305	65.6
Total	465	100
School education		
Primary and secondary school	57	12.2
Pre-university	50	10.8
Bachelor's	276	59.4
Master's and higher	82	17.6
Total	465	100
A health professional		
Yes	30	6.5
No	435	93.5
Total	465	100
Having a chronic illness		
Yes	28	6
No	423	91
Do not know	14	3
Total	465	100
Regions in Malaysia		
Central Region	220	47.3
Northern Region	67	14.4
Southern Region	94	20.2
East Coast	71	15.3
East Malaysia (Sabah & Sarawak)	13	2.8
Total	465	100

TABLE 2. Mean scores of knowledge, self-efficacy, barriers, and drivers

	Min	Max	Mean	SD
Knowledge domains				
People at increased risk	1.00	8.00	7.39	1.14
Symptoms	1.00	9.00	6.80	1.82
Treatment	1.00	1.00	0.92	0.27
Transmission	1.00	2.00	1.92	0.31
Infection	1.00	2.00	1.72	0.47
Knowledge (Total)	5.00	22.00	18.74	2.51
Perceived self-efficacy	5.00	14.00	11.07	1.72
Barriers	2.00	14.00	5.20	2.81
Drivers	7.00	49.00	39.72	5.17

Barriers

The total mean score for barriers was 5.20 (SD: 2.81). Almost 81.3% of the respondents disagreed with the statement "I seldom have access to water and soap," and 60% of them disagreed with the statement "My hands dry out when I wash them frequently" (Table 2).

Drivers

More than 80% of the participants agreed to drivers' statements such as "I see my family and friends washing their hands frequently" and "Health authorities urge me to wash my hands frequently." Less than half (33.4%) agreed to protect others by avoiding crowded areas; "I want to protect others by avoiding crowded areas." The mean score for drivers was 39.72 (SD: 5.17) (Table 2).

Preventive behaviors

A high percentage of the respondents claimed that hand washing for 20 seconds (97.2%); wearing a face mask (83.2%); using hand disinfectants (97.6%); avoiding touching eyes, nose, and mouth with unwashed hands (99.4%); covering mouth when coughing (97.4%); staying home when sick (97.5%); and not traveling abroad (99.4%) are the effective preventive measures to prevent the spread of the disease. A high percentage was also aware of other preventive measures, such as exercising regularly (80.9%) and taking food supplements (81.7%).

More than 90% of the respondents adhered to the recommended preventive measures; hand washing for 20 seconds (96.8%), wearing a face mask (98.5%), using hand disinfectants (92.9 %), covering mouth when coughing (98.1%), staying home when sick (97.0%), and not traveling abroad (98.5%). Less than half of the participants believed social distancing (48.2%), practicing self-quarantine (41.5%), and avoiding crowded places (48.0%) are effective preventive measures. In practice, 75.9% of the participants practiced social distancing, and 98% of them performed self-quarantine. However, less than half (47.3%) avoided touching eyes, nose, and mouth with unwashed hands, and only a low percentage of them (38.3%) avoided crowded places. With regard to other preventive behaviors, a high percentage of the respondents practiced having a balanced diet (91.8%) and taking food supplements (80.4%). Table 3 presents the frequencies of the responses to the effective measures for preventing the spread of COVID-19 and preventive behaviors.

TABLE 3. Effective measures to prevent the spread and infection of COVID-19 (N = 465)

Variables	Effective measures			Taken effective measures		
	Yes N (%)	No N (%)	Do not know N (%)	Yes N (%)	No N (%)	Do not apply N (%)
Hand washing for 20 seconds	452 (97.2)	9 (1.9)	4 (0.9)	450 (96.8)	14 (3.0)	1 (0.2)
Wearing a face mask	387 (83.2)	44 (9.5)	34 (7.3)	458 (98.5)	4 (0.9)	3 (0.6)
Social distancing	224 (48.2)	188 (40.4)	53 (11.4)	353 (75.9)	76 (16.3)	36 (7.7)
Use of disinfectants to clean hands when soap and water is not available for washing hands	454 (97.6)	7 (1.5)	4 (0.9)	432 (92.9)	27 (5.8)	6 (1.3)
Avoid touching eyes, nose, and mouth with unwashed hands	462 (99.4)	3 (0.6)	0(0.0)	220 (47.3)	171 (36.8)	74 (15.6)
Covering mouth when cough	453 (97.4)	0 (0.0)	12 (2.6)	456 (98.1)	5 (1.1)	4 (0.9)
Staying home when you are sick or when having a cold	453 (97.4)	10 (2.2)	2 (0.4)	451 (97.0)	10 (2.2)	4 (0.9)
Self-quarantine	193 (41.5)	191 (41.1)	81 (17.4)	456 (98.1)	4 (0.9)	5 (1.1)
Avoiding close contact with someone who is infected	348 (74.8)	82 (17.6)	35 (7.5)	459 (98.7)	3 (0.6)	3 (0.6)
Avoiding places where many people gather	223 (48.0)	170 (36.6)	72 (15.5)	178 (38.3)	211 (45.4)	76 (16.3)
Not traveling abroad	462 (99.4)	3 (0.6)	0 (0.0)	458 (98.5)	5 (1.1)	2 (0.4)
Exercising regularly	376 (80.9)	55 (11.8)	34 (7.3)	346 (74.4)	80 (17.2)	39 (8.4)
Ensuring a balanced diet	214 (46.0)	167 (35.9)	84 (18.1)	427 (91.8)	30 (6.5)	8 (1.7)
Taking herbal supplements	354 (76.1)	81 (17.4)	30 (6.5)	354 (76.1)	94 (20.2)	17 (3.7)
Taking food supplements	380 (81.7)	68 (14.6)	17 (3.7)	374 (80.4)	73 (15.7)	18 (3.9)
Taking antibiotics	251 (54.0)	165 (35.5)	49 (10.5)	307 (66.0)	122 (26.2)	36 (7.7)
Using homeopathic remedies	351 (75.5)	88 (18.9)	26 (5.6)	112 (24.1)	279 (60.0)	74 (15.9)
Getting a flu shot	83 (17.8)	235 (50.5)	147 (31.6)	359 (77.2)	87 (18.7)	19 (4.1)
Drinking ginger tea	354 (76.1)	92 (19.8)	19 (4.1)	283 (60.9)	138 (29.7)	44 (9.5)
Drinking coconut juice	62 (13.3)	296 (63.7)	107 (23)	358 (77.0)	93 (20.0)	14 (3.0)
Practicing caution when opening the mail	343 (73.8)	91 (19.6)	31 (6.7)	168 (36.1)	225 (48.4)	72 (15.5)
Avoiding eating meat	345 (74.2)	112 (24.1)	8 (1.7)	204 (43.9)	210 (45.2)	51 (11.0)

Hand washing for 20 seconds was not associated with the background of the respondents, such as gender, age, level of education, having a chronic illness, and region of living ($p > 0.05$) but was significantly associated with work as a health provider ($p < 0.001$). Hand washing for 20 seconds was also insignificantly associated with knowledge, self-efficacy, barriers, and drivers ($p > 0.05$). Meanwhile, wearing a face mask was not associated with participants' background, knowledge, self-efficacy, and barriers ($p > 0.05$) but was significantly associated with drivers ($p < 0.01$). Social distancing was significantly associated with age ($p < 0.05$) and drivers ($p < 0.001$). Other preventive behaviors were significantly associated with the background of the respondents, namely, age, level of education, presence of illness, region of residency, and whether they are healthcare providers. The presence of chronic illnesses was significantly associated with staying home when sick ($p = 0.037$), covering mouth when coughing ($p = 0.005$), avoiding contact with an infected person ($p < 0.001$), and practicing self-quarantine ($p < 0.001$).

A regression analysis was performed to determine the predictive factors associated with preventive behaviors: hand washing, wearing a face mask, and social distancing. The results showed that perceived self-efficacy was the predictive factor for wearing a face mask (OR: 1.70; 95% CI: 1.11, 2.60; $p < 0.05$). For every unit increase in the self-efficacy score, the chance of the participants wearing a face mask increased 1.7 times as likely. Barriers were found to be a predictive factor for wearing a face mask (OR: 1.69; 95% CI: 1.03, 2.76; $p < 0.05$) and social distancing (OR: 1.10; 95% CI: 1.01, 121; $p < 0.05$). These results indicate that those who agreed to having problems with access to water and soap and hands drying out when washed frequently had 1.10 times as likely barriers compared with those who disagreed. Last, the high mean score of drivers was 1.12 times as likely predictors of social distancing (95% CI: 1.07, 1.17; $p < 0.001$) compared with those with lower scores (Table 4).

Self-efficacy was also found to be related with barriers and drivers; for every unit increase in barriers, the mean self-efficacy score decreased by 0.07 ($p < 0.05$); and for every unit increase in drivers, the mean of self-efficacy score increased by 0.07 ($p < 0.001$). The nonhealth providers were found to have lower mean scores of barriers than health providers by 1.26 ($p < 0.05$). Respondents older than 55 years old and who have master's degrees and higher had the mean knowledge scores of 18.26 ($p < 0.001$) (Table 5).

TABLE 4. Factors associated with the taken preventive measures: Findings from the regression analysis

	Wash hand			Face mask			Social distance		
	OR	CI (95%)	*p*	OR	CI (95%)	*p*	OR	CI (95%)	*p*
Knowledge									
Knowledge	1.14	0.92, 1.42	0.238	0.98	0.68, 1.41	0.906	1.07	0.97, 1.18	0.167
Self-efficacy									
Self-efficacy	0.98	0.73, 1.34	0.925	1.70	1.11, 2.60	0.014*	0.89	0.76, 1.03	0.106
Preparedness									
Barriers	1.12	0.90, 1.40	0.297	1.69	1.03, 2.76	0.037*	1.10	1.01, 1.21	0.034*
Drivers	1.07	0.96, 1.20	0.205	1.07	0.92, 1.25	0.362	1.12	1.07, 1.17	0.000*

Multiple logistic regression, $R^2 1 = 0.213$, $R^2 2 = 0.500$, $R^2 3 = 0.168$, *$p < 0.05$

TABLE 5. Relationship of knowledge, self-efficacy, barriers, and drivers with the significant independent variables in the final model

Variables	Estimate	SE	*p*	Multiple comparison*
Knowledge				
Age				
18–25 yrs old	-0.176	0.639	0.001	1 < 3 < 4
26–35 yrs old	0.790	0.668		
36–45 yrs old	1.010	0.670		
46–55yrs old	1.326	0.652		
*>55 yrs old				
Education				
Primary and secondary school	-0.968	0.437	0.30	1 < 2
Pre-university	0.445	0.444		
Bachelor's	0.006	0.340		
Master's and higher				
Intercept	18.259	0.648	< 0.001	
Self-efficacy				
Barriers	-0.070	0.028	0.012	

Table 5. Continue

Variables	Estimate	SE	*p*	Multiple comparison*
Drivers	0.070	0.015	< 0.001	
Intercept	8.652	0.612	< 0.001	
Barrier				
Self-efficacy	-0.171	0.075	0.024	
Health Provider				
No	-1.264	0.526	0.017	
Yes				
Intercept	8.269	0.993	< 0.001	
Drivers				
Self-efficacy	0.643	0.136	< 0.001	
Education				
Primary and secondary school	-1.826	0.864	0.003	1 < 3 < 2
Pre-university	1.632	0.900		
Bachelor's	-0.622	0.630		
Master's and higher				
Intercept	33.017	1.605	< 0.001	

ANCOVA analysis of covariance; * Bonferroni

DISCUSSION

This study aimed to determine the COVID-19 knowledge, perceived self-efficacy, barriers, and drivers and to investigate the associations between these variables with the preventive behaviors among the population in Malaysia. This research may be the first to assess COVID-19 knowledge, perceived self-efficacy, barriers, drivers, and preventive behaviors by using WHO guidelines in the Malaysian community.

Most of the respondents had good knowledge about the COVID-19 outbreak. The data were collected during the end stages of the second wave of COVID-19 in Malaysia. The results proved that there had been good dissemination of COVID-19 information to the population via official and social media, such as television and telegram. Internet access was also widely used and well established; along with social media, the information dissemination can occur at a fast rate.[32] The information could easily be accessed anywhere and at any time.[33] The values scored in each domain were above average. The highest mean score achieved by the respondents was for the treatment and transmission domains, which indicated that they were in the knowledge about no effective treatment being available for COVID-19 at this stage and about the mode of the disease transmission. This was followed by the infection domain, people at risk of severe illness, and the symptoms of COVID-19 infection.

As for the symptoms, a high percentage of the respondents agreed that fever, cough, shortness of breath, and sore throat are related to COVID-19. By contrast, more than half of them agreed that other symptoms, such as runny nose, muscle ache, headache, and fatigue, are related to the disease. Only approximately half of the respondents agreed that diarrhea is related to COVID-19. The results showed that the most common symptoms were well-known among the public, but not for other related symptoms, such as headache, muscle ache, and diarrhea. A high percentage of the respondents also agreed that no drug treatment or vaccine is currently available for COVID-19. With regard to transmission, a high percentage of them knew that the novel coronavirus is transmissible from person to person; that it can be transmitted via droplets through coughing, sneezing or intimate contact, and the incubation time can be up to 14 days. This result is in contrast to that found in a study conducted on healthcare workers in early March 2020.[34] Although the time frame was different, the results related to the transmission of the disease were alarming, as the participants were healthcare workers. Concerning the immune response, only two thirds of the respondents answered the related question correctly (i.e., after a person has recovered from the disease, he/she is not necessarily immune to COVID-19). Despite the low percentage of respondents in some items, this study showed that the population has good knowledge about the COVID-19 infection. This result is expected, as the government updated and disseminated the information through various means of communication. In addition, social media has been found to be one of the effective ways to deliver the knowledge.[33]

This study also reported high self-efficacy among the respondents, in contrast to the finding in another research measuring self-efficacy related to COVID-19 among a community.[35] They found that the population had a low level of self-efficacy, correlated with perceived severity of infection, although a high level of self-efficacy was reported, which was positively correlated with preventive behaviors. The present study revealed that a high level of self-efficacy was positively correlated with knowledge. The same finding was reported by another

study, which showed that illness perceptions toward COVID-19 had a significant indirect effect on self-efficacy, but a direct effect on the adherence to preventive measures.[36] Thus, self-efficacy has a strong impact on someone's health behaviors.[24] Knowledge of the disease, awareness of risk factors, and subjective perceptions are shown to have positive impacts on self-efficacy.[37,38] Therefore, the public health intervention should focus on enhancing self-efficacy among the community to increase compliance toward preventive behaviors.

In this research, a high percentage of the respondents exhibited preventive behaviors, such as washing hands, using hand disinfectants, wearing a face mask, practicing cough etiquette, avoiding close contact with a COVID-19 positive person, adhering to self-quarantine, and staying home when sick. Less than half of them claimed that they neither avoid crowded places nor avoid touching their eyes, mouth, and nose with unwashed hands. In addition, hand cleaning (hand washing and using hand disinfectants) and mouth covering (wearing a face mask and practicing cough etiquette) were the effective measures and preventive behaviors taken by the respondents to prevent the spread of the infection. Meanwhile, less than half of them claimed social distancing and avoiding crowded places as effective measures. As for preventive behaviors, almost three quarters of the respondents were found to have practiced social distancing measures, whereas only slightly above a quarter of them were reported to have avoided crowded places. Many of the preventive behaviors are voluntary in nature, and ensuring their cooperation requires great efforts. Social distancing measures, especially avoiding places where many people gather, were hardly adhered. This finding is in contrast to that in an earlier study in Malaysia.[39] A research performed at the earlier stage of the second wave pandemic in Malaysia reported that more than three quarters of the participants (83%) avoided crowded places, but wearing a face mask was at a lower percentage (51%). This result was quite expected, as the study was conducted during the earlier period of the pandemic where people were more concerned about the infection. The reason could be due to the lack of belief that wearing a face mask can protect them from the disease, resulting in its low compliance compared with in the later stage of the pandemic. Furthermore, due to a long period of movement control order and the continuing outbreak, a psychological impact might have an influence on the adherence to the preventive behaviors.[40,41]

Social distancing measures impose lifestyle changes, which are against the social norms of most people, mainly in the adolescent group.[42,43] The same finding was revealed in this study where a significant association was observed between social distancing and age. More than half of the younger respondents were found to be not in compliance with social distancing measures. A similar finding was also obtained with avoiding places where many people gather, although it was insignificant. Another research has revealed that social distancing requires the strongest influential factors, such as wanting to protect themselves and their family members and being able to communicate remotely.[44] Other studies have shown that compliance to social distancing depends on factors such as flexible working time, belief that social distancing plays a role in preventing the spread of the disease, and their responsibility to protect the community.[45,46]

In general, adequate and timely information helps increase preventive behaviors. The dissemination of knowledge or information by using proper means is essential to accentuate the importance of preventive behaviors. Nudges in the forms of prompts, cues, and reminders have also been used in Malaysia[47] as tools to direct or cause people to behave in specific ways, with the potential to change people's behaviors effectively and improve outcomes.[48] A study about social distancing was conducted on a total of 500 adults in Ireland; it reported that an informative public health message via a poster helps motivate social distancing and reduce the spread of COVID-19.[49] Hence, well-designed information is crucial to improve voluntary compliance for ensuring the containment of the COVID-19 infection.

The present study added that respondents take other measures to prevent the spread of the infection, such as exercising regularly, ensuring a balanced diet, taking food and herbal supplements, taking antibiotics, getting a flu shot, and drinking ginger tea and coconut juice. Few other preventive measures, such as using homeophatic remedies, avoiding eating meat, and practicing caution when opening meals, were also thought as being effective, although less than half of them were actually doing them.

Furthermore, barriers such as infrequent access to water and soap and hands that dry out when washed frequently had low scores of agreements. Thus, both factors were not barriers to the participants. Meanwhile, drivers showed high mean scores on most items, such as "I see my family and friends washing their hands frequently" and "Health authorities urge me to avoid crowded areas," except for item "I want to protect others by avoiding crowded areas." Therefore, the participants did not strongly agree that they will protect others by avoiding crowded areas. The results emphasized that social distancing is not a preventive measure that is easily accepted by the population. The causal drivers of the participants in this study were based highly on the norms and higher authorities, different from a research on social distancing in the United States,[50] which involved 2,500 participants; it showed that higher information seeking, higher financial security, and higher worry about

the coronavirus were the causal drivers for social distancing. The differences found in both studies may be related to the culture, lifestyle, and environment of the population. Therefore, policymakers may have to fully understand the impact of social distancing and target an efficient intervention model for social distancing among the targeted population.

A few limitations were identified in the present study, which should be highlighted in future research. First, most of the participants were not health professionals. Therefore, the results might have reflected general population responses, which were unrelated to health professionals. In addition, the results cannot be generalized to the whole population because the sample size was small. In addition, a high percentage of them had bachelor degrees and higher, in agreement with an earlier study conducted in China by Zhong *et al*. (2002).[51] Thus, the results only focus on the higher education population. Second, those who have no tertiary education or those living in rural areas might have no access to the questionnaire, as this study was conducted online. Therefore, any decision to generalize these findings to other categories of the population must be made thoughtfully. Third, the complete set of questionnaires was lengthy and time-consuming. Thus, the number of responses was low, and the sample size could not be achieved within the time frame. Moreover, online survey response rates were reported to be lower than paper-based surveys.[52] Fourth, the questionnaire was adapted directly from WHO. Hence, the validity and reliability were not conducted. Last, the questionnaire was self-administrated, and it might have led to certain types of limitation biases, such as social desirability.

CONCLUSIONS

The results of this study are expected to have significant application for policy design and future research in Malaysia. This research sheds light on the relevant factors concerning preventive behaviors in reducing the spread of COVID-19 infection. It highlights that barriers and driver, along with self-efficacy, are the most significant factors in predicting individuals' preventive behaviors. Therefore, policymakers have a significant role in ensuring individuals' engagement in effective preventive behaviors, including social distancing, which largely contributes to the reduction of COVID-19 transmission.

CONFLICT OF INTEREST

No potential competing interest was reported by the authors.

FUNDING

This work was not supported by any grant.

Received: April 13, 2021 | Accepted: June 12, 2021

REFERENCES

1. World Health Organization. *WHO Director-General's opening remarks at the media briefing on COVID-11 March 2020*. New York: World Health Organization, 2020.
2. World Health Organization. *COVID-19 Weekly epidemiological update–10 November 2020*. New York: World Health Organization, 2020.
3. Riou J, Althaus CL. Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. *Euro Surveill*. 2020;25:2000058.
4. Bai Y, Yao L, Wei T, Tian F, Jin DY, Chen L, *et al*. Presumed asymptomatic carrier transmission of COVID-19. *JAMA*. 2020;323:1406–7.
5. Rothe C, Schunk M, Sothmann P, Bretzel G, Froeschl G, Wallrauch C, *et al*. Transmission of 2019-nCoV infection from an asymptomatic contact in germany. *N Engl J Med*. 2020;382:970–1.
6. World Health Organization. *Critical preparedness, readiness and response actions for COVID-19: interim guidance, 4 November 2020*. New York: World Health Organization, 2020.
7. Hann KEJ, Freeman M, Fraser L, Waller J, Sanderson SC, Rahman B, *et al*. Awareness, knowledge, perceptions, and attitudes towards genetic testing for cancer risk among ethnic minority groups: A systematic review. *BMC Pub Health*. 2017;17:503.
8. Sumankuuro J, Crockett J, Wang S. Factors influencing knowledge and practice of birthpreparedness and complication readiness in sub-saharan Africa: A narrative review of cross-sectional studies. *Int J Community Med Pub Health*. 2016;3:3297–307.
9. Tostmann A, Bradley J, Bousema T, Yiek WK, Holwerda M, Bleeker-Rovers C, *et al*. Strong associations and moderate predictive value of early symptoms for SARS-CoV-2 test positivity among healthcare workers, the Netherlands, March 2020. *Euro Surveill*. 2020;25:2000508.
10. Bedford J, Enria D, Giesecke J, Heymann DL, Ihekweazu C, Kobinger G, *et al*. COVID-19: Towards controlling of a pandemic. *Lancet*. 2020;395:1015–8.
11. Zhang L, Tao Y, Shen M, Fairley CK, Guo Y. Can self-imposed prevention measures mitigate the COVID-19 epidemic? *PLoS Med*. 2020;17:e1003240.
12. Alagoz O, Sethi AK, Patterson BW, Churpek M, Safdar N. Effect of timing of and adherence to social distancing measures on COVID-19 burden in the United States: A simulation modeling approach. *Ann Intern Med*. 2021;174:50–7.
13. Gao J, Zheng P, Jia Y, Chen H, Mao Y, Chen S, *et al*. Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One*. 2020;15:e0231924.
14. Berger ZD, Evans NG, Phelan AL, Silverman RD. Covid-19: Control measures must be equitable and inclusive. *BMJ*. 2020;368:m1141.

15. Hale T, Petherick A, Phillips T, Webster S. Variation in government responses to COVID-19. Oxford: Blavatnik School of Government; 2020. (BSG-WP-2020/031).
16. Yan Q, Tang S, Gabriele S, Wu J. Media coverage and hospital notifications: Correlation analysis and optimal media impact duration to manage a pandemic. *J Theor Biol*. 2016;390:1–13.
17. Allington D, Duffy B, Wessely S, Dhavan N, Rubin J. Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency. *Psychol Med*. 2020:1–7.
18. Bendau A, Petzold MB, Pyrkosch L, Mascarell Maricic L, Betzler F, Rogoll J, *et al*. Associations between COVID-19 related media consumption and symptoms of anxiety, depression and COVID-19 related fear in the general population in Germany. *Eur Arch Psychiatry Clin Neurosci*. 2021;271:283–91.
19. Bandura A. Self-efficacy. In Weiner IB, Craighead WE. *The Corsini Encyclopedia of Psychology*. John Wiley & Sons, Inc., 2010, p. 1–3.
20. Martinez-Calderon J, Zamora-Campos C, Navarro-Ledesma S, Luque-Suarez A. The role of self-efficacy on the prognosis of chronic musculoskeletal pain: A systematic review. *J Pain*. 2018;19:10–34.
21. Truong TNN, Wang C. Understanding Vietnamese college students' self-efficacy beliefs in learning English as a foreign language. *System*. 2019;84:123–32.
22. Bandura A. Guide for constructing self-efficacy scales. In Pajares F, Urdan TC. Self-efficacy Beliefs of Adolescents. *Info Age Publ*. 2006;5:307–37.
23. Hevey D, Smith MI, McGee HM. Self-efficacy and health behaviour: A review. *Ir J Psychol Med*. 1998;19:248–73.
24. Sheeran P, Maki A, Montanaro E, Avishai-Yitshak A, Bryan A, Klein WM, *et al*. The impact of changing attitudes, norms, and self-efficacy on health-related intentions and behavior: A meta-analysis. *Health Psychol*. 2016;35:1178–88.
25. Zheng X, Yu H, Qiu X, Chair SY, Wong EM, Wang Q. The effects of a nurse-led lifestyle intervention program on cardiovascular risk, self-efficacy and health promoting behaviours among patients with metabolic syndrome: Randomized controlled trial. *Int J Nurs Stud*. 2020;109:103638.
26. Syed ST, Gerber BS, Sharp LK. Traveling towards disease: Transportation barriers to health care access. J Community Health. 2013;38:976–93.
27. Shoesmith A, Hall A, Wolfenden L, Shelton RC, Powell BJ, Brown H, *et al*. Barriers and facilitators influencing the sustainment of health behaviour interventions in schools and childcare services: A systematic review. *Implement Sci*. 2021;16:62.
28. Pallin ND, Beeken RJ, Jones KP, Woznitza N, Fisher A. A survey of therapeutic radiographers' knowledge, practices, and barriers in delivering health behaviour advice to cancer patients. *J Cancer Educ*. 2020. [in press]
29. Arora NK, Johnson P, Gustafson DH, McTavish F, Hawkins RP, Pingree S. Barriers to information access, perceived health competence, and psychosocial health outcomes: Test of a mediation model in a breast cancer sample. *Patient Educ Couns*. 2002;47:37–46.
30. Ensor T, Cooper S. Overcoming barriers to health service access: Influencing the demand side. Health Policy Plan. 2004;19:69–79.
31. World Health Organization. *Guidance and protocol: Monitoring knowledge, risk perceptions, preventive behaviours and trust to inform pandemic outbreak response*. Copenhagen: World Health Organization, 2020.
32. Ng FK, Wallace S, Coe B, Owen A, Lynch J, Bonvento B, *et al*. From smartphone to bed-side: Exploring the use of social media to disseminate recommendations from the National Tracheostomy Safety Project to front-line clinical staff. *Anaesthesia*. 2020;75(2):227–33.
33. Chan AKM, Nickson CP, Rudolph JW, Lee A, Joynt GM. Social media for rapid knowledge dissemination: Early experience from the COVID-19 pandemic. *Anaesthesia*. 2020;75:1579–82.
34. Bhagavathula AS, Aldhaleei WA, Rahmani J, Mahabadi MA, Bandari DK. Knowledge and perceptions of COVID-19 among health care workers: Cross-sectional study. *JMIR Pub Health Surveill*. 2020;6:e19160.
35. Yıldırım M, Güler A. COVID-19 severity, self-efficacy, knowledge, preventive behaviors, and mental health in Turkey. *Death Stud*. 2020:1–8.
36. Chong YY, Chien WT, Cheng HY, Chow KM, Kassianos AP, *et al*. The role of illness perceptions, coping, and self-efficacy on adherence to precautionary measures for COVID-19. *Int J Environ Res Public Health*. 2020;17:6540.
37. Kang Y, Yang IS. Cardiac self-efficacy and its predictors in patients with coronary artery diseases. *J Clin Nurs*. 2013;22:2465–73.
38. D'Souza MS, Karkada SN, Parahoo K, Venkatesaperumal R, Achora S, Cayaban ARR. Self-efficacy and self-care behaviours among adults with type 2 diabetes. *Appl Nurs Res*. 2017;36:25–32.
39. Azlan AA, Hamzah MR, Sern TJ, Ayub SH, Mohamad E. Public knowledge, attitudes and practices towards COVID-19: A cross-sectional study in Malaysia. *PLoS One*. 2020;15:e0233668.
40. Rodríguez-Rey R, Garrido-Hernansaiz H, Collado S. Psychological impact and associated factors during the initial stage of the Coronavirus (COVID-19) pandemic among the general population in Spain. *Front Psychol*. 2020;11:1540.
41. Serafini G, Parmigiani B, Amerio A, Aguglia A, Sher L, Amore M. The psychological impact of COVID-19 on the mental health in the general population. *QJM*. 2020;113:531–7.
42. Farias JEM, Pilati R. Violating social distancing amid COVID-19 pandemic: Psychological factors to improve compliance. *PsyArXiv*. 2020.
43. Andrews JL, Foulkes L, Blakemore SJ. Peer influence in adolescence: Public-health implications for COVID-19. *Trends Cogn Sci*. 2020;24:585–7.
44. Coroiu A, Moran C, Campbell T, Geller AC. Barriers and facilitators of adherence to social distancing recommendations during COVID-19 among a large international sample of adults. *PLoS One*. 2020;15:e0239795.

45. Jones CJ, Philippon T, Venkateswaran V. Optimal mitigation policies in a pandemic: Social distancing and working from home. Massachusetts: National Bureau of Economic Research; 2020. (Working Paper No. 26984).
46. Oosterhoff B, Palmer CA. Attitudes and psychological factors associated with news monitoring, social distancing, disinfecting, and hoarding behaviors among US adolescents during the Coronavirus disease 2019 pandemic. *JAMA Pediatr*. 2020;174:1184–90.
47. Ab Malik N, Abdul Kadir N. Nudging people for healthcare protection. *New Straits Times*. 2020 Apr 14; Research.
48. Szaszi B, Palinkas A, Palfi B, Szollosi A, Aczel B. A systematic scoping review of the choice architecture movement: Toward understanding when and why nudges work. *J Behav Decis Mak*. 2018;31:355–66.
49. Lunn PD, Timmons S, Belton CA, Barjaková M, Julienne H, Lavin C. Motivating social distancing during the COVID-19 pandemic: An online experiment. *Soc Sci Med*. 2020;265:113478.
50. Charles G, Jain M, Caplan Y, Kemp H, Keisler A, Sgaier SK. Increasing uptake of social distancing during COVID-19: Behavioral drivers and barriers among US population segments. *SSRN*. 2020.
51. Zhong BL, Luo W, Li HM, Zhang QQ, Liu XG, Li WT, *et al*. Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: A quick online cross-sectional survey. *Int J Biol Sci*. 2020;16:1745–52.
52. Nulty DD. The adequacy of response rates to online and paper surveys: what can be done? *Assess Eval High Educ*. 2008;33:301–14.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 3

8-30-2021

Loneliness and Health Outcomes Among Malaysian Older Adults

Siti Zuhaida Hussein
Nursing Department, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur 56000, Malaysia, zuhaida_hussein@ukm.edu.my

Azera Hasra Ismail
Nursing Department, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur 56000, Malaysia, azera@ppukm.ukm.edu.my

Suraya Hanim Abu Bakar
Nursing Department, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur 56000, Malaysia, suraya_hnm@yahoo.com

Makara J Health Res. 2021;25(2):87–93
doi: 10.7454/msk.v25i2.1277

Makara Journal of Health Research

Loneliness and Health Outcomes Among Malaysian Older Adults

Siti Zuhaida Hussein*, Azera Hasra Ismail, Suraya Hanim Abu Bakar

Nursing Department, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur 56000, Malaysia

Abstract

Background: Loneliness is a major social problem among the elderly all over the world.

Methods: A community-based survey was conducted among 380 community-dwelling older adults residing in Malaysia. A proportional stratified random sampling method was used to examine the relationship between health factors and loneliness. Data were collected using the short-form Social and Emotional Loneliness Scale for Adults, Geriatric Depression Scale-15, and RAND SF-20. $p < 0.05$ was considered to be statistically significant, and data analysis was performed using Statistical Package for the Social Sciences Statistics 26.0 for Windows.

Results: Results revealed that 32.6% of the respondents had social loneliness, 39.9% had emotional loneliness, and 9.2% had family loneliness. Bivariate analyses showed that social and emotional loneliness are significantly related to depression. Moreover, emotional and social loneliness were significantly associated with chronic illness. The results of the multiple logistic regression indicated that depression was a significant predictor of social loneliness (OR = 2.5, 95% CI: 1.1–5.7; $p = 0.03$) and that chronic illness (OR = 0.4, 95% CI: 0.2–0.8; $p = 0.02$) remained a significant predictor of family loneliness.

Conclusions: The loneliness prevalence experienced by older adults is at a low level. The classification of loneliness in this study would be beneficial in the establishment of loneliness intervention strategies.

Keywords: depression, elderly, health, loneliness

INTRODUCTION

The phenomenon of loneliness is a growing international public health problem in modern society. Although loneliness occurs throughout one's life, individuals over the age of 60 years are at a relatively high risk of experiencing loneliness later in life. With the growth of an aging population, loneliness imposes high costs related to people's health and well-being, thereby putting a strain on social care resources and affecting clinical and public health practice.[1] In previous decades, loneliness was considered a hidden pathological state that greatly influenced the quality of life, especially that of older adults.[2–6]

Many adults aged 60 years and above experience loneliness that puts their health at risk. Loneliness among older adults is viewed to exert a negative impact on this population's mental state, cognitive function, and physical and psychosocial characteristics.[2,4,7–11] Previous studies have recognized that prolonged loneliness affects a significant number of older adults and puts them at risk for mental issues (e.g., depression) and chronic conditions (e.g., heart disease). Moreover, prolonged loneliness is significantly associated with poor physical performance in older adults[12,13] and severe depressive symptoms.[14] Particularly concerning is the fact that loneliness can be related to unhealthy lifestyles, self-neglect (e.g., excessive alcohol consumption), poor hygiene, and undernourishment.[3,15]

The worst scenario is the increase in mortality rate in older people. The results of a longitudinal study revealed that feelings of loneliness for more than 6 years are associated with increased mortality risk among older adults.[12] In addition, past studies have shown that heart failure patients who experience loneliness face an increased risk of death and hospital readmission.[9,16]

Loneliness is generally viewed as a negative emotional expression resulting from a severance of a relationship, especially from a social network comprising family members, friends, or the community. However, it remains a taboo subject among older adults, especially in Southeast Asia. Therefore, older adults do not always express their feelings of loneliness. Meanwhile, numerous studies have stated that loneliness is a unique concept and leads to different forms of psychological depression.[3]

In an aging population, loneliness is costly for one's health and well-being, and it puts a strain on social care resources and affects clinical and public health practice. Loneliness has become a major scholarly, public, and policy concern. Therefore, the concern about the

***Corresponding author:**
Siti Zuhaida Hussein
Nursing Department, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia
E-mail: zuhaida_hussein@yahoo.com

prevalence of loneliness has increased, and estimates vary according to study population, age, and the definitions utilized. However, knowledge about the relationship between types of loneliness (social, emotional, and family) and the health status of older adults is still limited. Few studies have examined functional status and loneliness among older adults, especially those living in Malaysia. The question usually asked is as follows: "Is the low level of health of older adults the cause of their loneliness?" or "Is the rise of loneliness the main reason for the deterioration of older adults' health?" Hence, the present study was conducted to investigate the relationship between the three main types of loneliness (social, emotional, and family loneliness) and health factors.

METHODS

This study was conducted with the approval of the Universiti Kebangsaan Malaysia Research Ethics Committee. Prior to participation, the respondents gave written informed consent. This study is a cross-sectional community-based survey conducted among 380 community-dwelling older adults aged 60 years and over who live in the suburban community in Pontian, Johor, Malaysia. This study aimed to examine the relationship between loneliness (social, emotional, and family) and health perceptions, depression, physical health, and chronic diseases. The design was chosen to provide data that complement each method and to thus generate meaningful data. Pontian is the smallest district in Johor, and it is located at around 320 km from Kuala Lumpur and 60 km from Singapore. In Pontian, most of the elderly work in the fields of agriculture and fishery or are pensioners.

The proportionate stratified random sampling technique was utilized in this study, and the sample included senior citizens aged 65 years and older who reside in Pontian. The first stage involved selecting zones within the district on the basis of comparable elderly population proportions. The second stage of sampling entailed selecting townships while the third stage involved identifying the significant villages. The exclusion criteria included older persons who were in full-time care facilities and those with physical limitations. This study complied with the STROBE guidelines and is consistent with them.

For the data collection, the respondents were identified using a door-to-door census and were invited to participate voluntarily. The researchers made follow-up visits to potential older individuals who were not at home during the initial visit. This procedure was repeated until a sufficient number of samples were obtained. All data were acquired through the use of questionnaires. For potential participants who were not at home during the first visit, follow-up visits were conducted twice before their exclusion. This process was repeated until a sufficient number of samples were obtained. The respondents completed the questionnaires independently. For those who had difficulty reading, the caregiver read the questionnaires aloud to them, and the respondents selected their own response choices. Most of the respondents required approximately 20–30 min to complete the questionnaire and return it to the researcher, although the researcher provided a postal return option.

In this study, the questionnaire was divided into two parts. The first part covered the participants' sociodemographic information, chronic illnesses, and health perceptions. The perceptions of their health status were assessed with one question prepared by the researcher on the basis of the literature review. The second part involved four survey instruments. First, the types of loneliness were measured using the short-form of the Social and Emotional Loneliness Scale for Adults (SELSA-S) developed by DiTommaso and Spinner (1993).[17] The scale consists of 15 items and was translated into Bahasa Malaysia for this work. The test–retest was 0.88 to 0.91 for the loneliness domains (social, romantic, and family loneliness). Meanwhile, the translated version had excellent internal consistencies of 0.87 and 0.90. The ceiling effect of the questionnaire was calculated when most of the respondents chose the upper scale (e.g., 95% of the questionnaire's total score). The floor effect was calculated when most of the participants chose responses that were at the lower limit of the scale (e.g., 5% of the questionnaire's total score).

In this study, the level of depression was measured using the Geriatric Depression Scale-15 (GDS-15). This scale consists of 15 items and was translated into Bahasa Malaysia. GDS-15 showed good internal reliability with a Cronbach α coefficient of 0.84 and test–retest of 0.84. RAND SF-20 was also chosen to measure the physical health of the respondents. This scale is a series of generic indicators and had good internal consistency with a Cronbach α coefficient value exceeding 0.81–0.87 and test–retest value of 0.96; all items were correlated above 0.7.

In this study, data were collected and then analyzed using the Statistical Package for the Social Sciences Statistics version 25.0 for Windows. The significance level was set at $p < 0.05$. A descriptive analysis was performed to identify the distributions of the sociodemographic factors and health status variables. Meanwhile, a Chi-square test and multiple regressions were performed to examine the relationship between the groups.

RESULTS

The response rate in this study was 100%. Table 1 shows the distribution of sociodemographic factors. Most of the respondents were female and had primary education.

In addition, more than 90% of the respondents had no physical health deterioration and perceived their health to be in good condition. Of the respondents, 37.6%, 40.3%,

TABLE 1. Distribution of sociodemographic factors (N = 380)

Variables	Frequency (N)	Percentage (%)
Age		
65 – 74 years	274	72.1
75 – 84 years	85	22.4
85 years and above	21	5.5
Gender		
Male	145	38.2
Female	235	61.8
Ethnic		
Malay	289	76.1
Chinese	88	23.2
India	3	0.7
Level of education		
Not schooling	66	17.4
Primary education	170	44.7
Secondary education	84	22.1
Tertiary education	60	15.8
Marital status		
Single	7	1.8
Married	252	66.3
Divorce/ separate	17	4.5
Widow	104	27.4
Living arrangement		
Alone	95	25.0
With partner only	155	40.8
With others	130	34.2
Physical health		
No deterioration	362	95.2
Deterioration	18	4.8
Depression		
No	241	63.3
Yes	139	36.7
Chronic illness		
No	164	43.2
Yes	216	56.8
Health perceptions		
Bad	32	8.4
Good	348	91.6
Experience of social loneliness		
No	237	62.4
Yes	143	37.6
Experience of emotional loneliness		
No	227	59.7
Yes	153	40.3
Experience of family loneliness		
No	339	89.2
Yes	41	10.8

and 10.8% reported social loneliness, emotional loneliness, and family loneliness, respectively.

Table 2 reveals that social loneliness was experienced by 62.2% of the respondents with depression, 41.9% of those with physical health deterioration, and 46.9% of those who had good health perceptions. A significant relationship was thus noted between social loneliness and depression ($p = 0.001$).

As for emotional loneliness, it was experienced by the respondents who had depression (37.9%) and bad health perceptions (37.4%). The respondents with no history of chronic illness (45.7%) and no deterioration of physical health (39.8%) also experienced emotional loneliness. Emotional loneliness was associated significantly with depression ($p = 0.004$) and chronic illness ($p = 0.01$).

Family loneliness was experienced by the respondents with depression (13.5%), those who did not report any physical health deterioration (8.9%), those without any chronic illness, and those with good health perceptions. A significant relationship was noted between family loneliness and chronic illness ($p = 0.03$).

Table 3 shows the results of the multiple logistic regression analysis for Models II and Model III to identify the factors influencing social, emotional, and family loneliness. This study found that depression influenced social loneliness (OR = 3.02, 95% CI: 1.49–6.11; $p = 0.002$). In the final analysis, depression was a significant predictor of social loneliness (OR = 2.52, 95% CI: 1.12–5.66; $p = 0.03$). The Cox and Snell R square for Model III was 0.21.

For emotional loneliness, the results of the multiple logistic regression tests showed that depression (OR = 2.68, 95% CI: 1.31–5.48, $p = 0.01$), chronic illness (OR = 0.59, 95% CI: 0.38–0.91; $p = 0.02$) and health perception (OR = 2.96, 95% CI: 1.19–7.34; $p = 0.02$) influenced emotional loneliness but were not related in the final analysis.

The results of the multiple logistic regression analysis also indicated that family loneliness was influenced by chronic diseases (OR = 0.50, 95% CI: 0.25–1.01; $p = 0.05$) and health perceptions (OR = 6.37, 95% CI: 1.98–20.49; $p = 0.002$). For Model III, the results showed that chronic disease (OR = 0.43, 95% CI: 0.21–0.88; $p = 0.02$) remained a significant predictor of family loneliness. The Cox and Snell R square for Model III was 0.08.

DISCUSSION

This study aimed to identify the prevalence of loneliness and its influencing factors among the elderly in the Pontian district. One-third of the older adults in this work reported experiencing social or emotional loneliness

TABLE 2. Distribution of social, emotional, and family loneliness and health status (N = 380)

	N	Social Loneliness		Emotional Loneliness		Family Loneliness	
		No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)
Depression							
No	343	223 (65.0)	120 (35.0)	213 (62.1)	130 (37.9)	307 (89.5)	36 (10.5)
Yes	37	14 (37.8)	23 (62.2)	14 (37.8)	23 (62.2)	32 (86.5)	5 (13.5)
		p = 0.001*		p = 0.004*		p = 0.57	
Deterioration of physical health							
No	337	213 (63.2)	124 (36.8)	203 (60.2)	134 (39.8)	307 (91.1)	30 (8.9)
Yes	43	25 (58.1)	18 (41.9)	30 (69.8)	13 (30.2)	40 (93.0)	3 (7.0)
		p = 0.52		p=0.23		p = 0.67	
Chronic illness							
No	164	104 (63.4)	60 (36.6)	89 (54.3)	75 (45.7)	144 (87.8)	20 (12.2)
Yes	216	134 (63.0)	82 (37.0)	144 (66.7)	72 (33.3)	203 (94.0)	13 (6.0)
		p = 0.78		p = 0.01*		p = 0.03*	
Health Perceptions							
Bad	348	221 (63.5)	127 (36.5)	218 (62.6)	130 (37.4)	320 (92.0)	28 (8.0)
Good	32	17 (53.1)	15 (46.9)	15 (46.9)	17 (53.1)	27 (84.4)	5 (15.6)
		p = 0.24		p = 0.08		p = 0.14	

$p < 0.05$

TABLE 3. Logistic regression within types of loneliness and health status (N = 380)

Health Status	MODEL II					MODEL III				
	Wald	Sig.	OR	95% C.I		Wald	Sig.	OR	95% C.I	
				Lower	Upper				Lower	Upper
Social Loneliness										
Physical health (yes)	1.66	0.20	1.64	0.77	3.50	-	-	-	-	-
Depression (yes)	9.45	**0.002**	3.02	1.49	6.11	**5.02**	**0.03**	**2.52**	**1.12**	**5.66**
Chronic disease (yes)	0.13	0.71	1.09	0.70	1.69	-	-	-	-	-
Health Perceptions (yes)	0.05	0.83	0.91	0.38	2.16	-	-	-	-	-
Cox & Snell R square [Model 2b]	[0.03]	-	-	-	-	-	-	-	-	-
Cox & Snell R square [Model 3]	-	-	-	-	-	[0.21]	-	-	-	-
Emotional Loneliness										
Physical health (yes)	2.29	0.13	0.53	0.23	1.21	-	-	-	-	-
Depression (yes)	7.32	**0.01**	2.68	1.31	5.48	2.40	0.12	2.05	0.83	5.10
Chronic disease (yes)	5.66	**0.02**	0.59	0.38	0.91	1.42	0.23	0.72	0.42	1.24
Health Perceptions (yes)	5.46	**0.02**	2.96	1.19	7.34	0.01	0.97	1.02	0.36	2.87
Cox & Snell R square [Model 2b]	[0.05]	-	-	-	-	-	-	-	-	-
Cox & Snell R square [Model 3]	-	-	-	-	-	[0.36]				
Family Loneliness										
Physical health (yes)	3.08	0.08	0.26	0.06	1.17	-	-	-	-	-
Depression (yes)	0.09	0.76	1.18	0.41	3.37	-	-	-	-	-
Chronic disease (yes)	3.78	**0.05**	0.50	0.25	1.01	**5.29**	**0.02**	**0.43**	**0.21**	**0.88**
Health Perceptions (yes)	9.65	**0.002**	6.37	1.98	20.49	1.52	0.22	1.94	0.68	5.54
Cox & Snell R square [Model 2b]	[0.03]	-	-	-	-	-	-	-	-	-
Cox & Snell R square [Model 3]	-	-	-	-	-	[0.08]				

while less than 11% experienced family loneliness. This result was found to be similar to that of the study conducted by Nor and Ghazali.[18] In their work, most of the respondents suffered more from emotional loneliness than from social and family loneliness. Moreover, about 43% of the participating Malaysian older adults reported experiencing loneliness.[18] The prevalence of loneliness in the current study is higher than that reported by Teh, Tey, and Ng[19], but their work only examined loneliness in general. In the current study, loneliness was categorized into social, emotional, and family loneliness. The older adults in the community reported experiencing more social and emotional loneliness than family loneliness.

Herein, a significant association was observed between depression and social and emotional loneliness; the same was not found for family loneliness. After controlling for the demographic variables in the multivariate analysis, depression was still a significant predictor of social loneliness. Furthermore, this study confirmed the findings of past studies that reported the positive and significant relationship between loneliness and depression.[1,2,7,20–22] Plezter and Pengpid explained that the strong relationship between loneliness and depressive symptoms could be explained by loneliness being a symptom of depression.[20] Previous study also reported that loneliness is a significant predictor of depression among older adults.[22] Lim and Eh found that the loneliness factor among older adults contributes to a consistent increase in depression scores.[21]

Depression and loneliness are believed to be strongly related. For example, Choi *et al*. stated that the association between depression and loneliness has been highlighted in several studies.[23] Moreover, a large-scale study identified that loneliness is significantly associated with depression and anxiety, as well as suicidal ideation.[24] According to Park *et al*., loneliness has a moderate to large effect on overall health outcomes, but its effect is particularly great on the mental health of older adults.[25] Nonetheless, these results may be confused by the large number of studies linking the relationship between loneliness and mental health relative to other health outcomes.[25] Thus, health professionals need to know how to differentiate the signs and symptoms of loneliness and depression experienced by older adults.

In the current work, less than 10% of the respondents had a bad perception of their health as most of them rated their health to be in good condition. Nevertheless, these respondents still reported experiencing emotional, social, and family loneliness. The results of the multiple logistic regression showed that emotional and family loneliness were associated significantly with health perceptions. However, health perceptions were not found to be a significant predictor of loneliness (social, emotional, and family). These results are similar to the findings in a study conducted in the 1900s.[26] Fees *et al*. stated that low self-perception of health has a consistent relationship with high levels of loneliness.[26]

Chronic illness is often associated with the aging process and the elderly population. The health of older adults is affected when they suffer from chronic diseases, and if they are not treated regularly, their well-being may be put at risk. Furthermore, this study showed that the respondents with and without chronic illnesses experienced social, emotional, and family loneliness. Chronic diseases are significantly associated with family and emotional loneliness. After controlling for the demographic variables, the multiple logistic regression analysis for Model III revealed that chronic disease remained a significant predictor of family loneliness. The results of this study are similar to those of previous research that reported chronic diseases to be significantly related to loneliness.[1,20,27] Peltzer and Pengpid found that loneliness is significantly associated with physical and mental variables, including having one or more chronic medical conditions.[20] A positive association indeed exists between recent physician visits for a chronic illness and hospitalization rate.[1] Teh, Tey, and Ng also reported a similar result that indicated chronic diseases to be correlated positively with loneliness.[19] Loneliness has also been related to a high risk of multiple chronic diseases and poor self-rated health.[2,28]

The impact of loneliness evolves gradually over time. Hence, this situation can reduce individuals' physiological defenses and thus make them vulnerable to health problems. Such a statement is reasonable. Many reviews have found that loneliness is a significant factor in determining an older adult's well-being.[2–4,7] Berg–Weger and Morley highlighted that loneliness significantly negatively affects older adults, particularly those who have chronic loneliness.[3] Chronic loneliness can be particularly destructive, particularly for those suffering from coronary heart disease, cognitive impairment, and insomnia. In addition, individuals who experience loneliness are at a high risk for developing a mental illness across their life span.[4] Therefore, this study highlights the need for healthcare providers to define the relationship between loneliness and health factors in older adults.

This study offers various strengths. For example, the classification of loneliness into social, emotional, and family loneliness would be beneficial in the establishment of intervention strategies that are focused on the types of loneliness. Thus, the findings may help build evidence-based data for strengthening health promotion activities, especially those related to loneliness among older adults. In addition, this study could help the community design a specific nursing care program for older adults according to the types of loneliness.

The limitation of this study is related to the low participation of certain groups. For example, the elderly

participants in this work were minimal in number. Moreover, the study employed a cross-sectional design, which does provide information about the current state of experience but is not useful in exploring loneliness in depth. Thus, the results of this study cannot be generalized to all older persons in Malaysia.

CONCLUSIONS

Most Malaysian older adults in this work had low levels of social, emotional, and family loneliness. The findings from this study contribute to the knowledge about the relationship between health factors and the three types of loneliness (social, emotional, and family loneliness). Social and emotional loneliness were found to be significantly associated with depression, chronic diseases, and health perceptions. This study is important to healthcare institutions in Malaysia that aim to understand and develop ways to reduce loneliness among the growing population of older adults. Other extensive studies on loneliness among older adults should be conducted in large populations within a varied environment. In addition, a longitudinal study is recommended to identify the incidence of loneliness in several stages and in different time frames.

ACKNOWLEDGMENT

We would like to acknowledge the Faculty of Medicine, Universiti Kebangsaan Malaysia (Project/C: FF-2013-300) and Pontian District's Officer for their support in the completion of this work.

CONFLICT OF INTEREST

None declared.

FUNDING

The study was funded by the Universiti Kebangsaan Malaysia Medical Centre (UKMREC Project code: FF-2013-300).

Received: June 22, 2021 | Accepted: July 21, 2021

REFERENCES

1. Zhang J, Xu L, Li J, Sun L, Ding G, Qin W, *et al*. Loneliness and health service utilization among the rural elderly in Shandong, China: A cross-sectional study. *Int J Environ Res Pub Health*. 2018;15:1468.
2. Dahlberg L, McKee KJ, Frank A, Naseer M. A systematic review of longitudinal risk factors for loneliness in older adults. *Aging Ment Health*. 2021:1–25.
3. Berg-Weger M, Morley J. Editorial: Loneliness in old age: An unaddressed health problem. *J Nutr Health Aging*. 2020;24:243–5.
4. Malcolm M, Frost H, Cowie J. Loneliness and social isolation causal association with health-related lifestyle risk in older adults: A systematic review and meta-analysis protocol. *Syst Rev*. 2019;8:48.
5. Courtin E, Knapp M. Social isolation, loneliness and health in old age: A scoping review. *Health Soc Care Commun*. 2017;25:799–812.
6. Davies K, Maharani A, Chandola T, Todd C, Pendleton N. The longitudinal relationship between loneliness, social isolation, and frailty in older adults in England: A prospective analysis. *Lancet Healthy Longev*. 2021;2:E70–7.
7. Lee SL, Pearce E, Ajnakina O, Johnson S, Lewis G, Mann F, *et al*. The association between loneliness and depressive symptoms among adults aged 50 years and older: A 12-year population-based cohort study. *Lancet Psych*. 2021;8:48–57.
8. Tilvis RS, Laitala V, Routasalo PE, Pitkälä KH. Suffering from loneliness indicates significant mortality risk of older people. *J Aging Res*. 2011;2011:534781.
9. Perissinotto CM, Stijacic Cenzer I, Covinsky KE. Loneliness in older persons: A predictor of functional decline and death. *Arch Intern Med*. 2012;172:1078–83.
10. Valtorta N, Hanratty B. Loneliness, isolation and the health of older adults: do we need a new research agenda? *J R Soc Med*. 2012;105:518–22.
11. Boss L, Kang DH, Branson S. Loneliness and cognitive function in the older adult: A systematic review. *Int Psychogeriatr*. 2015;27:541–53.
12. Luo Y, Hawkley LC, Waite LJ, Cacioppo JT. Loneliness, health, and mortality in old age: A national longitudinal study. *Soc Sci Med*. 2012;74:907–14.
13. Philip KEJ, Polkey MI, Hopkinson NS, Steptoe A, Fancourt D. Social isolation, loneliness and physical performance in older-adults: Fixed effects analyses of a cohort study. *Sci Rep*. 2020;10:13908.
14. Holvast F, Burger H, de Waal MM, van Marwijk HW, Comijs HC, Verhaak PF. Loneliness is associated with poor prognosis in late-life depression: Longitudinal analysis of the Netherlands study of depression in older persons. *J Affect Disord*. 2015;185:1–7.
15. Ong AD, Uchino BN, Wethington E. Loneliness and health in older adults: A mini-review and synthesis. *Gerontology*. 2016;62:443–9.
16. National Academies of Sciences, Engineering, and Medicine. *Social isolation and loneliness in older adults: Opportunities for the health care system*. Washington, DC: The National Academies Press; 2020.
17. DiTommaso E, Spinner B. The development and initial validation of the Social and Emotional Loneliness Scale for Adults (SELSA). *Pers Individ Differ*. 1993;14:127–34.
18. Nor NNFM, Ghazali S. Loneliness and its impacts to the health of elderly in rural Pahang. *Int J Environ Soc Space*. 2016;4:29–37.
19. Teh JK, Tey NP, Ng ST. Family support and loneliness among older persons in multiethnic Malaysia. *Sci World J*. 2014;654382.
20. Peltzer K, Pengpid S. Loneliness correlates and associations with health variables in the general population in Indonesia. *Int J Ment Health Syst*. 2019;13:24.

21. Lim LL, Kua EH. Living alone, loneliness, and psychological well-being of older persons in Singapore. *Curr Gerontol Geriatr Res*. 2011;2011:673181.
22. Wan Mohd Azam WM, Din NC, Ahmad M, Ghazali SE, Ibrahim N, Said Z, *et al*. Loneliness and depression among the elderly in an agricultural settlement: Mediating effects of social support. *Asia Pac Psych*. 2013;5 Suppl 1:134–9.
23. Choi H, Irwin MR, Cho HJ. Impact of social isolation on behavioral health in elderly: Systematic review. *World J Psych*. 2015;5:432–8.
24. Beutel ME, Klein EM, Brähler E, Reiner I, Jünger C, Michal M, *et al*. Loneliness in the general population: Prevalence, determinants and relations to mental health. *BMC Psych.* 2017;17:97.
25. Park C, Majeed A, Gill H, Tamura J, Ho RC, Mansur RB, *et al*. The effect of loneliness on distinct health outcomes: A comprehensive review and meta-analysis. *Psych Res*. 2020;294:113514.
26. Fees BS, Martin P, Poon LW. A model of loneliness in older adults. *J Gerontol B Psychol Sci Soc Sci*. 1999;54B:P231–9.
27. Momtaz YA, Hamid TA, Yusoff S, Ibrahim R, Chai ST, Yahaya N, *et al*. Loneliness as a risk factor for hypertension in later life. *J Aging Health*. 2012;24:696–710.
28. Jessen MAB, Pallesen AVJ, Kriegbaum M, Kristiansen M. The association between loneliness and health - a survey-based study among middle-aged and older adults in Denmark. *Aging Ment Health*. 2018;22:1338–43.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 4

8-30-2021

Prevalence and Correlates of Frequent and Infrequent Bullying Victimization Among School Adolescents from Five Southeast Asian Countries

Karl Peltzer
Department of Research Administration and Development, University of Limpopo, Turfloop 0727, South Africa, kfpeltzer@gmail.com

Supa Pengpid
ASEAN Institute for Health Development, Mahidol University, Nakhon Pathom 73170, Thailand, supaprom@yahoo.com

Makara J Health Res. 2021;25(2):94–100
doi: 10.7454/msk.v25i2.1282

Makara Journal of Health Research

Prevalence and Correlates of Frequent and Infrequent Bullying Victimization Among School Adolescents from Five Southeast Asian Countries

Supa Pengpid[1,2], Karl Peltzer[2,3*]

[1]ASEAN Institute for Health Development, Mahidol University, Nakhon Pathom 73170, Thailand
[2]Department of Research Administration and Development, University of Limpopo, Turfloop 0727, South Africa
[3]Department of Psychology, College of Medical and Health Science, Asia University, Taichung 41354, Taiwan

Abstract

Background: Little is known about the frequency of bullying victimization (BV) among adolescents in Association of Southeast Asian Nations (ASEAN) member states. This study aims to assess the prevalence and correlates of frequent and infrequent BV among school-going adolescents in five ASEAN member states.

Methods: The cross-sectional sample of the Global School-based Student Health Survey (GSHS) of 2015 comprised 33,184 school adolescents (14.6 years mean age) from five ASEAN countries. Students completed a paper-based, self-administered questionnaire on BV in their own languages during classroom periods. Multinomial logistic regression was used to predict frequent and infrequent BV, with no BV as the reference category.

Results: Results indicate that 30.6% of participants reported any past-month BV, 33.9% in boys and 27.5 in girls, ranging from 11.8% in Laos to 48.7% in the Philippines. In the adjusted multinomial logistic regression analysis of students from the Philippines and Thailand, experience of hunger, sedentary behavior, attendance at physical education classes, being underweight, overweight, or obese, ever amphetamine use, physical assault, school truancy, participation in a physical fight, injury, low peer support, and psychological distress were all associated with BV.

Conclusions: Approximately one in three adolescents was bullied. Several associated variables were identified which can assist in targeting strategies of intervention.

Keywords: adolescents, Asia, bullying

INTRODUCTION

Bullying refers to aggressive behavior that is repetitive and intentional in which a power differential exists between the victim and the bully. The negative effects of bullying on an individual's mental and physical health can be substantial and in line with other major forms of child maltreatment.[1] Bullying victimization (BV) can be better prevented if the epidemiology and determinants are known in a given population.[1]

Globally, there is a high proportion of BV among adolescents in Asian countries (about 30% past month),[2] ranging from past month levels of 50.9% in Nepal,[3] 45.0% in 2011 in the Philippines,[4] 41.3% in Pakistan,[5] and 44.6% in China[6] to a low of 27.8% in Thailand.[7] There is limited recent information on the prevalence and correlates of the frequency of BV among adolescents in ASEAN countries.[8] In order to better design anti-bullying programs among adolescents in ASEAN countries, it is important to assess the prevalence and specific determinants of the frequency of BV.

Sociodemographics along with externalizing and internalizing factors have been identified as correlates of BV. Sociodemographic correlates of BV include younger age groups, boys, and lower socioeconomic status.[6,7,9] Externalizing symptoms increasing the odds of BV may include substance abuse, violence, injury, and truancy.[6,7,9] Internalizing symptoms increasing the odds may include mental distress, lack of close friends, and sedentary behavior.[6,7,9] In contrast, parental and peer support have been identified as protective against BV.[10,11]

METHODS

Participants and procedures

The study aimed to estimate the prevalence and correlates of BV among in-school adolescents in five ASEAN countries. It used secondary cross-sectional data from the 2015 ASEAN Global School-based Student Health Survey (GSHS The GSHS data are in the public domain).[12]

Using a two-stage cluster sampling strategy, nationally representative samples of middle school students were produced that year in Indonesia, Laos, the Philippines,

***Corresponding author:**
Karl Peltzer
Department of Research Administration and Development, University of Limpopo, Turfloop, South Africa
E-mail: kfpeltzer@gmail.com

Thailand, and Timor-Leste.[12] At the first stage, schools were chosen with probability proportional to size sampling, and at the second stage, classrooms with students aged 13–15 years were randomly selected in each school.[12] Under the supervision of trained survey administrators, students completed a self-administered questionnaire in their language during classroom periods.[12] All students in the selected classrooms, regardless of their ages, were eligible to participate. The questionnaire was translated into the local language of each participating country.[12]

This study complies with the STROBE guidelines. The study proposal was approved by the Ministry of Education or Health and a national ethics committee in each country, and verbal or written consent was obtained from the participating schools, parents, and students before the survey was administered.[12]

Measures

The GSHS study measure[12] used is shown in Table 1. BV was assessed with the question, During the past 30 days, on how many days were you bullied?[12] Infrequent BV was defined as 1–2 days/month and frequent BV as 3–30 days/month.[12] The psychological distress items (no close friends, loneliness, anxiety, suicidal ideation, and suicide attempts) were totaled, and grouped into 0=0, 1=1 single and 2–5=2 multiple.[13] Cronbach alpha for the psychological distress measure was 0.7 in this study. Underweight was defined as less than −2SD from the median for BMI by age and sex, and overweight or obesity was classified as more than +1 standard deviation (SD) from the median body mass index by age and sex.[14] The four items on parental or guardian support were totaled and classified into three groups: 0–1 low, 2 medium, and 3–4 high support.[13] Cronbach alpha for the parental support measure was 0.7 in this study. Sedentary behavior was defined as spending three or more hours per day sitting.[15]

Data analysis

Statistical analyses were conducted with STATA software version 15.0 (Stata Corporation, College Station, Texas, USA), taking the complex sampling design of the study into account. Frequencies, percentages, and means were used to describe the study characteristics. Multinomial logistic regression was used to predict frequent and infrequent BV, with no BV as the reference category. Only complete cases were included in the analysis, and $p<0.05$ indicated significance.

TABLE 1. Description of questions

Variables	Items	Responses (coding)
Age	How old are you?	11 years old or younger to 18 years old or older
Gender	What is your sex?	Male, Female
Economic status	During the past 30 days, how often did you go hungry because there was not enough food in your home?	1=never to 5=always (coded 1–3=0 and 4–5=1)
Bullying victimization	[Bullying occurs when a student or a group of students say or do bad and unpleasant things to another student. It is also bullying when a student is teased a lot in an unpleasant way or forced to withdraw from certain activities on purpose. It is not bullying when two students of about the same strength or power argue or fight or when teasing is done in a friendly and humorous way.] During the past 30 days, on how many days were you bullied?	1=0 days to 7=All 30 days (coded 1=1, 2=2 and 3–7=3)
Sedentary behavior	How much time do you spend during a typical day sitting and watching television, playing computer games, talking with friends, or doing other sitting activities, such as country examples?	1=less than 1 hour per day; 2=1–2 hrs/day; 3=3–4 hrs/day; 4=5–6 hrs/day; 5=7–8 hrs/day and 6=8 or more hours per day
Physical education (≥3 days/week)	During this school year, on how many days did you go to physical education (PE) class each week?	1=0 days to 6=5 or more days (coded 1–3=0 and 4–6=1)
Height	How tall are you without your shoes on?	
Weight	How much do you weigh without your shoes on?	
Current tobacco use	During the past 30 days, on how many days did you smoke cigarettes/use any tobacco products other than cigarettes, such as … country examples?	1=0 days to 7=All 30 days (coded 1=0 and 2–7=1)
Amphetamine use	During your life, how many times have you used amphetamines or methamphetamines?	1=0 times to 5=20 or more times (coded 1=0 and 2–5=1)
Truancy	During the past 30 days, on how many days did you miss classes or school without permission?	1=0 days to 5=10 or more days (coded 1=0 and 2–5=1)
Physical assault	During the past 12 months, how many times were you physically attacked?	1=0 times to 8=12 or more times

Table 1. continues

Variables	Items	Responses (coding)
Injury	During the past 12 months, how many times were you seriously injured?	1=0 times to 8=12 or more times (coded 1=0 and 2–8=1)
Psychological distress		
No close friends	How many close friends do you have?	1=0 to 4=3 or more (coded 1+=0, 0=1)
Lonely	During the past 12 months, how often have you felt lonely?	1=never to 5=always (coded 1–3=0 and 4–5=1)
Worry	During the past 12 months, how often have you been so worried about something that you could not sleep at night?	1=never to 5=always (coded 1–3=0 and 4–5=1)
Suicidal ideation	During the past 12 months, did you ever seriously consider attempting suicide?	Yes, No
Suicide attempt	During the past 12 months, how many times did you actually attempt suicide?	1=0 times to 5=6 or more times (coded 1=0 and 2–5=1)
	Social and family related protective indicators	
Peer support	During the past 30 days, how often were most of the students in your school kind and helpful?	1=never to 5=always (coded 1–3=0 and 4–5=1)
Parental supervision	During the past 30 days, how often did your parents or guardians check to see if your homework was done?	1=never to 5=always (coded 1–3=0 and 4–5=1)
Parental connectedness	During the past 30 days, how often did your parents or guardians understand your problems and worries?	1=never to 5=always (coded 1–3=0 and 4–5=1)
Parental bonding	During the past 30 days, how often did your parents or guardians really know what you were doing with your free time?	1=never to 5=always (coded 1–3=0 and 4–5=1)
Parental respect for privacy	During the past 30 days, how often did your parents or guardians go through your things without your approval?	1=never to 5=always (coded 1–3=0 and 4–5=1)

RESULTS

Sample characteristics

The overall sample comprised 33,184 school adolescents with a mean age of 14.6 years (SD=1.7) from Indonesia (overall response rate=94%), Laos (72%), Philippines (79%), Thailand (89%) and Timor-Leste (response rate=79%). Almost one in three participants (30.6%) reported any BV in the past 30 days (33.9% in boys and 27.5 in girls). The prevalence of past month BV ranged from 11.8% in Laos to 48.7% in the Philippines. Almost one in five students (18.6%) reported BV on one to two days in the past month and 12.0% on three to 30 days in the past month (Table 2).

Associations with bullying victimization

For students from the Philippines and Thailand in the adjusted multinominal logistic regression analysis, experience of hunger, sedentary behavior, attending physical education classes, being underweight, being overweight or obese, ever amphetamine use, school truancy, physically attacked, injury, involvement in physical fighting, and psychological distress were positively associated with infrequent and/or frequent BV. Being from Laos and Timor-Leste and peer support decreased the odds of infrequent and/or frequent BV (Table 3).

DISCUSSION

The 2015 investigation assessed the prevalence and correlates of BV among school adolescents in five ASEAN countries. The overall prevalence of BV (30.6%) was similar to the global prevalence (30%),[2] but lower than in Nepal (50.9%),[3] and Pakistan (41.3%).[5] The prevalence of past-month BV (29.3%) in Thailand was similar to the 2008 Thailand GSHS (27.8%),[7] the 48.7% in the Philippines was higher than the 2003 to 2011 GSHS (34.7%–45.0%),[7] and of 20.6% in Indonesia was much lower than in the 2007 GSHS (50.0%) there.[16] It is possible that school-based anti-bullying interventions in Indonesia have been effective in reducing BV.[17] Among the five ASEAN study countries, Laos had the lowest prevalence of BV (11.8%). These figures may compare with the prevalence of any physical violence victimization among adolescents (13–17 years) (8.2% in boys and 6.6% in girls) in the past 12 months in the 2014 Violence against Children Survey in Laos.[18] The lower prevalence of BV among adolescents in Laos may be attributed to specific cultural norms and practices in that country, while the relatively high prevalence in Timor-Leste may be attributed due to the effects of a long history of conflict.[19]

Consistent with some previous research,[6,20] this study found that the experience of hunger (or lower socioeconomic status) was associated with BV. This could mean that the provision of school food programs may help in reducing BV. Unlike some prior studies,[21,22] this study did not find significant sex and age differences in the prevalence of BV. This could imply that bullying prevention in schools may be equally targeting boys and girls and adolescents of different age groups. Further research is needed to explore the nonsignificant age and sex differences.

TABLE 2. Sample and bullying victimization (BV) characteristics

Variables	Sample	Infrequent BV	Frequent BV
	Percentage (%)	Percentage (%)	Percentage (%)
Sociodemographic indicators			
All	100	18.6	12.0
Country			
Indonesia	33.6	13.9	6.7
Laos	11.1	9.3	2.5
Philippines	26.4	28.2	20.5
Thailand	17.8	15.6	13.7
Timor-Leste	11.2	21.5	7.1
Age (years)			
≤13	29.1	18.3	12.2
14	20.7	19.7	12.5
15	19.4	20.6	12.8
≥16	30.9	16.7	10.5
Gender			
Female	51.1	17.6	9.6
Male	48.9	19.8	14.1
Hunger			
Never	40.4	13.8	8.7
Rarely	20.0	20.8	14.0
Sometimes/mostly/always	39.6	22.6	14.3
Risk behavior			
Sitting 3 or more hours (during leisure-time)	32.6	17.4	15.1
Attending physical education classes	22.8	24.7	17.3
Body Mass Index			
Normal	77.3	17.7	10.8
Underweight	8.7	20.0	13.0
Overweight or obese	14.0	15.9	15.9
Current tobacco use	13.9	26.3	22.4
Current alcohol use	2.5	26.9	22.6
Ever amphetamine use	3.0	34.6	39.7
School truancy	25.3	25.4	18.8
Physically attacked	33.1	28.0	21.4
In physical fight	28.0	30.4	23.4
Sustained injury	36.9	27.9	21.5
Psychological distress			
0	76.8	16.0	7.6
1	14.6	25.8	19.1
2–3	8.6	27.9	30.6
Social-familial protective indicators			
High peer support	36.8	15.2	9.8
Parental support			
0–1	51.6	21.0	13.8
2	27.0	17.7	10.0
3–4	21.4	14.8	9.1

TABLE 3. Associations with bullying victimization (BV) frequency

Variable	Infrequent BV	Frequent BV	Infrequent BV	Frequent BV
	URRR (95% CI)	URRR (95% CI)	ARRR (95% CI)	ARRR (95% CI)
Sociodemographic indicators				
Country				
Indonesia	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Laos	0.60 (0.22, 0.52)***	0.34 (0.22, 0.52)***	0.69 (0.54, 0.88)**	0.54 (0.35, 0.85)**
Philippines	3.14 (2.68, 3.66)***	4.72 (2.97, 5.61)***	2.28 (1.93, 2.68)***	3.48 (2.80, 4.34)***
Thailand	1.26 (1.05, 1.51)*	2.30 (1.78, 2.96)***	1.17 (0.99, 1.38))	1.64 (1.32, 2.03)***
Timor-Leste	1.72 (1.44, 2.04)***	1.19 (0.91, 1.55)	1.09 (0.88, 1.34)	0.69 (0.52, 0.92)*
Age (years)				
≤13	1 (Reference)	1 (Reference)	---	---
14	1.10 (0.97, 1.26)	1.05 (0.89, 1.24)		
15	1.17 (0.96, 1.43)	1.10 (0.91, 1.32)		
≥16	0.87 (0.72, 1.05)	0.83 (0.66, 1.04)		
Gender				
Female	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Male	1.23 (1.11, 1.36)***	1.55 (1.32, 1.82)***	0.95 (0.86, 1.06)	1.16 (0.96, 1.41)
Experience of hunger				
Never	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Rarely	1.80 (1.62, 2.01)***	1.91 (1.62, 2.25)***	1.22 (1.08, 1.39)**	1.16 (0.99, 1.36)
Sometimes/mostly/always	2.02 (1.85, 2.21)***	2.02 (1.77, 2.30)***	1.61 (1.44, 1.80)***	1.50 (1.30, 1.73)***
Risk behavior				
Sitting 3 or more hours (during leisure-time)	0.94 (0.85, 1.05)	1.52 (1.33, 1.73)***	0.91 (0.80, 1.03)	1.40 (1.21, 1.61)***
Attending physical education classes	1.83 (1.64, 2.03)***	2.10 (1.85, 2.37)***	1.26 (1.11, 1.44)***	1.29 (1.07, 1.55)**
Body mass index				
Normal	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Underweight	1.21 (1.05, 1.39)*	1.29 (1.10, 1.50)**	1.22 (1.00, 1.48)*	1.24 (1.04, 1.47)*
Overweight or obese	0.89 (0.78, 1.01)	1.09 (0.01, 1.31)	0.98 (0.83, 1.17)	1.30 (1.08, 1.57)**
Current tobacco use	2.13 (1.69, 2.68)***	3.04 (2.39, 3.88)***	1.17 (0.95, 1.41)	1.04 (0.82, 1.32)
Current alcohol use	2.23 (1.87, 2.65)***	3.19 (2.53, 4.01)***	1.07 (0.89, 1.28)	0.86 (0.71, 1.05)
Ever amphetamine use	5.30 (3.41, 8.23)***	10.03 (7.08, 14.24)***	1.79 (1.08, 2.96)*	1.96 (1.11, 3.46)*
School truancy	2.04 (1.79, 2.33)***	2.56 (2.18, 3.00)***	1.18 (1.04, 1.33)**	1.14 (0.97, 1.35)
Physically attacked	3.08 (2.77, 3.43)***	4.44 (3.94, 5.01)***	1.93 (1.72, 2.17)***	2.39 (2.06, 2.76)***
In physical fight	3.61 (3.22, 4.06)***	5.19 (4.51, 5.98)***	1.77 (1.54, 2.03)***	2.03 (1.70, 2.43)***
Sustained injury	3.53 (3.14, 3.97)***	5.52 (4.71, 6.48)***	1.99 (1.77, 2.24)***	2.33 (2.03, 2.67)***
Psychological distress				
0	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
1	2.24 (1.95, 2.57)***	3.49 (2.99, 4.07)***	1.57 (1.35, 1.84)***	2.16 (1.85, 2.51)***
2–3	3.20 (2.74, 3.75)***	7.41 (6.29, 8.71)***	1.74 (1.46, 2.08)***	3.47 (2.87, 4.19)***
Social-familial indicators				
High peer support	0.64 (0.57, 0.72)***	0.66 (0.58, 0.74)***	0.79 (0.70, 0.89)***	0.87 0.74, 1.02)
Parental support				
0–1	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
2	0.76 (0.67, 0.87)***	0.65(0.57, 0.75)***	1.00 (0.89, 1.13)	0.94 (0.80, 1.11)
3–4	0.61 (0.53, 0.70)***	0.56(0.48, 0.66)***	0.92 (0.81, 1.06)	0.94 (0.79, 1.12)

URRR=Unadjusted Relative Risk Ratio; ARRR=Adjusted Relative Risk Ratio; CI=Confidence Interval; ***p<.001; ** p <.01; * p <.05

Consistent with previous findings,[7,21,23–25] the study found an association between externalizing symptoms (ever amphetamine use, school truancy, physically attacked, in a physical fight, and injury), internalizing symptoms (psychological distress and sedentary behavior) and BV. Steenberg, Palic, and Elklit[26] note that victims of bullying generally lack in the use of adaptive coping strategies, making students with high externalizing and internalizing

symptoms more vulnerable to BV. On the other hand, adolescents who are being bullied may consequently develop more externalizing and internalizing symptoms.[22,24] Findings underline the importance of coping and social skills training in reducing BV.[27]

Some previous studies among adolescents[10,11] found parental support protective against BV. While this was found in bivariate analysis in this study, it was no longer significant in the multivariable model. Peer support was protective against infrequent BV. This finding is consistent with a prior review where positive peer interaction was the strongest protective factor against being a bully/victim.[28] In this study, the attendance of physical education increased the odds for BV, while in another study BV was associated with fewer days in physical education.[29] It is possible that in our study attending physical education classes increased the risk of BV. Consistent with a large previous study,[30] this survey showed that both underweight and overweight/obesity were associated with BV. Previous research showed that weight stigmatization translates into pervasive victimization, teasing, and bullying.[31] Anti-bullying programs may want to include peer and parental support strategies in general, and strategies that support students who attend physical education and/or are underweight or overweight/obese, in particular.

Study strengths included the large, nationally representative adolescent school samples and the uniform GSHS methodology applied in the five study countries. Study limitations include self-reported data, the cross-sectional design, and the focus on school adolescents. Due to the cross-sectional design, we are unable to draw causative conclusions. For example, we do not have information on the validity of the GSHS questionnaire, though the GSHS is similar to the *CDC Youth Risk Behavior Survey* for which test and retest reliability has been established.[32]

CONCLUSIONS

The study found that approximately one in three school-going adolescents across five ASEAN countries was bullied in the past month. Several risk factors for BV were identified, including hunger or food insecurity, sedentary behavior, attending physical education classes, being underweight, overweight or obese, ever amphetamine use, being physically attacked, physical fighting, injury, truancy, psychological distress, and low peer support, which can assist in designing intervention strategies in this adolescent school population.

ACKNOWLEDGMENT

The data source, the World Health Organization NCD Microdata Repository (URL: https://extranet.who.int/ncdsmicrodata/index.php/catalog), is hereby acknowledged.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research received no external funding.

Received: June 6, 2021 | Accepted: July 23, 2021

REFERENCES

1. Rettew DC, Pawlowski S. Bullying. *Child Adolesc Psychiatr Clin N Am*. 2016;25:235–42.
2. Elgar FJ, McKinnon B, Walsh SD, Freeman J, D Donnelly P, de Matos MG, *et al*. Structural determinants of youth bullying and fighting in 79 countries. *J Adolesc Health*. 2015;57:643–50.
3. Rahman MM, Rahman MM, Khan MMA, Hasan M, Choudhury KN. Bullying victimization and adverse health behaviors among school-going adolescents in South Asia: Findings from the global school-based student health survey. *Depress Anxiety*. 2020;37:995–1006.
4. Peltzer K, Pengpid S. Health risk behaviour among in-school adolescents in the Philippines: Trends between 2003, 2007 and 2011, A cross-sectional study. *Int J Environ Res Public Health*. 2015;13:73.
5. Shaikh MA. Bullying victimization among school-attending adolescents in Pakistan. *J Pak Med Assoc*. 2013;63:1202–3.
6. Zhu Y, Chan KL. Prevalence and correlates of school bullying victimization in Xi'an, China. *Violence Vict*. 2015;30:714–32.
7. Pengpid S, Peltzer K. Bullying and its associated factors among school-aged adolescents in Thailand. *ScientificWorldJournal*. 2013;2013:254083.
8. Sittichai R, Smith PK. Bullying in South-East Asian countries: A review. *Aggress Violent Behav*. 2015;23:22–35.
9. Seo HJ, Jung YE, Kim MD, Bahk WM. Factors associated with bullying victimization among Korean adolescents. *Neuropsychiatr Dis Treat*. 2017;13:2429–35.
10. Abdirahman H, Fleming LC, Jacobsen KH. Parental involvement and bullying among middle-school students in North Africa. *East Mediterr Health J*. 2013;19:227–33.
11. Boel-Studt S, Renner LM. Individual and familial risk and protective correlates of physical and psychological peer victimization. *Child Abuse Negl*. 2013;37:1163–74.
12. World Health Organization. *Global school-based student health survey* (GSHS). New York: World Health Organization, 2019.
13. Pengpid S, Peltzer K. Bullying victimization and externalizing and internalizing symptoms among in-school adolescents from five Southeast Asian countries. *Child Youth Serv Rev*. 2019;106:04473.

14. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: International survey. *BMJ*. 2000;320:1240–3.
15. Guthold R, Cowan MJ, Autenrieth CS, Kann L, Riley LM. Physical activity and sedentary behavior among schoolchildren: A 34-country comparison. *J Pediatr*. 2010;157:43–9.e1.
16. World Health Organization (WHO). *Global School-based Student Health Survey Indonesia 2007 Fact Sheet*. New York: World Health Organization, 2007.
17. Sivaraman B, Nye E, Bowes L. School-based anti-bullying interventions for adolescents in low- and middle income countries: A systematic review. *Aggress Violent Behav*. 2019;45:154–62.
18. National Commission for Mothers and Children, Lao Statistics Bureau and UNICEF Lao PDR. *National Violence against Children Survey in Lao PDR*. Preliminary Report. Lao PDR: National Commission for Mothers and Children, 2016.
19. Silove D, Brooks R, Bateman Steel CR, Steel Z, Hewage K, Rodger J, *et al*. Explosive anger as a response to human rights violations in post-conflict Timor-Leste. *Soc Sci Med*. 2009;69:670–7.
20. Wilson ML, Dunlavy AC, Berchtold A. Determinants for bullying victimization among 11–16-year-olds in 15 low- and middle-income countries: A multi-level study. *Soc Sci*. 2013;2:208–20.
21. Fleming LC, Jacobsen KH. Bullying among middle-school students in low and middle income countries. *Health Promot Int*. 2010;25:73–84.
22. Siziya S, Rudatsikira E, Muula AS. Victimization from bullying among school-attending adolescents in grades 7 to 10 in Zambia. *J Inj Violence Res*. 2012;4:30–5.
23. Acquah EO, Wilson ML, Doku DT. Patterns and correlates for bulling among young adolescents in Ghana. *Soc Sci*. 2014;3:827–40.
24. Arhin DK, Oppong Asante K, Kugbey N, Oti-Boadi M. The relationship between psychological distress and bullying victimisation among school-going adolescents in Ghana: A cross-sectional study. *BMC Res Notes*. 2019;12:264.
25. Eastman M, Foshee V, Ennett S, Sotres-Alvarez D, Reyes HLM, Faris R, *et al*. Profiles of internalizing and externalizing symptoms associated with bullying victimization. *J Adolesc*. 2018;65:101–10.
26. Steenberg LM, Palic S, Elklit A. A review of psychological factors related to bullying victimization in schools. *Aggress Violent Behav*. 2012;17:383–7.
27. Silva JLD, Oliveira WA, Carlos DM, Lizzi EADS, Rosário R, Silva MAI. Intervention in social skills and bullying. *Rev Bras Enferm*. 2018;71:1085–91.
28. Zych I, Farrington DP, Ttofi MM. Protective factors against bullying and cyberbullying: A systematic review og meta-analyses. *Aggress Violent Behav*. 2019;45:4–19.
29. Roman CG, Taylor CJ. A multilevel assessment of school climate, bullying victimization, and physical activity. *J Sch Health*. 2013;83:400–7.
30. Lian Q, Su Q, Li R, Elgar FJ, Liu Z, Zheng D. The association between chronic bullying victimization with weight status and body self-image: A cross-national study in 39 countries. *PeerJ*. 2018;6:e4330.
31. Puhl RM, King KM. Weight discrimination and bullying. *Best Pract Res Clin Endocrinol Metab*. 2013;27:117–27.
32. Brener ND, Collins JL, Kann L, Warren CW, Williams BI. Reliability of the youth risk behavior survey questionnaire. *Am J Epidemiol*. 1995;141:575–80.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 5

8-30-2021

Patient Care Delivery: Electronic Nursing Documentation in Malaysia

Siti Zuhaida Hussein
Department of Nursing, Faculty of Medicine, Universiti Kebangsaan Malaysia, Cheras 56000, Malaysia, zuhaida_hussein@ukm.edu.my

Norazilah Khalip
Department of Nursing, Faculty of Medicine, Universiti Kebangsaan Malaysia, Cheras 56000, Malaysia, arzk@ppukm.ukm.edu.my

Rosnita Hashim
Department of Nursing, Faculty of Medicine, Universiti Kebangsaan Malaysia, Cheras 56000, Malaysia, rosnita@ppukm.ukm.edu.my

Rohaizah Harun
Department of Nursing, Faculty of Medicine, Universiti Kebangsaan Malaysia, Cheras 56000, Malaysia, mummyairis82@gmail.com

Nor Fazlina Fazilah
Department of Nursing, Faculty of Medicine, Universiti Kebangsaan Malaysia, Cheras 56000, Malaysia, fazlinafazilah@gmail.com

See next page for additional authors

Recommended Citation

Hussein SZ, Khalip N, Hashim R, Harun R, Fazilah NF, Shah NM. Patient Care Delivery: Electronic Nursing Documentation in Malaysia. Makara J Health Res. 2021;25.

Patient Care Delivery: Electronic Nursing Documentation in Malaysia

Authors

Siti Zuhaida Hussein, Norazilah Khalip, Rosnita Hashim, Rohaizah Harun, Nor Fazlina Fazilah, and Norazilah Mat Shah

Makara J Health Res. 2021;25(2):101–106
doi: 10.7454/msk.v25i2.1288

Makara Journal of Health Research

Patient Care Delivery: Electronic Nursing Documentation in Malaysia

Siti Zuhaida Hussein*, Norazilah Khalip, Rosnita Hashim, Rohaizah Harun, Nor Fazlina Fazilah, Norazilah Mat Shah

Department of Nursing, Faculty of Medicine, Universiti Kebangsaan Malaysia, Cheras 56000, Malaysia

Abstract

Background: The evolution of nursing documentation from paper to electronic format aims to improve patient safety and care quality. This study aimed to determine the knowledge and attitudes of registered nurses toward electronic nursing process documentation.

Methods: This cross-sectional study was conducted among 189 registered nurses who work in medical wards at a teaching hospital in Kuala Lumpur. Simple random sampling was used. Respondents' knowledge of electronic nursing documentation was measured using a questionnaire developed by Guedes, and their attitudes toward electronic nursing documentation were measured using a questionnaire developed by Hagos. Data analysis was performed using Statistical Package for the Social Sciences Statistics 26.0 for Windows and $p < 0.05$ was considered significant.

Results: In this study, 50.8% of the respondents have a low knowledge level of electronic nursing documentation, and 89.4% have a positive attitude toward electronic nursing documentation. No significant relationship was found between sociodemographic factors, such as age, education level, working experience, knowledge level, and attitude, and electronic nursing documentation.

Conclusions: Nurses had a higher knowledge level of and positive attitudes toward electronic nursing documentation. A longitudinal and comparative study was suggested for further research.

Keywords: electronic health records, Malaysia, medical nursing

INTRODUCTION

Nursing is critical for caring, maintaining, and protecting the health of the global population. Nurses make up about a quarter of the world's workforce, accounting for more than half of all healthcare professionals.[1,2] In 2018, approximately 16,373 nurses in Malaysia were working in hospitals and public health, with a ratio of 1 to 304 patients.[2] In addition to treating patients, nurses are responsible for providing adequate documentation to plan for efficient nursing care for patients. The preparation of nursing process documentation plays a vital role in identifying patients' problems, planning, implementing, and evaluating nursing interventions. Indeed, adequate documentation can improve the safety and quality of life of a patient and lower the morbidity rate.[1–3]

Safe and efficient nursing care remains a crucial factor in improving the health of patients in healthcare facilities. For centuries, the nursing process is considered a written proof of nursing practices.[4] Proper use of the nursing process can update the planning and implementation of care, and if there are any changes, the intervention can be administered accordingly. A well-organized nursing process can assess the patient's overall health status, which helps tailor the current needs of the patients and treatment response.[4]

The nursing process remains an integral component of providing optimal and holistic healthcare.[4] This documentation can assess patients' problems and implement and evaluate the nursing interventions provided. Briefly, documentation can be recognized as proof of inpatient care. A study conducted in Malaysia found that more than half of the respondents had a positive attitude toward electronic documentation, and they express confidence in using the electronic documentation system.[5] A positive attitude toward electronic nursing documentation is associated with computer education and training.

Essentially, the successful implementation of nursing documentation, either by paper or electronically, could make nursing care be more accessible and increase nurses' time on delivering care.[6,7] In addition, electronic nursing documentation introduces contemporary features such as copy and paste, electronic interfaces, and prearranged dropdown menus that are not available in paper-based documentation.[5] This feature can improve nurses' recording and thus can enhance the quality of nursing care.

***Corresponding author:**
Siti Zuhaida Hussein
Department of Nursing, Faculty of Medicine,
Universiti Kebangsaan Malaysia, Cheras, Malaysia
E-mail: zuhaida_hussein@ukm.edu.my

Previous studies have found that nurses with higher computer skills have more positive attitudes toward the use of electronic health records, so they can improve patient care and value.[8,9] Some data indicate that implementing an electronic nursing documentation system in acute hospital settings saves time and reduces rates of documentation errors, falls, and infections.[10–12] Undeniably, the quality of patient care increases when the nursing documentation is tailored to each patient.[3] This feature can improve nurses' records and thus enhances the quality of nursing care.

Kelley, Brandon, and Docherty (2011) highlighted an unclear relationship between electronic nursing documentation and improving patient outcomes.[10] Several factors can influence the lack of compliance in nursing documentation, such as nurses' lack of knowledge of the purpose of documentation and the principles of nursing process documentation.[13] Hagos (2014) highlighted that non-exposure to computers is a factor of non-compliance in documenting nursing care.[14] A review study also reported that poor knowledge of the literal meaning of the nursing process had increased the rate of the improper use of nursing documentation.[13]

Moreover, previous studies have shown that more than three-quarters of hospitals use electronic documentation to manage their patients and improve efficiencies in the hospital.[4,10] Nevertheless, less than 29% of the electronic nursing care plan is systematically documented following the standard of nursing classification systems such as NANDA-I.[15] Gazari et al. (2020) stated that electronic health records are inadequate if used alone to support the work of nurses, especially during the submission of reports for each work shift, causing them to rely on paper forms[4]

The question is to what extent nurses could identify and document appropriately and accurately patient's problems and the level of treatment needed by the patients. This is anticipated to result in practice errors, and the lack of quality of treatment will decrease the performance value of nurses. Thus, a knowledge gap may lead nurses to provide treatment to patients without thinking critically. Nurses' irrelevant actions will increase the treatment cost. Therefore, this study was conducted to determine the knowledge level of and practices toward electronic nursing documentation among medical registered nurses at a teaching hospital in Kuala Lumpur.

METHODS

Ethical approval was obtained from the Hospital Universiti Kebangsaan Malaysia and the Faculty of Medicine UKM research ethics committee before conducting the study. In addition, all participants provided written informed consent before participation. This quantitative cross-sectional study was conducted to identify the knowledge level and practices of electronic nursing documentation among 189 registered nurses who work in medical wards at a teaching hospital in Kuala Lumpur. Simple random sampling method was used, and this sampling method gives everyone in the population an equal chance of being included in the sample. The exclusion criteria were as follows: nurses on leave for more than 3 months and nursing students who had a clinical placement in the medical wards. The total population was 278 nurses. The sample size was calculated using the methods reported by Krejcie and Morgan (1970). With an accepted margin of error of 5% and a 95% confidence interval, the sample size consisted of 203 respondents. The inclusion rate was 93.1% (189 respondents), which included nurses who did not participate due to having a long leave, such as maternity leave, and refused to participate in the study.

This study was conducted at the medical wards of a teaching hospital in Kuala Lumpur. This is a government-funded hospital that provides secondary and tertiary treatment services and is a referral center from all over the country. Furthermore, this hospital has established strengths and excellence in the fields of psychiatry, pediatrics, neurology, neurosurgery, neonatology, nephrology, hematology, gynecology, endocrinology, and spinal surgery.

In this study, nurses' knowledge of and attitudes toward electronic nursing documentation are measured using a self-administered questionnaire. The knowledge level of electronic nursing documentation was measured using questionnaires developed by Guedes.[16] This instrument consists of five items with a Likert's scale range of 1 (none) to 4 points (a lot) (4). Accordingly, poor knowledge is characterized by scores <15, whereas good knowledge is defined by scores >15. For this, questionnaires have an excellent internal consistency by Cronbach's alpha of 0.88.

Meanwhile, attitudes toward electronic nursing documentation were measured with a questionnaire developed by Hagos.[14] This questionnaire has good internal consistency, with Cronbach's alpha of 0.88. Furthermore, this questionnaire consists of 20 items and uses Likert's scale, ranging from strongly disagree (1) to strongly agree (5). There are 10 positive questions (questions 1, 2, 3, 5, 6, 9, 11, 12, 15, and 16) and 10 negative questions (questions 4, 7, 8, 10, 13, 14, 17, 18, 19, and 20). The total score is 100, and the 50% cut-off points from the maximum total score achievable were used in this study. A score of ≤50 points indicates a negative attitude toward electronic nursing documentation. At the same time, scores 51–100 points are defined as a positive attitude toward electronic nursing documentation

The data collection process began in April and May 2020 among registered nurses working in the medical wards. At the start of the study, the researchers approached nurses

who met the inclusion and exclusion criteria of the study. Each eligible respondent was explained the study objectives, and respondents who agreed to participate in the study signed the consent form provided before filling out the questionnaire. The response rate was 100%.

Data were analyzed using the Statistical Package for the Social Sciences Statistics 26.0 for Windows. The significance level was set at $p \leq 0.05$. Descriptive analyses were conducted to indicate the distributions of the demographic and inferential analyses, such as the chi-square test.

RESULTS

A total of 189 respondents participated in this study, and the sociodemographic characteristics are presented in Table 2. In this study, 65.6% of the respondents were <30 years old. Most of the respondents were educated up to the diploma level (69.3%) and have worked <10 years (91.0%). In addition, 50.8% of the respondents had a low knowledge level of electronic nursing documentation and 89.4% had a positive attitude toward electronic nursing documentation (Table 1).

This study shows that the mean attitude value toward electronic nursing documentation was 1.95–3.85, and the mean knowledge level of electronic nursing documentation was 3.29–3.37. The mean and standard deviation of electronic nursing documentation knowledge level were: assessment (3.37±0.56), interview (3.31±0.55), diagnosis (3.29±0.56), prescriptive (3.36±0.58), and evaluation (3.30±0.60). In this study, 55.0% of the respondents had moderate knowledge of nursing assessments, 60.3% had moderate knowledge of nursing interviews, and 59.8% had moderate knowledge of nursing diagnosis. Moreover, 71–79 respondents had a high knowledge level of nursing implementation and nursing evaluation (Table 2). Meanwhile, the distributions of attitude toward electronic nursing documentation are displayed in Table 3.

This study revealed that age, education level, and working experience were not associated with the knowledge of the electronic nursing documentation. Factors such as age, education level, and working experience are also not significantly associated with attitude toward electronic nursing documentation. The results are presented in Table 4.

DISCUSSION

This study was conducted to identify the knowledge and practices of electronic nursing documentation among 189 registered nurses who work in medical wards at a teaching hospital in Kuala Lumpur. In this study, the majority of the respondents were registered nurses aged <30 years, had worked <10 years, and studied until diploma level. Most of the respondents preferred electronic nursing documentation over paper-based documentation to write the patient care plan. Respondents also have a high knowledge level of electronic nursing documentation. This study reported that nearly 50% of the respondents had a high level of knowledge of the electronic nursing process, which consists of nursing assessment, interview, diagnosis, prescription, and nursing evaluation. In this study, the knowledge of a registered nurse of the electronic nursing documentation was measured using a questionnaire developed by Guedes.[16] The results of the present study are similar to those reported by a previous study.[17] Ebrahem *et al*. (2014) found that nurses had good knowledge of and positive practice toward electronic

TABLE 1. Distributions of sociodemographic factors (N = 189)

Sociodemographic factors	Frequency (N)	Percentage (%)
Age		
<30 years	124	65.6
>30 years	65	34.4
Level of education		
Diploma level	131	69.3
Degree level and above	58	30.7
Working period		
<10 years	172	91.0
>10 years	17	9.0
Types of nursing documentation preferred		
Electronic	180	95.2
Paper-based	9	4.8
Level of knowledge toward electronic nursing documentation		
High level	96	50.8
Low level	93	49.2
Attitude toward electronic nursing documentation		
Positive attitude	169	89.4
Negative attitude	20	10.6

TABLE 2. Knowledge level of electronic nursing documentation (N = 189)

Items	None F (%)	Little F (%)	Moderate F (%)	A lot F (%)
Nursing assessment	-	7 (3.7)	104 (55.0)	78 (41.3)
Nursing interview	-	8 (4.2)	114 (60.3)	67 (35.4)
Nursing diagnosis	-	10 (5.3)	113 (59.8)	66 (34.9)
Nursing implementation	-	10 (5.3)	100 (52.9)	79 (41.8)
Nursing evaluation	1 (0.5)	11 (5.8)	106 (56.1)	71 (37.6)

TABLE 3. Distributions of attitudes toward electronic nursing documentation (N = 189)

Attitude toward nursing documentation	Strongly disagree (%)	Disagree (%)	Not sure (%)	Agree (%)	Strongly agree (%)
I like the aim of the nursing process.	3.7	9.0	8.5	64.6	14.3
I am convinced that the nursing process will work if applied in inpatient care.	7.4	4.8	3.7	63.5	20.6
The nursing process is an elaborated Kardex system.	2.1	11.1	15.3	60.3	11.1
The nursing process should be used by nurses with a bachelor's degree and above only.	2.6	24.3	19.6	30.2	23.3
The nursing process can be used in rehabilitation settings.	2.6	9.5	9.0	57.1	21.7
The nursing process works well in practice.	4.8	8.5	11.6	57.1	21.7
The nursing process can be used in any setting.	24.3	3.7	10.6	60.8	5.0
There is not enough time to apply the nursing process during patient care.	4.8	15.3	19.6	32.8	27.5
The nursing process is a waste of time.	2.6	10.1	11.6	58.7	16.9
I am ready for the application of the nursing process.	1.1	16.4	34.9	28.6	19.0
The Kardex system of nursing records is unsatisfactory.	3.7	11.1	5.3	61.9	18.0
The process simplifies the awareness of patients' needs.	2.1	12.2	9.0	57.7	19.0
Priorities of care are easy to identify using the nursing process.	6.9	16.4	16.4	37.6	22.8
I am fed up with hearing about the nursing process.	27.5	38.1	18.5	12.2	3.7
The nursing process involves too much paperwork.	3.2	8.5	11.1	57.1	20.1
The nursing process enables nurses to provide quality nursing care to patients.	0.5	12.2	19.6	51.3	16.4
I am willing to apply the nursing process during patient care.	6.9	20.6	29.1	31.7	11.6
I think the introduction of the nursing process will cause a problem.	6.9	20.6	29.1	31.7	11.6
I think the patients will not like to be cared for using the nursing process.	5.3	15.9	35.4	27.5	15.9
I think the nursing staffs are unwilling to apply the nursing process.	5.3	11.6	36.0	32.3	14.8

TABLE 4. Relationship among the sociodemographic factors, knowledge level, and attitude toward electronic nursing documentation (N = 189)

Sociodemographic factors	Nursing process	
	Knowledge level	Attitude
Age	$p = 0.16$	$p = 0.28$
Education level	$p = 0.28$	$p = 0.56$
Working period	$p = 0.50$	$p = 0.24$

nursing documentation. A possible explanation is that they are proficient in data entry.[17] Nurses who have a higher knowledge level of using computers more effectively used electronic documentation to record patient care.[8] By contrast, nurses did not have a high knowledge level of the benefits of using an electronic documentation system. Essentially, nurses were more skeptical of the role of computer information systems in assisting them, reducing cost, improving healthcare quality, and applying the documentation system into their daily work routine.[18] However, this finding is contrary to those of previous studies, which found that nurses had insufficient knowledge of electronic nursing documentation, especially those who were unfamiliar with the standard operation of nursing documentation.[18–20] Indeed, nurses who are unfamiliar with the nursing standards of documentation are 2–3 times likely to not document their patient care plan correctly, and more than half of the nurses would not document their nursing care plan.[20] A previous study did not find an association between the extent to which nursing staff felt supported by the electronic health records and the use of specific standardized terminologies.[21]

In this study, most of the respondents had a positive attitude toward electronic nursing documentation in the delivery of patient care. In the researcher's opinion, a positive attitude toward electronic nursing documentation can provide quality nursing care because it can easily prioritize patient care. Similar to findings from previous studies, most nurses have a positive attitude toward computerization.[22–25] Hafizah and Lee (2018) reported that Malaysian nurses had a positive attitude toward electronic nursing documentation.[5] Meanwhile,

positive attitudes are seen among nurses who have more experience with new technologies.[8,23] By contrast, Kahouei *et al*. (2014) reported that most of the nurses with negative attitudes also had a poor implementation of the electronic nursing documentation.[25] This situation was significantly associated with factors such as the inadequacy of documenting sheets, time, staff, and operational standard of nursing documentation and the lack of motivation.[7,18,26] They also suggested that employment institutions should provide training on electronic nursing documentation to improve nurses' knowledge and provide adequate documentation requirements to carry out nursing services.[9]

In this study, no significant association was found between knowledge of and attitude toward electronic nursing documentation. Additionally, sociodemographic factors such as age, education level, and working experience are not significantly associated with attitudes toward electronic nursing documentation. In other words, nurse's attitudes toward and knowledge of electronic documentation were not influenced by age, working experience, and education level. Thus, old age or high educational attainment does not necessarily indicate that nurses are more knowledgeable of safekeeping patient information in electronic records. These results are similar to those of previous studies that did not find a significant relationship between work experience and attitudes toward computers.[23–25]

According to Yontz *et al*. (2015), the education level of the respondents did not have a significant relationship with their attitudes toward electronic medical records.[24] Nurses reported that electronic documentation improves the quality of clinical documentation by preventing duplication and incomplete data entry.[26] Moreover, most nurses use computers nowadays. Indeed, computers appear to be a part of nursing activities, and electronic nursing documentation effectively enhances nurses' perception of electronic nursing documentation programs. However, permanent educational actions are needed to improve the incorporation and effective use of information technology in healthcare services and nursing in primary healthcare.

Electronic nursing documentation is an essential aspect of inpatient care and multidisciplinary communication.[27,28] Nursing staff felt that electronic health records aided them in performing nursing activities and provision of care.[3,29,30] In a previous study, nurses reported increased satisfaction in the usability of electronic nursing documentation.[21] By contrast, the nurse turnover had significantly increased from the pre-implementation to the post-implementation period and failed to return to the baseline level.[2] Moreover, incorporating electronic, evidenced-based practice tools into the bedside workflow of nurses promotes decision making at the point of care and thus may improve quality without negative effect on direct cost.[3,21]

The strength of this study is related to its analysis of the knowledge level of and attitude toward electronic nursing documentation, which will allow nurses to plan quality patient care. The findings of this study may help make evidence-based decisions to optimize the effectiveness of electronic documentation in the surgical and medical wards of a tertiary hospital. This study also had limitations as it uses a cross-sectional study design that appears to provide information about the situation but cannot explore the direction of a relationship of electronic nursing documentation. Thus, we cannot predict whether nurses with high knowledge levels will practice good documentation about patient care plans in the future. Therefore, the results of this study cannot be generalized to other nurses in Malaysia. For future research, a qualitative study is necessary to explore nurses' experiences in electronic nursing documentation. An intervention study was also recommended to evaluate the current electronic documentation.

CONCLUSIONS

This cross-sectional study was conducted to identify the knowledge of and practices toward electronic nursing documentation. This study showed that most nurses have a high knowledge level of and a positive attitude toward electronic nursing documentation. No significant relationship was found among sociodemographic factors, knowledge level of, and attitude toward electronic nursing documentation.

ACKNOWLEDGMENT

We would like to acknowledge the Faculty of Medicine UKM for their support in achieving this work (UKMREC Project code: FF-2016136).

CONFLICT OF INTEREST

None declared.

FUNDING

This study was supported by the Universiti Kebangsaan Malaysia.

Received: June 21, 2021 | Accepted: July 26, 2021

REFERENCES

1. World Health Organization. *Nursing and midwifery*. New York: World Health Organization, 2020.
2. Ministry of Health. *Health indicator 2019*. Malaysia: Ministry of Health, 2020.

3. De Groot K, Sneep EB, Paans W, Francke AL. Patient participation in electronic nursing documentation: An interview study among community nurses. *BMC Nurs*. 2021;20:72.
4. Gazari T, Apiribu F, Dzomeku VM, Boama AB, Adoliwine Amooba PA. Application of the nursing process: A phenomenological study of registered nurses experiences at a district hospital in Ghana. *Int J Sci Healthc Res*. 2020;5:365–72.
5. Hafizah SN, Lee K. Nurses' perceptions, attitudes and preferences in using electronic documentation in a public hospital, Selangor. *Int J Public Health Clin Sci*. 2018;5:307–17.
6. Akhu-Zaheya L, Al-Maaitah R, Bany Hani S. Quality of nursing documentation: Paper-based health records versus electronic-based health records. *J Clin Nurs*. 2018;27:e578–89.
7. Wisner K, Lyndon A, Chesla CA. The electronic health record's impact on nurses' cognitive work: An integrative review. *Int J Nurs Stud*. 2019;94:74–84.
8. Shabnum S, Afzal M, Hussain M, Gilani SA. Nursing perceptions of electronic documentation. *Saudi J Med Pharm Sci*. 2017;3:926–35.
9. De Groot K, De Veer AJE, Paans W, Francke AL. Use of electronic health records and standardized terminologies: A nationwide survey of nursing staff experiences. *Int J Nurs Stud*. 2020;104:103523.
10. Kelley TF, Brandon DH, Docherty SL. Electronic nursing documentation as a strategy to improve quality of patient care. *J Nurs Scholarsh*. 2011;43:154–62.
11. McCarthy B, Fitzgerald S, O'Shea M, Condon C, Hartnett-Collins G, Clancy M, *et al*. Electronic nursing documentation interventions to promote or improve patient safety and quality care: A systematic review. *J Nurs Manag*. 2019;27:491–501.
12. Baumann LA, Baker J, Elshaug AG. The impact of electronic health record systems on clinical documentation times: A systematic review. *Health Pol*. 2018;122:827–36.
13. Lotfi M, Zamanzadeh V, Valizadeh L, Khajehgoodari M, Rezaei ME, Khalilzad MA. The implementation of the nursing process in lower-income countries: An integrative review. *Nurs Open*. 2020;7:42–57.
14. Hagos F, Alemseged F, Balcha F, Berhe S, Aregay A. Application of nursing process and its affecting factors among nurses working in Mekelle Zone Hospitals, Northern Ethiopia. *Nurs Res Pract*. 2014;2014:675212.
15. Johnson L, Edward KL, Giandinoto JA. A systematic literature review of accuracy in nursing care plans and using standardised nursing language. *Collegian*. 2018;25:355–61.
16. Guedes EDS, Turrini RNT, de Sousa RMC, Baltar VT, da Cruz DDALM. Attitudes of nursing staff related to the nursing process. *Rev Esc Enferm*. 2012;46:130–7.
17. Ebrahem R, El-Din S, Habib N, El Kheir SA. Nurses' knowledge, attitude and practices of nursing informatics system in outpatient clinics of children's cancer hospital at Cairo. *J Educ Pract*. 2014;5:82–7.
18. Tasew H, Mariye T, Teklay G. Nursing documentation practice and associated factors among nurses in public hospitals, Tigray, Ethiopia. *BMC Res Notes*. 2019;12:612.
19. Chand S, Sarin J. Confident or confused: Nurses' perception and acceptability of electronic nursing documentation. *Int J Health Sci Res*. 2019;9:197–203.
20. de Veer AJ, Francke AL. Attitudes of nursing staff towards electronic patient records: A questionnaire survey. *Int J Nurs Stud*. 2010;47:846–54.
21. Walker-Czyz A. The impact of an integrated electronic health record adoption on nursing care quality. *J Nurs Adm*. 2016;46:366–72.
22. Salameh B, Eddy LL, Batran A, Hijaz A, Jaser S. Nurses' attitudes toward the use of an electronic health information system in a developing country. *SAGE Open Nurs*. 2019;5:2377960819843711.
23. Kaya N. Factors affecting nurses' attitudes toward computers in healthcare. *Comput Inform Nurs*. 2011;29:121–9.
24. Yontz LS, Zinn JL, Schumacher EJ. Perioperative nurses' attitudes toward the electronic health record. *J Perianesth Nurs*. 2015;30:23–32.
25. Kahouei M, Baba Mohammadi H, Askari Majdabadi H, Solhi M, Parsania Z, Said Roghani P, *et al*. Nurses' perceptions of usefulness of nursing information system: Module of electronic medical record for patient care in two university hospitals of iran. *Mater Sociomed*. 2014;26:30–4.
26. Lee SH, Yu S. Changes in nursing professions' scope of practice: A pilot using electronic nursing records. *Health Policy Technol*. 2018;7:15–22.
27. Shala DR, Jones A, Fairbrother G, Tran DT. Completion of electronic nursing documentation of inpatient admission assessment: Insight from Australian metropolitan hospitals. *medRxiv*. 2021;06:21259005.
28. Heidarizadeh K, Rassouli M, Manoochehri H, Zagheri Tafreshi M, Kashef Ghorbanpour R. Nurses' perception of challenges in the use of an electronic nursing documentation system. *Comput Inform Nurs*. 2017;35:599–605.
29. Hariyati RTS, Hamid AY, Eryando T, Hasibuan ZA. Usability and satisfaction of using electronic nursing documentation, lesson-learned from new system implementation at a hospital in Indonesia. *Int J Health Manag*. 2018;13:45–52.
30. Aris Winata IMN, Hariyati RTS. Nurse satisfaction level using electronic nursing documentation. *Enferm Clin*. 2021;31:S109–12.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 6

8-30-2021

Use of Internet Platforms for Information About Sensitive Teeth Among Indonesian Adults: A Cross-Sectional Study

Safira Khairina
Department of Preventive and Public Health Dentistry, Faculty of Dentistry, Universitas Indonesia, Jakarta 10430, Indonesia, safira.khairina@ui.ac.id

Diah Ayu Maharani
Department of Preventive and Public Health Dentistry, Faculty of Dentistry, Universitas Indonesia, Jakarta 10430, Indonesia, diah.ayu64@ui.ac.id

Yasemin Yavuz
Department of Restorative Dentistry, Harran Üniversity, Şanlıurfa 63300, Turkey, yyavuz-21@hotmail.com

Febriana Setiawati
Department of Preventive and Public Health Dentistry, Faculty of Dentistry, Universitas Indonesia, Jakarta 10430, Indonesia, febriana_s@ui.ac.id

Makara J Health Res. 2021;25(2):107–112
doi: 10.7454/msk.v25i2.1285

Makara Journal of Health Research

Use of Internet Platforms for Information About Sensitive Teeth Among Indonesian Adults: A Cross-Sectional Study

Safira Khairina[1], Diah Ayu Maharani[1], Yasemin Yavuz[2], Febriana Setiawati[1*]

[1]Department of Preventive and Public Health Dentistry, Faculty of Dentistry, Universitas Indonesia, Jakarta 10430, Indonesia

[2]Department of Restorative Dentistry, Harran Üniversity, Şanlıurfa 63300, Turkey

Abstract

Background: The behavior of seeking oral health information (OHI), especially the topic of sensitive teeth (ST), among the Indonesian adult population has rarely been studied. Hence, the current work aimed to analyze the characteristics of the Indonesian adult population who reported having ST and to explore their practice of self-medication in terms of their behavior of seeking OHI on the internet.

Methods: A cross-sectional study was conducted between January and March 2021 in Indonesia. This study used a self-administered questionnaire comprising questions about sociodemographic data, oral health behavior, diet, and subjective oral health. Bivariate analysis based on a chi-square test was conducted for statistical evaluation.

Results: Results showed that 63.3% of the respondents used Google, 24.5% used Instagram, and 24.2% used YouTube to search for OHI about ST. Most of them felt improvement with self-perceived medication, with YouTube (odds ratio [OR] = 5.13, 95% confidence interval [CI] = 2.26, 11.62), Google (OR = 2.94, 95% CI = 1.79–4.84), and Instagram (OR = 1.84, 95% CI = 1.11, 3.06) as their main OHI sources.

Conclusions: Internet platforms provide information that helps adults to cope with their ST. Professionals should consider using internet-based interventions as a powerful tool for dental health education.

Keywords: dentin hypersensitivity, Indonesia, oral health

INTRODUCTION

Sensitive teeth (ST) are relatively common among adults, and the defining symptom is short, sharp pain unrelated to any other dental pathology or defect.[1] The stimulus is usually thermal, chemical, tactile, osmotic, or even related to evaporation.[2] Epidemiological studies have shown that the prevalence of ST varies between 1.34% and 98%.[2] This heterogeneity can be explained by several factors, such as the sample population (ethnicity, study location, periodontal status, dental care regime), the different diagnostic criteria used to define ST, and whether the source data are based on clinical evaluations of patient-based questionnaires.[1] Thus, patients and health professionals, mainly dentists and physicians, should be educated about the risk factors, signs, and symptoms of ST. In this context, the use of the internet as a source of oral health information (OHI) has grown over the years. Patients and professionals have resorted to this tool for knowledge.[3]

Studies have shown that online OHI can contribute to individuals' awareness of oral health, improved prognosis and adherence to treatment, and the facilitation of professional–patient communication.[4,5] However, several authors have warned about the difficulty in ascertaining the validity and reliability of the information published on the individuals' awareness of oral health, improved prognosis internet.[4] The most commonly used internet tools for access to OHI are search engines such as Google.[6] In addition, other platforms, such as YouTube and Instagram, have been used as channels of communication and access to OHI.[7] OHI can be disseminated through a variety of forms over social media, such as blogs, podcasts, tweets, Facebook pages or posts, and YouTube videos. This development may be especially relevant in Indonesia, where users have been reported to spend more time on the internet in comparison with users in other parts of the world.[8] Thus, the internet may offer an opportunity to disseminate OHI targeting Indonesians.

Indonesia is one of the largest countries in Southeast Asia. It consists of many islands and is divided into 34 provinces. According to the 2010 census data, the Indonesian population during the period was 237,641,326. Indonesia is the fourth largest country in the world after China, India, and the United States.[9] It is home to 117.21 million internet users, which make up 64.8% of the country's population.[10] The current study explores an important topic about using the internet to retract information about ST. This topic is suitable for the current

***Corresponding author:**
Febriana Setiawati
Department of Preventive and Public Health Dentistry,
Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia
E-mail: febriana_s@ui.ac.id

environment in which the COVID-19 pandemic has resulted in limited access to dental clinics because of stay-at-home restrictions. The use of the internet may help inform patients about the many aspects of ST. Thus, this study would be beneficial and impactful for the development of teledentistry. The objectives of this study were to analyze the characteristics of the adult population of Indonesia who had reported ST and to explore their practice of self-medication in terms of their behavior of seeking OHI on the internet.

METHODS

The study was approved by the Ethics Committee of the Faculty of Dentistry, Universitas Indonesia, No. 82/Ethical Approval/FKGUI/II/2021 No. Protocol 030871220. A cross-sectional questionnaire-based study was conducted among adults in Indonesia in 2021. The reporting of the present study is in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.[11] Sample size was calculated on the basis of an assumed margin of error of 3%, confidence level of 95%, and percentage of using internet to obtain OHI of 93%.[8] The required sample size was 278 participants, and it was increased by 20% to compensate for potential nonresponse. The employed questionnaire was based on a previous study.[2] The original questionnaire was translated to Bahasa Indonesia and then back translated to English and compared with the original English version to resolve inconsistencies. Some words were modified so that their meanings in the Bahasa Indonesian version would be consistent with those in the original English version. Furthermore, a pilot test of the modified questionnaire was conducted among adults to determine the clarity and comprehensiveness of the wording. The final questionnaire was used as a self-administered Bahasa Indonesia form. The questionnaire was divided into three sections. The first section collected personal information, including gender, age, domicile, education, and occupation. The second section assessed oral health practices, including brushing twice daily, regular visits to the dentist, and presence of dental pain in the last six months; the items were close-ended questions requiring "yes" or "no" responses. The third section assessed the use of the internet for OHI. The participants were asked about the internet platforms they used to search for OHI.

Descriptive analysis was conducted, and summary measures were calculated as means and standard deviations or frequencies and percentages. The dependent variable was using various internet platforms to obtain OHI (categorized into using Google, Instagram, YouTube, or none), and the independent variables included factors reflecting interest in oral health based on their adoption of oral health practices, such as brushing and dental visits and the need for OHI due to the presence of dental pain. The independent factors also included searching for OHI related to various aspects of oral diseases. Chi-square analysis was used to assess the association between the dependent and independent variables. Odds ratios and 95% confidence intervals (CIs) were calculated. Significance was set at 5%.

RESULTS

A total of 335 respondents completed the questionnaire and reported having ST. Table 1 shows that most of the participants were female (n = 200; 59.7%) with a mean age of 29.7 ± 9.8 years. The age range of the respondents was 15–65 years. Most of the participants completed university and postgraduate education (80.9%) and reported brushing twice daily (79.4%). The results showed that of the participants, 63.3% used Google, 24.5% used Instagram, and 24.2% used YouTube to search for OHI. The participants also used social media, such as Twitter (5.4%) and Facebook (4.8%).

TABLE 1. Personal profile, toothbrushing, dental visits, and dental pain among Indonesian adult participants who reported having sensitive teeth (N = 335)

Variables	Number of subjects (N)	Percentage (%)
Gender		
Male	135	40.3
Female	200	59.7
Age		
<34	269	80.3
>35	66	19.7
Domicile		
Java	216	64.5
Others	119	35.5
Education		
High school	64	19.1
Higher education	271	80.9
Occupation		
Unemployed	127	37.9
Employee	208	62.1
Toothbrushing frequency		
At least twice per day	266	79.4
Less than twice daily	69	20.6
Types of pain		
Acute	161	48.1
Discomfort	280	83.6
Pulsatile	171	51
Occurrence of pain		
Spontaneously	78	23.3
Induced	257	76.7
Causes of pain		
Cold	237	70.7
Heat	53	15.8
Sweet	123	36.7
Air	73	21.8

Table 1. continues

Variables	Number of subjects (N)	Percentage (%)
Frequency of pain		
Frequently	8	2.4
Occasionally	129	38.5
Rarely	198	59.1
Duration of pain		
Persistent	27	8.1
Short	308	91.9
Pain effect on daily life		
Oral hygiene habits affected by pain	74	22.1
Diet affected by pain	138	41.2
Drinks affected by this pain	149	44.5
Lifestyle affected by this pain	45	13.4
Mentioning sensitive teeth problems to health professional		
Dentist	155	46.3
Doctor or Nurse	13	3.9
Never	167	49.8
Learning source for sensitive teeth self-medication		
Google	212	63.3
Television advertisement	179	53.4
Friends/Family	169	50.4
Instagram	82	24.5
YouTube	81	24.2
Print media	50	14.9
Radio advertisement	30	9
Twitter	18	5.4
Facebook	16	4.8
Feeling improvement with the self-medication		
Yes	245	73.1
No	90	26.9

Table 2 shows that various factors were differently associated with the use of Google, Instagram, and YouTube relative to the non-usage of such apps to obtain OHI. Gender was associated with a significantly lower likelihood of using Instagram (OR = 2.03, 95% CI = 1.18, 3.50) but had no significant association with using Google (OR = 1.13, 95% CI = 0.72, 1.78) and YouTube (OR = 1.04, 95% CI = 0.62, 1.74). Pain effect on daily life, especially when drinking, was significantly associated with the use of Instagram (OR = 1.86, 95% CI = 1.12, 3.07) and YouTube (OR = 2.06, 95% CI = 1.24, 3.42) but had no significant association with the use of Google (OR = 1.09, 95% CI = 0.58, 1.43). Feeling improvement with self-medication was associated with significantly greater likelihood of using Google (OR = 2.94, 95% CI = 1.79, 4.84), Instagram (OR = 5.23, 95% CI = 2.30, 11.85), and YouTube (OR = 5.13, 95% CI = 2.26, 11.62).

DISCUSSION

This study explored the behavior of seeking OHI about ST on the internet among the adult population in Indonesia. The results revealed that using the internet for seeking OHI is likely for those who had higher education and had access to smartphones and the internet. Several studies have reported that access to e-health information and the usefulness of the internet for decision making are of great importance for patients with high e-health literacy. This finding may be attributed to the fact that people with high e-health literacy have the skills needed for obtaining OHI from the internet and therefore consider using this medium as one of the most important and useful resources for obtaining OHI.[12] The necessary skills and abilities include the ability to access the internet, use computers, utilize search engines, develop search keyword strategies, and differentiate between high- and low-quality information.[13] Other studies have found that high educational attainment is a significant predictor of the behavior of seeking online dental procedural information before consultations.[14] Such findings are consistent with reports of older foreign-born Latinos with lower education levels using less internet and communication technologies than others.[15] Similar to previous reports, the current work found that the participants with higher education were likely to state that they had searched online for general health information.[16]

According to a recent study, women are more likely than men to use social network services in general. Such findings are consistent with reports emphasizing that the rate of internet use is increasing more rapidly among girls than among boys. Moreover, girls have been found to be more likely than boys to use the internet for social networking services, Facebook, shopping, games, information acquisition, and formation of relationships in the virtual world. This pattern is different from that observed in boys' main use of the internet, which is for gaming purposes.[17] This study showed that among the population of social media users, those in younger age groups tend to use more social media than those in older age groups. Another study found that college students aged 18–30 years tend to seek health information on the internet. The authors concluded that social media show great promise as an effective source of medical information for this age group.[18]

The internet has great potential for spreading OHI. Regardless of the communication channel used, content is known to influence the decisions of individuals about their health, including changes in lifestyles.[5] Google was the most popular internet platform for OHI-seeking behavior in the present study. This result is in accordance with that of another study that reported the important role of Google as a search engine because the platform actively mediates and shapes the information seen by users.[19]

The current literature highlights the various benefits and challenges for patients when using social media for health purposes. Overall, this review shows the apparent potential of social media use in healthcare because it can

TABLE 2. Odds ratios (OR, 95% CI) of factors associated with seeking OHI from Google, Instagram, and YouTube by adults in Indonesia

	Google		Instagram		YouTube	
	Yes	OR (95% CI)	Yes	OR (95% CI)	Yes	OR (95% CI)
Gender		1.13 (0.72-1.78)		2.03 (1.18-3.50)*		1.04 (0.62-1.74)
Male (ref)	83 (61.5%)		23 (17.0%)		32 (23.7%)	
Female	129 (64.5%)		59 (29.5%)		49 (24.5%)	
Age		1.20 (0.68-2.12)		0.48 (0.23-1.00)		1.35 (0.73-2.46)
<34 (ref)	168 (62.5%)		72 (26.8%)		62 (23.0%)	
>35	44 (66.7%)		10 (15.2%)		19 (28.8%)	
Domicile		1.04 (0.65-1.65)		0.99 (0.589-1.668)		1.01 (0.60-1.71)
Java (ref)	136 (63.0%)		53 (24.5%)		52 (24.1%)	
Others	76 (63.9%)		29 (24.4%)		29 (24.4%)	
Education		1.04 (0.59-1.83)		1.39 (0.76-2.55)		1.42 (0.77-2.61)
University level (ref)	171 (63.1%)		63 (23.2%)		62 (22.9%)	
High school	41 (64.1%)		19 (29.7%)		19 (29.7%)	
Toothbrushing frequency		1.22 (0.71-2.11)		1.50 (0.77-2.92)		1.47 (0.76-2.87)
Less than twice per day (ref)	41 (59.4%)		13 (18.8%)		13 (18.8%)	
At least twice per day	171 (64.3%)		69 (25.9%)		68 (25.6%)	
Pain effect on daily life						
Oral hygiene habits		0.91 (0.53-1.57)		1.11(0.60-2.04)		1.08 (0.59-2.00)
Yes (ref)	48 (64.9%)		17 (23.0%)		17 (23.0%)	
No	164 (62.8%)		65 (24.9%)		64 (24.5%)	
Diet		1.35 (0.85-2.13)		1.41 (0.85-2.33)		1.65 (1.00-2.74)
No (ref)	119 (60.4%)		43 (21.8%)		40 (20.3%)	
Yes	93 (67.4%)		39 (28.3%)		41 (29.7%)	
Drinks		1.09 (0.58-1.43)		1.86(1.12-3.07)*		2.06 (1.24-3.42)*
No (ref)	116 (62.4%)		36 (19.4%)		34 (18.3%)	
Yes	96 (64.4%)		46 (30.9%)		47 (31.5%)	
Feeling improvement with the self-medication		2.94 (1.79-4.84)*		5.23 (2.30-11.85)*		5.13 (2.26-11.62)*
No (ref)	40 (44.4%)		7 (7.8%)		7 (7.8%)	
Yes	172 (70.2%)		75 (30.6%)		74 (30.2%)	

*$p < 0.05$; ref = reference category

be used as a tool to engage and empower patients.[20] In an existing study, the participants explained their use of social media sources for health information with the following statement: "because a lot of them are having the same problem I am or another user on these sites had asked the same question, and as a result, the best answer was already identified."[18] Anther study found several benefits to using that type of digital social media. The authors noted that online videos are a more effective way of sharing health information than written text. They also reported that patients easily described their experiences and firsthand impressions related to their disease by using YouTube. Patients could describe and share their emotional perspectives and acquire coping skills, support, and resources.[21]

ST is a relatively common problem encountered in clinical practice, and it was found to be related to substantially impaired oral health-related quality of life.[22] The study showed that choice of beverages is affected by ST. ST may disturb patients during eating, drinking, and brushing.[23] This observation is similar to those in other studies, which reported that drinks are most often modified because of ST; for example, subjects may limit their intake of cold and/or acidic drinks because they want to prevent possible discomfort/pain or because they had discussed the impact of these elements with their dentists. Although most people with ST noted little impact of such behavior on their overall quality of life, some reported a significant impact.[2]

In the present study, the prevalence of self-medication for ST was high. However, the resources about the practice of self-medication for ST are limited as the existing studies are generally about self-medication for oral health problems. This percentage is similar to those reported in several studies.[24-26] A few limitations were identified in the current study, and they should be highlighted for future research. For example, the results cannot be generalized to the whole Indonesian population. Therefore, any decision to generalize these findings to other categories of the population must be made thoughtfully. The questionnaire was adapted directly from a previous study. Hence, validity and reliability tests were not conducted. In addition, the questionnaire was self-administered and might have led to a certain type of limitation bias, such as social desirability.

CONCLUSIONS

The findings of this study showed that the adult population in Indonesia rely more on Google than on Instagram and YouTube when seeking OHI about ST on the internet. People who use the internet to seek OHI are likely to have had higher education and have access to smartphones and the internet. This study also showed that the choice of drinks is affected by ST and that people who seek information about self-medication for ST feel improvement thereafter. Further study should be conducted to develop and analyze internet-based intervention program for oral health education.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

FUNDING

None declared.

Received: June 1, 2021 | Accepted: July 12, 2021

REFERENCES

1. West N, Sanz M, Lussi A, Bartlett D, Bouchard P, Bourgeois D. Prevalence of dentine hypersensitivity and study of associated factors: A European population-based cross- sectional study. *J Dent*. 2013;41:841–51.
2. Blaizot A, Offner D, Trohel G, Bertaud V, Bou C, Catteau C, et al. Prevalence of sensitive teeth and associated factors: A multicentre, cross-sectional questionnaire survey in France. *BMC Oral Health*. 2020;20:234.
3. Delli K, Livas C, Vissink A, Spijkervet FK. Is YouTube useful as a source of information for Sjögren's syndrome? *Oral Dis*. 2016;22:196–201.
4. Jayaratne YS, Anderson NK, Zwahlen RA. Readability of web-sites containing information on dental implants. *Clin Oral Implants Res*. 2014;25:1319–24.
5. Varela-Centelles P, Ledesma-Ludi Y, Seoane-Romero JM, Seoane J. Information about oral cancer on the Internet: our patients cannot understand it. *Br J Oral Maxillofac Surg*. 2015;53:393–5.
6. López-Jornet P, Camacho-Alonso F. The quality of internet sites providing information relating to oral cancer. *Oral Oncol*. 2009;45:95–8.
7. Neiger BL, Thackery R, Burton SH, Giraud-Carrier CG, Fagen MC. Evaluating social media's capacity to develop engaged audiences in health promotion settings: Use of Twitter metrics as a case study. *Health Promot Pract*. 2013;14:157–62.
8. Maharani DA, El Tantawi M, Yoseph MG, Rahardjo A. The use of internet platforms for oral health information and associated factors among adolescents from Jakarta: A cross sectional study. *BMC Oral Health*. 2021;21:22.
9. Maharani DA. Perceived need for and utilization of dental care in Indonesia in 2006 and 2007: A secondary analysis. *J Oral Sci*. 2009;51:545–50.
10. APJII. Penetrasi & Profil Perilaku Pengguna Internet Indonesia Tahun 2018. *Apjii*; 2019. p.51.
11. Von Elm E, Altman DG, Egger M, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. *Ann Intern Med*. 2007;147:573–7.
12. Valizadeh-Haghi S, Rahmatizadeh S. eHealth literacy and general interest in using online Health information: a survey among patients with dental diseases. *Online J Publ Health Informat*. 2018;10.
13. Chesser A, Burke A, Reyes J, Rohrberg T. Navigating the digital divide: A systematic review of eHealth literacy in underserved populations in the United States. *Inform Health Soc Care*. 2015;41:1–19.
14. Hanna K, Sambrook P, Armfield J, Brennan D. Internet use, online information seeking and knowledge among third molar patients attending public dental services. *Aust Dent J*. 2017;62:323–30.
15. Leite L, Buresh M, Rios N, Conley A, Flys T, Page KR. Cell phone utilization among foreign-born Latinos: A promising tool for dissemination of health and HIV information. *J Immigr Minor Health*. 2014;16:661–9.
16. Nölke L, Mensing M, Krämer A, Hornberg C. Sociodemographic and health-(care-) related characteristics of online health information seekers: A

cross-sectional German study. *BMC Pub Health*. 2015;15:31.
17. Do KY, Lee ES, Lee KS. Association between excessive internet use and oral health behaviors of Korean adolescents: A 2015 national survey. *Community Dental Health*. 2017;34:183–9.
18. Prybutok G, Ryan S. Social media: The key to health information access for 18- to 30-year-old college students. *CIN: Comp Inform Nurs*. 2015;33:132–41.
19. Mager A. Search engines matter: From educating users towards engaging with online health information practices. *Pol Int*. 2012;4:1–21.
20. Househ M, Borycki E, Kushniruk A. Empowering patients through social media: The benefits and challenges. *Health Inform J*. 2014;20:50–8.
21. Clerici CA, Veneroni L, Bisogno G, Trapuzzano A, Ferrari A. Videos on rhabdomyosarcoma on YouTube: An example of the availability of information on pediatric tumors on the web. *J Pediatr Hematol Oncol*. 2012;34:e329–31.
22. Bekes K, John M, Schaller H, Hirsch C. Oral health-related quality of life in patients seeking care for dentin hypersensitivity. *J Oral Rehab*. 2009;36:45–51.
23. Cunha-Cruz J, Wataha JC, Heaton LJ, Rothen M, Sobieraj M, Scott J, et al. The prevalence of dentin hypersensitivity in general dental practices in the Northwest United States. *J Am Dent Assoc*. 2013;144:288–96.
24. Agbor M, Azodo C. Self-medication for oral health problems in Cameroon. *Int Dent J*. 2011;61:204-9.
25. Albatti T, Alawwad S, Aldueb R, Alhoqail R, Almutairi R. The self medication use among adolescents aged between 13–18 years old; Prevalence and behavior, Riyadh – Kingdom of Saudi Arabia, from 2014–2015. *Int J Pediat Adol Med*. 2017;4:19–25.
26. Aldeeri A, Alzaid H, Alshunaiber R, Meaigel S, Shaheen N, Adlan A. Patterns of self-medication behavior for oral health problems among adults living in Riyadh, Saudi Arabia. *Pharm*. 2018;6:15.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 7

8-30-2021

The Pharyngeal Airways of Patients with Class II Malocclusion: A Cone-Beam Computed Tomography Analysis

Yazgı Ay Ünüvar
Department of Orthodontics, Faculty of Dentistry, Aydın Adnan Menderes University, Aydın 09010, Turkey,
yazgiay@hotmail.com

Fundagül Bilgiç Zortuk
Department of Orthodontics, Faculty of Dentistry, Hatay Mustafa Kemal University, Hatay 31070, Turkey,
fundagulbilgic@hotmail.com

Törün Özer
Department of Orthodontics, Faculty of Dentistry, Dokuz Eylül University, İzmir 35340, Turkey,
torunozer@gmail.com

Kadir Beycan
Department of Orthodontics, Faculty of Dentistry, Marmara University, İstanbul 34722, Turkey,
orthodonty@hotmail.com

Recommended Citation

Ünüvar YA, Zortuk FB, Özer T, Beycan K. Comparison of the Pharyngeal Airways of Patients with Class II Malocclusion with Different Sagittal Jaw Positions by Cone-Beam Computed Tomography. Makara J Health Res. 2021;25.

Makara J Health Res. 2021;25(2):113–121
doi: 10.7454/msk.v25i2.1272

Makara Journal of Health Research

The Pharyngeal Airways of Patients with Class II Malocclusion: A Cone-Beam Computed Tomography Analysis

Yazgı Ay Ünüvar[1*], Fundagül Bilgiç Zortuk[2], Törün Özer[3], Kadir Beycan[4]

[1]Department of Orthodontics, Faculty of Dentistry, Aydın Adnan Menderes University, Aydın 09010, Turkey
[2]Department of Orthodontics, Faculty of Dentistry, Hatay Mustafa Kemal University, Hatay 31070, Turkey
[3]Department of Orthodontics, Faculty of Dentistry, Dokuz Eylül University, İzmir 35340, Turkey
[4]Department of Orthodontics, Faculty of Dentistry, Marmara University, İstanbul 34722, Turkey

Abstract

Background: This study aimed to compare the minimum axial (min Ax) area and the volumes of the nasopharyngeal (NP) and oropharyngeal (OP) airways of patients with Class II malocclusion with different sagittal positions of the mandible and maxilla and patients with Class I malocclusion with normal jaw positions.

Methods: Airway areas and volumes of 51 patients with Class I malocclusion with normal maxillary and mandibular positions (0 < ANB < 4, 84 > SNA > 80, and 82 > SNB > 78) were compared with 21 patients with Class II malocclusion with normal maxillary and retrognathic mandibular positions (ANB>4, 84>SNA>80, and SNB<78) and 21 patients with Class II malocclusion with prognathic maxillary and normal mandibular positions (ANB>4, SNA>84, and 82>SNB>78).

Results: In the comparison of airway measurements between Class I and Class II groups, significant differences were found in the OP airway volume, total airway volume, and minimum OP axial area. Patients with Class II mandibular retrusion had smaller OP airway volume. The total airway volume and min *Ax* area were significantly lower in the Class II mandibular retrusion group than in other groups.

Conclusions: The sagittal position of the jaws affects the OP airway volume and the minimum axial airway area, but not the NP airway volume.

Keywords: cone-beam computed tomography, mandibular retrusion, obstructive sleep apnea

INTRODUCTION

Class II malocclusion is associated with skeletal discrepancy owing to the retruded position of the mandible, anterior position of the maxilla, or both.[1] According to McNamara, the single most common feature of Class II malocclusions is mandibular skeletal retrusion rather than maxillary prognathism.[2] Some researchers associated mouth breathing with Class II malocclusion.[3–6]

The narrowing of the pharyngeal airway is considered among the basic causes of the development of obstructive sleep apnea syndrome (OSAS). OSAS is a sleep-breathing disorder characterized by the interruption of the pharyngeal airway caused by periodic airway collapse during sleep and respiratory arrest.[7] Class II malocclusions with vertical growth patterns have been reported to be anatomical predisposing factors for the obstruction of the pharyngeal airway.[5,8] Most researchers have analyzed the relationship between facial morphology and pharyngeal airway shape on two-dimensional (2D) cephalometric radiographs.[3,5,6,9–12] However, 2D radiographies do not allow assessment of the pharyngeal volumes. The human airway is a three-dimensional (3D) structure, so lateral films represent the 3D structure in 2D view. Thus, analyzing a 3D structure in 2D view was a limitation of previous studies.[13,14]

The diagnostic capacity of the airway has expanded with the development of 3D computed tomography (CT); however, the routine use of CT devices is limited by the high-dose radiation they generate. The radiation dose has been reduced, thanks to the development of cone-beam CT (CBCT). CBCT has become a well-accepted maxillofacial diagnostic imaging technique because it emits lower radiation dose and has faster image acquisition times than conventional CT.[15,16]

Several studies[4,6,17,18] have shown that patients with retrognathic mandible have decreased pharyngeal airway, but how the prognathic maxilla affects the airway is still not certain. To the best of our knowledge, only one 3D study has addressed pharyngeal airway dimensions in skeletal discrepancies considering the sagittal position of the maxilla and mandible with regard to the cranial base.[19] The present study focused

***Corresponding author:**
Yazgı Ay Ünüvar
Department of Orthodontics, Faculty of Dentistry,
Aydın Adnan Menderes University, Aydın, Turkey
E-mail: yazgi.ay@adu.edu.tr

on Class II skeletal discrepancy with an extended sample size of each group.

This retrospective study aimed to compare the minimum axial (min Ax) area and the volumes of the nasopharyngeal (NP) and oropharyngeal (OP) airways of patients with Class I malocclusion with normal arch position and patients with Class II with different sagittal positions of the mandible and maxilla and to investigate whether the pharyngeal airway was affected by the sagittal position of the jaw.

METHODS

The protocol of this retrospective study was approved by the local ethical committee in University Faculty of Dentistry (ADÜDHF2018/030). All patients and their parents had signed an informed consent form allowing the use of their data and records for scientific purposes. The study followed a retrospective design, and no additional radiation was given to the patients. CBCT was performed to provide accurate an diagnosis of dental problems.

In this study, 1530 CBCT scans were evaluated. Scans that met the inclusion criteria were selected from among these data sets. A total set of 93 patients (aged 16–43 years) with Class I and Class II sagittal skeletal patterns were selected from the archive of the Oral Diagnosis and Radiology Department of University, Faculty of Dentistry. All CBCT images were obtained in a single 360° rotation using a ProMax 3D scanner (Planmeca, Helsinki, Finland). All images were taken at 8 mA and 90 kV in a scanning field of 20 by 17 cm and exposure time of 13.5 seconds. The axial slice thickness was 0.3 mm, and voxels were isotropic.

The exclusion criteria for this study were as follows: detectable pathology along the upper airway, missing teeth except for the third molars, previous orthodontic treatment or orthognathic surgery, craniofacial syndrome, adenoidectomy or tonsillectomy, severe hypodivergent growth pattern (Frankfort to mandibular plane angle, FMA<19), severe hyperdivergent growth pattern (FMA>31), nasal obstruction, and incomplete visualization of the upper airway.

A total set of 93 CBCT scans were used for this study. Airway areas and volumes of 51 patients with Class I normal maxillary and mandibular positions (0<ANB<4, 84>SNA>80, 82>SNB>78) were compared with 21 patients with Class II normal maxillary and retrognathic mandibular positions (ANB>4, 84>SNA>80, SNB<78) and 21 patients with Class II prognathic maxillary and normal mandibular positions (ANB>4, SNA>84, 82>SNB>78).
Lateral cephalograms were obtained automatically from CBCT data using the Dolphin 3D Imaging program (version 11, Dolphin Imaging & Management Solutions, LA, CA) and were traced with the same program to measure four angular (FMA, SNA, SNB, and ANB) parameters (Figure 1). All data were collected and measured by a single experienced orthodontist (Y.A.Ü.).

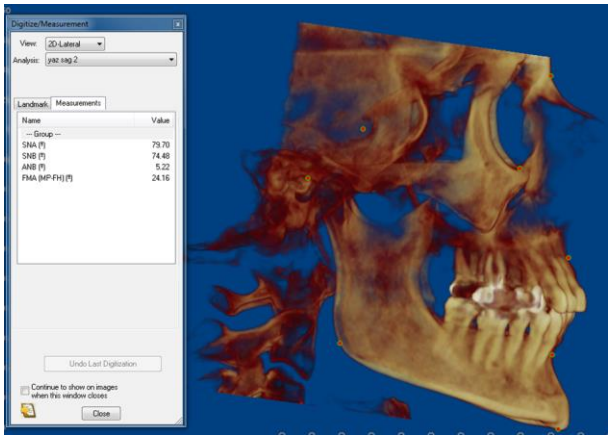


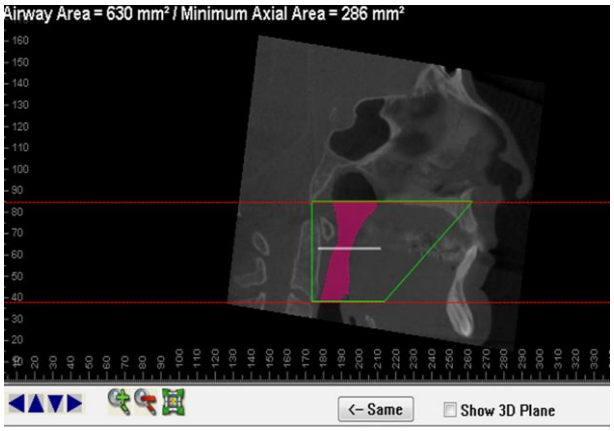
FIGURE 1. Sagittal and vertical skeletal measurements used in this study were created with the Dolphin 3D software program

The anteroposterior skeletal type was established by ANB measurements as Class I (0<ANB<4) and Class II (ANB>4). SNA and SNB angles were used to determine the maxillary and mandibular positions relative to the cranial base. Moreover, 84>SNA>80 and 82>SNB>78 were determined as the normal range of the positions of the maxilla and mandible, respectively. As a result, the patients were divided into three groups as Class I with normal maxillary and mandibular positions relative to the anterior cranial base and each other, Class II with normal maxillary and retrognathic mandibular positions relative to the anterior cranial base (ANB>4, SNB<78), and Class II with prognathic maxillary and normal mandibular positions relative to the anterior cranial base (ANB>4, SNA>84).

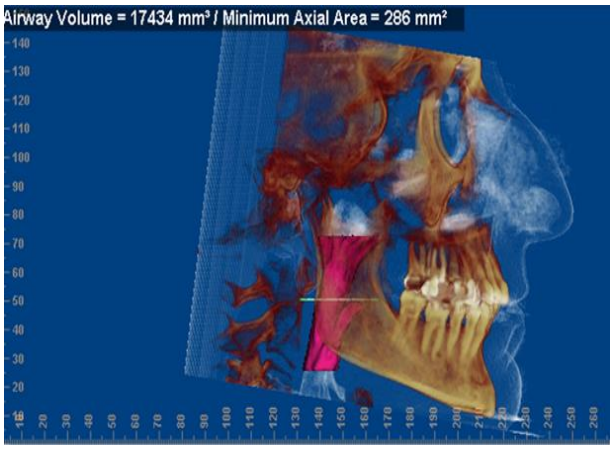
All skeletal and airway measurements were performed with Dolphin 3D (version 11, Dolphin Imaging & Management Solutions, LA, CA), a third-party software program. The OP airway volume was defined as the volume of the pharynx between the palatal plane (anterior nasal spine–posterior nasal spine) extending to the posterior wall of the pharynx and the plane parallel to the palatal plane passing through the most anteroinferior point of the second cervical vertebrae (Figure 2). The inferior limit of the NP airway was defined as the superior limit of the OP airway, and the superior limit of the NP airway was defined as the last slice before the nasal septum fused with the posterior wall of the pharynx. Thus, the superior border of the NP was defined on the axial slice and then reflected on the sagittal plane (Figure 3). The anterior border of the NP airway is the anterior wall of the pharynx. The superior and inferior limits of the OP and NP airways were determined from the limits used by El and Palomo.[20] In

addition to these volumetric measurements, the minimum axial (min Ax) area was calculated.

Descriptive statistics including mean, standard deviation, and minimum and maximum values for each group were calculated using SPSS for Windows (SPSS 11.0, Chicago, IL, USA). The significance level was set at 0.05. Chi-square test was performed to check the distribution of gender among groups. The Kolmogorov–Smirnov test was used to determine the normal distribution of data. Since the distribution of the variables was not normal, intergroup comparisons of age, skeletal patterns, and airway measurements were performed using the Mann–Whitney U-test and Kruskal–Wallis test. As the second step, the Mann–Whitney U-test with Bonferroni correction was used for further pairwise comparison of significant findings. Correlations between variables were tested with the Pearson correlation coefficient.



(a)



(b)

FIGURE 2. (a) Oropharyngeal minimum axial area (min Ax) and (b) Oropharyngeal airway (OP) volume rendering with the Dolphin 3D software program

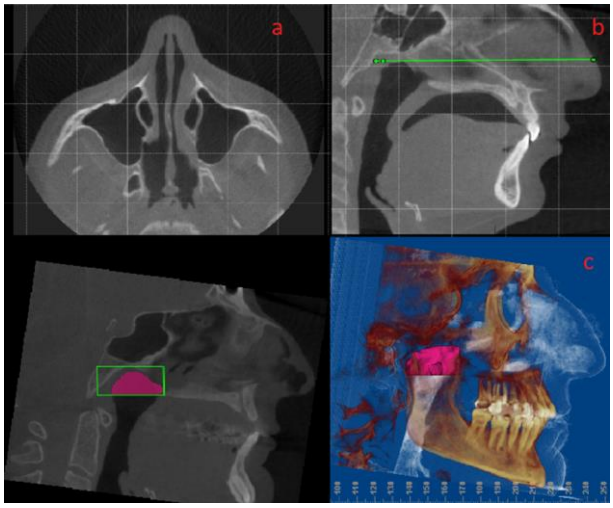


FIGURE 3. Nasopharyngeal airway borders. (a) Determination of the last slice before the nasal septum fused with the posterior wall of the pharynx on the axial plane. (b) Reflection on the sagittal plane. (c) Nasopharyngeal airway (NP) volume rendering with the Dolphin 3D software program

Images were re-measured 3 weeks after the initial measurements for reliability. Dahlberg's formula ($\sqrt{\sum d^2/2n}$) for linear, areal, and angular measurements and the intraclass correlation coefficient (ICC) for volumetric measurements were used to test reliability.

RESULTS

The operator's calibration was confirmed because the ICC results were between 0.928 and 0.941 and the results of Dalhberg's formula were between 0.354 and 0.802 for all variables assessed. The gender distributions of the groups are given in Table 1. A chi-square test was used to control the distribution of gender to match the groups. No differences were found between the groups owing to the similar male-to-female composition. Data were combined because no significant difference was found.

Descriptive demographic characteristics of the groups are given in Table 2. No significant age difference was found between the groups, and the mean age was 30.57 ± 11.47 years for the Class I normal growth pattern group, 31.57 ± 11.88 for the Class II mandibular retrusion group, and 31.09 ± 10.87 for the Class II maxillary protrusion group.

TABLE 1. Male–female composition of Class I and Class II subgroups

	Class I normal	Class II mandibular retrusion	Class II maxillary protrusion	Total	*p*
Female	25	12	11	48	>0.1
Male	26	9	10	45	
Total	51	21	21	93	

TABLE 2. Descriptive statistics showing the means, standard deviations, and minimum and maximum values of the Class I group and Class II groups and results of intergroup comparisons using Kruskal–Wallis test

Variables	Class I normal (N=51)			Class II mandibular retrusion (N=21)			Class II maxillary protrusion (n=21)			*P*
	Mean ± SD	Min	Max	Mean ± SD	Min	Max	Mean ± SD	Min	Max	
Age (years)	30.57 ± 11.47	17	40	31.57 ± 11.88	17	43	31.09 ± 10.87	17	41	NS
FMA(°)	25.54 ±3.30	19	30.4	26.58 ± 3.10	19.9	31	23.88 ± 4.29	19.6	29.7	NS
SNA(°)	81.86 ± 1.24	80	84	82.07 ± 1.45	80	84	86.06 ± 1.16	84.4	88.6	0.000***
SNB(°)	79.14 ± 1.05	78	82	75.89 ± 1.56	72	77.9	79.88 ± 1.44	78.5	82	0.000***
ANB(°)	2.72 ± 0.74	1.5	3.9	5.99 ± 1.08	4.4	8	6.20 ± 1.79	4.2	10.8	0.000***
OP vertical length (mm)	37.84 ± 4.17	29.4	44.1	37.99 ± 4.84	25.9	45.3	36.63 ± 5.02	22.6	43.95	NS
PAS (mm)	8.47 ± 2.84	4.9	14.8	7.43 ± 2.32	3.3	13.4	8.82 ± 2.73	4.3	13.8	NS
NP volume (mm3)	15262.58 ± 5515.48	4919.5	27121.7	15092.71 ± 5473.82	6065.2	23838.5	16112.72 ± 3478.88	11542	22429.1	NS
OP volume (mm3)	14363.56 ± 3036.34	8989.8	19763.2	9509.35 ± 2305.31	4650	12455.4	14119.08 ± 4099.82	8306.7	21936	0.000***
TOTAL volume (NP+OP) (mm3)	29626.14 ± 6540.06	18791.1	42353.1	24602.07 ± 6979.79	10715.2	34484.4	30231.80 ± 4975.67	23154.4	39895.8	0.031*
OP min area (mm2)	152.00 ± 79.19	70.6	361.3	83.61 ± 59.44	47.8	233.4	111.52 ± 47.12	67.5	205	0.002**

NP, nasal passage; OP, oropharynx; PAS, posterior airway space; min *Ax*, minimum area of the oropharynx on the axial slice; SD, standard deviation; min, minimum; max, maximum; NS, not significant; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$

Since FMA, SNA, SNB, and ANB were used to form the groups, significant differences in skeletal variables were expected between the groups.

For airway measurements, the OP airway volume, total airway volume, and minimum OP axial area were significantly different among the groups, while the OP vertical length, PAS, and NP volume were not different. Further pairwise comparisons are shown in Table 3. The Class II mandibular retrusion group presented the smallest OP airway volume (9509.35 ± 2305.31 mm^3), total airway volume (24602.07 ± 6979.79 mm^3), and min *Ax* area (83.61 ± 59.44 mm^2), and a significant difference was observed when compared with the other groups. No significant difference was found between the Class I normal and Class II maxillary protrusion groups. The NP volume did not demonstrate a significant difference between the groups.

Bivariate correlations are shown in Table 4. The SNB, OP vertical length, PAS, total airway volume, and min *Ax* area were significantly positively correlated with the OP airway volume. The ANB angle was significantly negatively correlated with both the OP airway volume and min *Ax* area. The NP volume showed a significant positive correlation with the total airway volume but a significant negative correlation with the FMA. Stronger correlations were found with the OP data than with NP volumes and min *Ax* area. The strongest correlations for OP volumes were with the SNB angle and total airway volume. The comparison of the total airway among the groups showed that individuals with mandibular retrusion had smaller OP airway volumes than individuals with normal ones.

TABLE 3. Results of the pairwise comparisons with Mann–Whitney U tests with the Bonferroni adjustment

	OP volume (mm^3)	TOTAL volume (NP+OP) (mm^3)	minAx (mm^2)
Mann-Whitney U test			
Class I Normal	Class II Mand Ret***	Class II Mand Ret*	Class II Mand Ret**
Class II Mand Ret	Class I***	Class I*	Class I **
	Class II Max Prot***	Class II Max Prot*	Class II Max Prot*
Class II Max Prot	Class II Mand Ret***	Class II Mand Ret*	Class II Mand Ret*
Kruskal-Wallis test	0.000***	0.031*	0.002**

Mand Ret = mandibular retrusion; Max Prot = maxillary protrusion; NP = nasal passage; OP = oropharynx; PAS = posterior airway space; min *Ax* = minimum area of the oropharynx on the axial slice; **P* < 0.05; ***P* < 0.01; ****P* < 0.001

DISCUSSION

Some researchers[11,12,18,21–23] claimed that individuals with Class II mandibular retrusion had a more backward tongue position that leads to the disturbance in the cervical region. The posterior displacement of the soft palate may narrow the OP airway, resulting in mouth breathing and OSAS. Previous studies[10,12,24,25] have compared major skeletal sagittal discrepancies, but the present study compared pharyngeal airway dimensions in individuals with Class II skeletal discrepancy, taking into account the different sagittal positions of the jaws relative to the cranial base. Moreover, samples of this study have not been used in previous studies.

Several studies[4,6,12,24-30] have tried to document the association of the airway with craniofacial morphology. The relationship between facial morphology and pharyngeal airway volume and shape was mostly evaluated by lateral cephalometric radiographies.[5,6,9,12,21,23] 2D radiographs have a limited capacity for measuring airway areas. The size of the pharynx continuously changes during respiration, so static images of this dynamic structure, such as cephalometric radiographs, may not be ideal for the evaluation of the pharyngeal airway.[31] Aboudara *et al*.[14] found much greater inter-individual variations in the volume and area of the upper airway in cephalograms than in CT. CBCT enables the determination of the craniofacial skeleton and soft tissues in 3D. The pharyngeal airway obtained with CBCT produced anatomically correct images without magnification or distortion. It also helps us understand the real morphology of the head and airways by allowing accurate measurements in all sagittal, coronal, and axial slices.[20] Drawing the airway circumference and computer calculations of the cross-sectional areas also greatly reduce operator-dependent bias. The present study was designed on CBCT because of these advantages.

Tourne´[8] described the growth of the bony nasopharynx mainly vertically, with a slight anteroposterior increase early in life and minimal change after the growth spurt in 2D cephalometric data, but they have no 3D longitudinal data on airway changes during growth. To examine airway differences related to the growth status, the study participants were selected among individuals between age 16 and 43 years with an average of 31.07 years, so the participants had already experienced a growth spurt. As a result, the airway volume did not correlate with age.

Dolphin 3D was used to calculate the desired airway measurements in the present study. El and Palomo[20] showed that this software program is highly reliable in calculating the airway volume.

TABLE 4. Pearson correlation coefficients for OP, NP, total volumes, and min Ax area compared with the variables used for this study

		SNA(°)	SNB(°)	ANB(°)	FMA(°)	OP vertical length (mm)	PAS (mm)	NP volume (mm^3)	OP volume (mm^3)	TOTAL volume (NP+OP) (mm^3)	min Ax (mm^2)
NP volume (mm3)	Correlation coefficient	0.072	0.095	-0.018	-0.254*	-0.073	0.096		0.115	0.830**	0.028
	p	0.490	0.367	0.861	-0.014	0.482	0.408		0.272	0.000	0.788
OP volume (mm3)	Correlation coefficient	0.173	0.474**	-0.267**	-0.036	0.231*	0.564**	0.115		0.649**	0.226*
	p	0.098	0.000	0.010	0.732	0.032	0.000	0.272		0.000	0.029
TOTAL volume (NP+OP) (mm3)	Correlation coefficient	-0.152	0.339**	-0.164	-0.215*	0.217*	0.623**	0.830**	0.649**		0.148
	p	0.145	0.001	0.016	0.039	0.037	0.000	0.000	0.000		0.156
min Ax (mm2)	Correlation coefficient	-0.175	0.246*	-0.312**	0.116	0.125	0.727**	0.028	0.226*	0.148	
	p	0.094	0.023	0.002	0.266	0.134	0.000	0.788	0.029	0.156	

NP, nasal passage; OP, oropharynx; min *Ax*, minimum area of the oropharynx on the axial slice; sum, sum of the inner angles; Nperp, nasion perpendicular

* correlation is significant at 0.05 level (two-tailed)
** correlation is significant at 0.01 level (two-tailed)

Measurements of the pharyngeal airway area have been reported and have shed light on the evaluation of the relationship between the craniofacial growth pattern and the airway. Aboudara *et al*.[14] found that 2D measurements of the NP airway area lacked much of the structural information because the 3D structure was compressed into a 2D image. In the present study, the structures of the pharynx were obtained from 3D CBCT scans, and measurements were performed on this dynamic source.

Some researchers[5,6,24,32] claimed that patients with hyperdivergent skeletal patterns tend to have narrower upper pharyngeal airways. We excluded severe individuals with hypodivergent and hyperdivergent skeletal patterns to rule out differences caused by the severe vertical growth pattern.

In our study, no significant differences were found in the NP airway volumes when the sagittal positions of the jaws were compared among the groups. This finding corroborated those of some previous studies that were conducted with other visualization techniques.[6,12,33] However, our findings contradict those of some other studies[34,35] that found narrower NP airways in individuals with Class II malocclusion. These contrasting results might be due to the differences in sample selection, delineation of the nasal passage, or visualization technique. Our study compared individuals with Class I and Class II malocclusions, while other studies compared nasal and mouth breathers.[34,35]

Kim *et al*.[25] showed that healthy preadolescent children with retruded mandibles have reduced total pharyngeal airway volumes. Grauer *et al*.[24] and El andPalomo[19] have also found that the total airway volume of patients with retrognathic mandible was significantly smaller than those with normal mandible position. In the present study, the OP airway volume demonstrated different sagittal relationships concurrent with previous studies.[12,36,37] We found that the Class II mandibular retrusion group had the smallest OP volume. This result clarifies that the mandible is responsible for this difference in Class II cases. Retrognatic and smaller mandibles will push the tongue toward the pharynx, affecting the position of the tongue. This situation causes a decrease in the OP volume. We found a negative correlation between the OP airway volume and ANB and a positive correlation between the SNB and OP airway volume, as reported by El and Palomo[36] and Kim *et al*.[25] These correlation results support our findings.

The most constricted cross-sectional area (min Ax) of the airway has been considered an important parameter for airway evaluation. If the min *Ax* area is narrow, the air passage will be restricted and will cause more problems. Therefore, analyzing the min *Ax* area may become more important than that of the airway volume. We also found a correlation between OP volume and min *Ax* area measurements. Tso *et al*.[38] also mentioned a high correlation between the min *Ax* area and total airway volume. El and Palomo[19] found a strong correlation between the OP airway volume and min *Ax* area, similar to our findings. As a result of our study, we thought that determining the narrow airways and the size and volume of the airways are important in clinical diagnosis and treatment plans.

Similar to the study of El and Palomo,[19] the current study presented that the PAS significantly correlated with the OP volume. We found a strong correlation between PAS and min *Ax* area. This was an expected result because the min *Ax* area is the axial representation of the PAS. However, as an advantage of 3D imaging, it is possible to determine the correct restriction zone, so that the min *Ax* area has become a more important parameter than PAS.

The development of CBCT technology provides a new perspective on volumetric airway studies. It is not sufficient to evaluate patients with orthodontic conditions only from a skeletal or dental point of view. For this reason, a detailed analysis of the airway volume and shape may provide a valuable diagnostic contribution in the field of orthodontics.

This study has several limitations. CBCT scans were taken in an upright position. As OSAS occurs during sleep, the evaluation of the pharynx in the supine position can provide more accurate information. The sample size was small, and the study design was retrospective. Further follow-up studies on pharyngeal airway volume with a larger sample size would have been more reliable. Body mass index can also help in better understanding the relationship between pharyngeal airways and skeletal patterns.

CONCLUSIONS

Patients with Class II malocclusion with mandibular retrusion had smaller OP airway volumes than those with Class I and Class II maxillary protrusions. Mandibular retrusion relative to the cranial base affected the OP airway volume. The min Ax area was the variable that best described the OP airway volume.

CONFLICT OF INTEREST

None declared.

FUNDING

None.

Received: May 28, 2021 | Accepted: June 30, 2021

REFERENCES

1. Ackerman JL, Proffit WR. The characteristics of malocclusion: A modern approach to classification and diagnosis. *Am J Orthod*. 1969;56:443–54.
2. McNamara JA, Bookstein FL, Shaughnessy TG. Skeletal and dental changes following functional regulator therapy on Class II patients. *Am J Orthod*. 1985;88:91–110.
3. Kerr WJS. The nasopharynx, face height, and overbite. *Angle Orthod*. 1985;55:31–6.
4. Zhong Z, Tang Z, Gao X, Zeng XL. A comparison study of upper airway among different skeletal craniofacial patterns in nonsnoring Chinese children. *Angle Orthod*. 2010;80:267–74.
5. Joseph AA, Elbaum J, Cisneros GJ, Eisig SB. A cephalometric comparative study of the soft tissue airway dimensions in persons with hyperdivergent and normodivergent facial patterns. *J Oral Maxillofac Surg*. 1998;56:135–9.
6. de Freitas MR, Alcazar NM, Janson G, de Freitas KM, Henriques JF. Upper and lower pharyngeal airways in subjects with Class I and Class II malocclusions and different growth patterns. *Am J Orthod Dentofacial Orthop*. 2006;130:742–5.
7. Banno K, Kryger MH. Sleep apnea: Clinical investigations in humans. *Sleep Med*. 2007;8:400–26.
8. Tourné LP. Growth of the pharynx and its physiologic implications. *Am J Orthod Dentofacial Orthop*. 1991;99:129–39.
9. Uçar Fİ, Uysal T. Orofacial airway dimensions in subjects with Class I malocclusion and different growth patterns. *Angle Orthod*. 2011;81:460–8.
10. Alves M, Franzotti E, Baratieri C, Nunes L, Nojima L, Ruellas A. Evaluation of pharyngeal airway space amongst different skeletal patterns. *Int J Oral Maxillofac Surg*. 2012;41:814–9.
11. Oz U, Orhan K, Rubenduz M. Two-dimensional lateral cephalometric evaluation of varying types of Class II subgroups on posterior airway space in postadolescent girls: A pilot study. *J Orofac Orthop*. 2013;74:18–27.
12. Ceylan I, Oktay H. A study on the pharyngeal size in different skeletal patterns. *Am J Orthod Dentofacial Orthop*. 1995;108:69–75.
13. Eslami E, Katz ES, Baghdady M, Abramovitch K, Masoud MI. Are three-dimensional airway evaluations obtained through computed and cone-beam computed tomography scans predictable from lateral cephalograms? A systematic review of evidence. *Angle Orthod*. 2017;87:159–67.
14. Aboudara C, Nielsen I, Huang JC, Maki K, Miller AJ, Hatcher D. Comparison of airway space with conventional lateral headfilms and 3-dimensional reconstruction from cone-beam computed tomography. *Am J Orthod Dentofacial Orthop*. 2009;135:468–79.
15. Palomo JM, Rao PS, Hans MG. Influence of CBCT exposure conditions on radiation dose. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2008;105:773–82.
16. Yeung AW, Jacobs R, Bornstein MM. Novel low-dose protocols using cone beam computed tomography in dental medicine: A review focusing on indications, limitations, and future possibilities. *Clin Oral Investig*. 2019;23:2573–81.
17. Thakur VK, Londhe S, Kumar P, Sharma M, Jain A, Pradhan I. Evaluation and quantification of airway changes in Class II division 1 patients undergoing myofunctional therapy using twin block appliance. *Med J Armed Forces India*. 2021;77:28–31.
18. Silva NN, Lacerda RHW, Silva AWC, Ramos TB. Assessment of upper airways measurements in patients with mandibular skeletal Class II malocclusion. *Dental Press J Orthod*. 2015;20:86–93.
19. El H, Palomo JM. An airway study of different maxillary and mandibular sagittal positions. *Eur J Orthod*. 2013;35:262–70.
20. El H, Palomo JM. Measuring the airway in 3 dimensions: A reliability and accuracy study. *Am J Orthod Dentofacial Orthop*. 2010;137:S50.e1–9.
21. Uslu-Akcam O. Pharyngeal airway dimensions in skeletal class II: A cephalometric growth study. *Imaging Sci Dent*. 2017;47:1–9.
22. Jena AK, Singh SP, Utreja AK. Sagittal mandibular development effects on the dimensions of the awake pharyngeal airway passage. *Angle Orthod*. 2010;80:1061–7.
23. Muto T, Yamazaki A, Takeda S. A cephalometric evaluation of the pharyngeal airway space in patients with mandibular retrognathia and prognathia, and normal subjects. *Int J Oral Maxillofac Surg. 2008;37:228–31.*
24. *Grauer D, Cevidanes LS, Styner* MA, Ackerman JL, Proffit WR. Pharyngeal airway volume and shape from cone-beam computed tomography: relationship to facial morphology. *Am J Orthod Dentofacial Orthop*. 2009;136:805–14.
25. Kim YJ, Hong JS, Hwang YI, Park YH. Three-dimensional analysis of pharyngeal airway in preadolescent children with different anteroposterior skeletal patterns. *Am J Orthod Dentofacial Orthop*. 2010;137:306.e1–11.
26. Kochhar AS, Sidhu MS, Bhasin R, Kochhar GK, Dadlani H, Sandhu J, *et al*. Cone beam computed tomographic evaluation of pharyngeal airway in North Indian children with different skeletal patterns. *World J Radiol*. 2021;13:40–52.
27. Shokri A, Miresmaeili A, Ahmadi A, Amini P, Falah-Kooshki S. Comparison of pharyngeal airway volume in different skeletal facial patterns using cone beam computed tomography. *J Clin Exp Dent*. 2018;10:e1017–28.
28. Shokri A, Mollabashi V, Zahedi F, Tapak L. Position of the hyoid bone and its correlation with airway dimensions in different classes of skeletal malocclusion using cone-beam computed tomography. *Imaging Sci Dent*. 2020;50:105–15.
29. Chen YS, Chou ST, Cheng JH, Chen SC, Pan CY, Tseng YC. Importance in the occurrence distribution of minimum oropharyngeal cross-sectional area in the

different skeletal patterns using cone-beam computed tomography. *BioMed Res Int*. 2021;2021:5585629.
30. Wanzeler AMV, Renda MDO, de Oliveira Pereira ME, Alves-Junior SM, Tuji FM. Anatomical relation between nasal septum deviation and oropharynx volume in different facial patterns evaluated through cone beam computed tomography. *Oral Maxillofac Surg*. 2017;21:341–6.
31. Kyung SH, Park YC, Pae EK. Obstructive sleep apnea patients with the oral appliance experience pharyngeal size and shape changes in three dimensions. *Angle Orthod*. 2005;75:15–22.
32. Flores-Blancas AP, Carruitero MJ, Flores-Mir C. Comparison of airway dimensions in skeletal Class I malocclusion subjects with different vertical facial patterns. *Dental Press J Orthod*. 2017;22:35–42.
33. Ung N, Koenig J, Shapiro PA, Shapiro G, Trask G. A quantitative assessment of respiratory patterns and their effects on dentofacial development. *Am J Orthod Dentofacial Orthop*. 1990;98:523–32.
34. Mergen DC, Jacobs RM. The size of nasopharynx associated with normal occlusion and Class II malocclusion. *Angle Orthod*. 1970;40:342–6.
35. Paul J, Nanda RS. Effect of mouth breathing on dental occlusion. *Angle Orthod*. 1973;43:201–6.
36. El H, Palomo JM. Airway volume for different dentofacial skeletal patterns. *Am J Orthod Dentofacial Orthop*. 2011;139:e511–21.
37. Kikuchi Y. Three-dimensional relationship between pharyngeal airway and maxillo-facial morphology. *Bull Tokyo Dent Coll*. 2008;49:65–75.
38. Tso HH, Lee JS, Huang JC, Maki K, Hatcher D, Miller AJ. Evaluation of the human airway using cone-beam computerized tomography. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2009;108:768–76.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 8

8-30-2021

Alveolar Bone Loss Analysis on Dental Digital Radiography Image

Aulia Karina Fitriananda
Department of Radiology, Faculty of Dentistry, Universitas Indonesia, Jakarta 10430, Indonesia,
auliakarinafitriananda@gmail.com

Bramma Kiswanjaya
Department of Radiology, Faculty of Dentistry, Universitas Indonesia, Jakarta 10430, Indonesia,
bramma_kiswanjaya@yahoo.com

Hanna H. Bachtiar-Iskandar
Department of Radiology, Faculty of Dentistry, Universitas Indonesia, Jakarta 10430, Indonesia,
hanna.bachtiar@gmail.com

Recommended Citation
Fitriananda AK, Kiswanjaya B, Bachtiar-Iskandar HH. Alveolar Bone Loss Analysis on Dental Digital Radiography Image. Makara J Health Res. 2021;25.

Makara J Health Res. 2021;25(2):122–127
doi: 10.7454/msk.v25i2.1281

Makara Journal of Health Research

Alveolar Bone Loss Analysis on Dental Digital Radiography Image

Aulia Karina Fitriananda, Bramma Kiswanjaya*, Hanna H. Bachtiar-Iskandar

Department of Radiology, Faculty of Dentistry, Universitas Indonesia, Jakarta 10430, Indonesia

Abstract

Background: Periodontal disease is the second most common tooth and mouth disease in Indonesia. Moreover, radiographic examination is the most useful tool to evaluate alveolar bone loss and diagnose periodontal diseases. This study aimed to analyze radiographically the relationship between alveolar bone loss and age among patients with chronic periodontitis.

Methods: A total of 192 digital periapical images of patients aged 25–40 years were collected. Four regions were selected, including the maxillary and mandibular central incisors and maxillary and mandibular first molars. Alveolar bone loss was measured in the mesial and distal surfaces.

Results: The mean and standard deviation for alveolar bone loss in age categories 1 (age 25–32 years) and 2 (age 33–40 years) were 4.03 ± 1.46 and 5.23 ± 2.5 (mm), respectively. Alveolar bone loss demonstrated a significant relationship with patient's age ($p < 0.001$, Mann–Whitney U test).

Conclusions: The mean and standard deviation of alveolar bone loss reduction in patients with chronic periodontitis was 4.87 ± 0.2 (mm). The alveolar bone loss on the mandibular central incisors' mesial surface is the highest among other regions.

Keywords: alveolar bone loss, chronic periodontitis, dental digital radiography

INTRODUCTION

Periodontitis is a common oral disease with a prevalence of 20%–50% in developed and developing countries.[1] Periodontitis begins with gingivitis, which is an inflammatory condition of gingival tissues caused by bacterial infection associated with dental plaque accumulation. Early stages of periodontitis are characterized by a decrease in the alveolar bone crest of the interproximal area (alveolar bone crest). At this stage, there is a decrease in cortical bone density, cortical bone rounding, and irregular/diffuse boundaries. In the anterior region, there is a blunting of the alveolar crests and slight loss of alveolar crestal bone height. In the posterior region, there is a loss of the usual sharp angle between the lamina dura, and the alveolar peak becomes blunter. Essential features of radiographic examination of periodontal conditions include the amount of bone present, alveolar crest condition, bone loss in the furcation area, width of the periodontal ligament, and local irritation factors. The risk factors of periodontal diseases are the presence of calculus and poor restoration, root length, root morphology, root–crown ratio, poor interproximal contact that can cause food impaction, anatomical alterations, and pathological conditions such as caries, periapical lesions, and root resorption.[2-4]

Radiographic examinations are essential to determine the diagnosis and prognosis of periodontal diseases and assess the extent of alveolar bone damage and periodontal tissue conditions that affect the prognosis of periodontitis.[5,6] Radiographic projections that can detect periodontal diseases include bitewing and periapical and panoramic projections. Studies in developed and developing countries have found that radiographic projections are often used in panoramic and periapical radiographic examinations.[7,8] Periapical images are more effective than panoramic images in identifying bone damage, especially in small defects.[9] However, in assessing the status of periodontal diseases, intraoral radiography has limitations, including periapical projection. These limitations will provide an incomplete overview of the status of the periodontal tissue. These limitations include intraoral radiography that provides a two-dimensional image and presents a less severe picture than the actual damage. Mild destructive lesions at the beginning of the loss do not cause bone density changes, so periapical radiographs cannot detect them. Furthermore, periapical radiographs do not show a relationship between soft and hard tissues, so they cannot provide information about the depth of the pocket.[10,11] However, the amount of radiation given to the patient is much smaller in radiography than in three-dimensional cone-beam computed tomography (CBCT) radiography. Therefore, intraoral radiography is still the first choice for radiographic examination of

***Corresponding author:**
Bramma Kiswanjaya
Department of Radiology, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia.
E-mail: bramma.kiswanjaya@ui.ac.id

periodontitis. In this study, only the mesial and distal sides of the teeth were selected to avoid misinterpretation due to the superimposition of the dental anatomy in the region of interest.

Alveolar bone loss is an indicator of the severity of periodontal diseases. The average value of alveolar bone loss reduction is useful as a reference for predicting the severity of periodontal disease radiographically, which in turn will affect the results of the management of periodontal diseases.[4]

This study aimed to measure the average value of alveolar bone loss from secondary data obtained from periapical images of patients with chronic periodontitis aged 25–40 years. This age range is taken bone density is at its peak and chronic periodontitis often occurs. These results are expected to be an initial reference to the average alveolar bone loss, which provides radiographic information about the mean alveolar bone loss.

METHODS

This analytic descriptive study with a cross-sectional approach was conducted at the dental hospital of the Faculty of Dentistry, Universitas Indonesia, from July to September 2017. This study was approved by the Dental Research Ethics Commission of the Faculty of Dentistry, Universitas Indonesia (Letter No. 05/Ethical Exempted/FKGUI/VI/2017).

In this study, periapical radiographic images were taken from the dental and medical records of patients with mild, moderate, and severe chronic periodontitis in the Dental Hospital of Faculty of Dentistry, Universitas Indonesia. Selected patients were between 25 and 40 years old, whose radiography images were of good quality and the region of interest can be seen and interpreted clearly. This study included 192 samples consisting of 24 dental periapical radiographs of each region. The four regions analyzed were the maxillary and mandibular central incisors and maxillary and mandibular first molars. Radiographic images of the teeth observed were the central incisors and maxillary and mandibular first molars. The incisors and first molars were analyzed because they are prone to bone loss, and maxillary molars have the most apparent periodontitis development.[12-14]

In this study, the distance from the cementoenamel junction (CEJ) to the remaining alveolar bone crest was measured. The inclusion criteria were as follows: patients aged 25–40 years with mild, moderate, and severe chronic periodontitis. The digital periapical intraoral radiographs had good quality. The regions of interest were the I1 and M1 upper teeth and lower teeth that do not experience caries or fillings in the proximal area. The proximal of the teeth were still in contact with the adjacent teeth and could be seen, anatomical landmarks, CEJ and primary bone damage could be clearly seen and interpreted. Tooth surfaces seen are mesial and distal surfaces.

Alveolar bone loss was measured using the Digora Optime for Windows® software (Soredex/Orion Corp., Helsinki, Finland). The first step in measuring the decrease in alveolar bone loss is to determine the CEJ distance between teeth by drawing a line from one tooth to the tooth next to it. Then, the dental axis was determined. In the anterior teeth, measure the line from the highest crown to the apical root. In the posterior teeth, the tooth's axis is determined by drawing a line from the pit to the furcation section (Figure 1). Then, draw a line parallel to the tooth axis from the predetermined CEJ toward the bone damage base.

Alveolar bone loss reduction is measured by calculating the distance between the CEJ to the remaining alveolar bone by two observers. The two observers took two measurements to test the suitability of the alveolar bone loss measurement. A reliability test was carried out through technical error measurement (TEM) using the Dahlberg formula by testing the intra- and interobserver reliability of all data, including alveolar bone loss reduction on periapical radiographs (Table 1). Intraobserver reliability was measured to assess the appropriateness of the observations evaluated by the same observer at different times. Interobserver reliability is measured to determine the reliability of the observational assessment between observers. The Dahlberg formula is obtained by squaring the difference between the first and second measurements and dividing it by twice the number of subjects observed. The square root of the difference in the average square divided by twice the subject can be considered the number of measurement errors, or a Dahlberg error.[15] The tolerance limit of the Dahlberg formula that is still acceptable, or the measurement tolerance, is a TEM of ≤1 mm.[16] To analyze the relationship between alveolar bone loss and age 25–40 years, the average alveolar bone loss on the mesial and distal surfaces was calculated. The age of the patients was divided into two categories with an interval of 8 years: 25–32 years and 33–40 years. After the normality test, the Mann–Whitney U test was chosen to analyze the relationship between the two variables. All statistical analyses were performed using SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA).

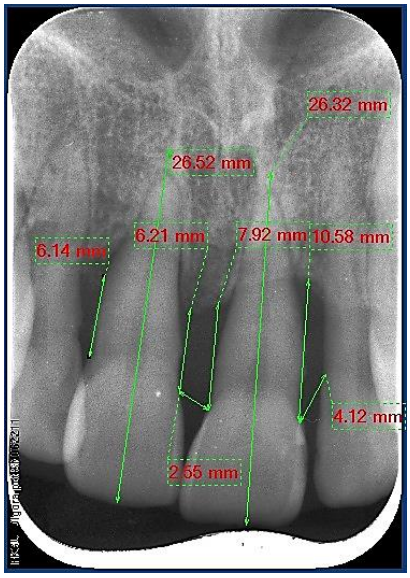


FIGURE 1. Measurement in the anterior and posterior teeth

TABLE 1. Technical error of measurement

Test	Observers	TEM (mm)
Intraobserver reliability	A1 VS A2	0.13
	B1 VS B2	0.41
Interobserver reliability	A1 VS B1	0.51
	A1 VS B2	0.57
	A2 VS B1	0.53
	A2 VS B2	0.45

A = first observer
B = second observer
1 = first observation time
2 = second observation time

RESULTS

The frequency of the sample was distributed equally in each category. In this study, measurements were carried out twice by two observers. In this study, the Dahlberg formula tested the reliability of measurements to get the TEM value. These results indicate that the value is still within the tolerance range of measurement, i.e., ≤1 mm.[15, 16]

As shown in Table 2, 7.98 mm is the highest average decrease in mesial surface alveolar bone loss, which is found in the mandibular central incisors. By contrast, 6.85 mm is the highest mean value of the highest distal alveolar bone loss reduction, which is found in the lower central incisors. The maxillary first molar has a lower mean mesial surface alveolar bone loss with an average of 3.73 mm. Moreover, the smallest mean distal surface alveolar bone loss on the lower first molar was 3.08 mm.

Table 3 shows that the average decrease in the alveolar bone loss on the mesial surface is higher than the average decrease in the alveolar bone loss on the distal surface. The mesial surface has an average value of 5.14 ± 0.31 mm. By contrast, the distal surface has an average value of 4.6 ± 0.26 mm.

Table 4 shows that most periodontitis cases in RSKGM FKG UI are mild, reaching more than half, affecting 98 bone surfaces, or 51% of the total radiograph samples, while moderate periodontitis was found in 40 bone surfaces, or 21% of the total radiograph samples. Severe periodontitis was found in 54 bone surfaces, or 28% of the total radiograph samples.

Table 5 shows the relationship between alveolar bone loss and patient's age (p = 0.044, Mann–Whitney U test). Radiography images were categorized into two according to the age of the patients: age 25–32 years as category 1 and age 33 – 40 years as category 2. The mean and standard deviation for the alveolar bone loss in categories 1 and 2 were 4.03 ± 1.46 mm and 5.23 ± 2.5 mm, respectively. A significant relationship was found between alveolar bone loss and patient's age (p = 0.044, Mann–Whitney U test). With increasing age, the severity of periodontitis also increased.

TABLE 2. Mean values, standard deviations, and minimum and maximum distances according to the teeth

Teeth	Mean ± SD (mm)	Minimum (mm)	Maximum (mm)
Maxillary central incisor			
Mesial	5.13 ± 0.58	2.31	12.94
Distal	3.82 ± 0.40	2.23	10.58
Maxillary first molar			
Mesial	3.73 ± 0.37	2.02	8.35
Distal	4.66 ± 0.55	2.03	15.46
Mandibular central incisor			
Mesial	7.98 ± 0.60	2.08	13.00
Distal	6.85 ± 0.48	2.20	11.33
Mandibular first molar			
Mesial	3.74 ± 0.43	2.14	12.67
Distal	3.08 ± 0.17	2.12	5.48

TABLE 3. Mean values, standard deviations, and minimum and maximum distances according to the surfaces of all teeth examined

Variable	Mean ± SD (mm)	Minimum (mm)	Maximum (mm)
Mesial surface of all teeth	5.14 ± 0.31	2.02	13.00
Distal surface of all teeth	4.60 ± 0.26	2.03	15.46

TABLE 4. Distribution of periodontitis based on the severity of all teeth examined

	Total surface (%)
Mild	98 (51%)
Moderate	40 (21%)
Severe	54 28%)

TABLE 5. Comparison between alveolar bone loss and patient's age category

	Mean ± SD (mm)	*p*
Category I (25–32 years old)	4.03±1.46	0.044*
Category II (33–40 years old)	5.28±2.50	

*Mann–Whitney U test

DISCUSSION

This study found that patients with an 8-year age difference had a significant bone loss of more than 1 mm (Table 5). The strength of this study is related to its use of digital radiography to obtain data. Compared with conventional radiography, digital radiography makes it easier to measure alveolar bone loss because it can zoom in and enhance images. The TEM values between observers are within the tolerance range of measurement. This is possibly due to the use of digital radiography, which is accompanied by the observer's experience in interpreting radiography images. The age range 25–40 years was used to avoid physiological aging because the bone density is at its peak at this age. This condition is caused by the rapid bone formation during puberty, where the bones become more prominent, longer, thicker, and denser. At age 40, the bone formation rate will progressively reduce, resulting in physiological bone loss.[17] A study found no significant difference in bone loss reduction in women <5 and >5 years of menopause and reported a significant relationship between periodontitis and age.[18] Another study of periodontitis involving 1,064 randomized participants (aged 18–95 years, 617 female, 447 male) showed that the risk of periodontitis significantly increased with age (odds ratio = 1.05, 95% confidence interval 1.04–1.06).[19] The results of this study indicate that periodontitis can become more severe with increasing age and can occur at any age. This reinforces the importance of maintaining oral health to prevent periodontitis that worsens with advancing age.[20,21]

Table 2 shows a wide variation in the average alveolar bone loss reduction among the maxillary central incisors, maxillary first molar, mandibular central incisors, and mandibular first molars. The highest average alveolar bone loss is found in the mandibular central incisors at 7.41 mm (standard deviation, 0.39 mm), followed by the maxillary central incisor at 4.47 mm (standard deviation, 0.36 mm), maxillary first molar, and finally mandibular first molar. Previous studies have shown similar results, i.e., among molars, canines, premolars, and incisors, the most severe alveolar bone loss is found in the incisors. This is caused by high deposition of calculus usually found in the lower incisor teeth and maxillary molar[22]. These studies also prove that lower incisor and upper molar teeth have the most plaque accumulation and are at risk for more progressive periodontal disease. The anatomy of the alveolar crest in the mandibular incisors also increased the risk of alveolar bone loss. The anatomy of the alveolar crest is very narrow, making bone damage easier. Concerning root anatomy, which is a predisposition factor for periodontal disease, the mandibular incisors have deeper root concavities than other teeth. Although no significant correlation was found between alveolar bone loss reduction and root concavity, such kind of root anatomy should not be ignored. It can interfere with periodontal instrument access, such as when cleaning subgingival calculus.[23] Alveolar bone loss in the maxillary molars can easily occur because of furcation, i.e., the presence of periodontitis will increase the risk of bone loss.[24] Many studies have reported that periodontitis is most severe in the maxillary molars.[23] However, their findings were not obtained by measuring the highest alveolar bone loss reduction, but by looking at the teeth that are most often lost in adulthood.

Table 3 shows that the mesial surface has an average decrease in alveolar bone height higher than that in the distal surface, where the mesial surface has an average decrease of 5.14 mm (standard deviation, 0.31 mm) and the distal surface has an average decrease of 4.6 mm (standard deviation, 0.26 mm). A previous study also presented the same results.[25] A study on the periodontal disease progression found that, during the study period, bone loss mostly occurred on the mesial surface of the first molar teeth.[25] Unlike the mesial surface, Fukuda *et al*. reported alveolar bone loss on the distal surface. In their study, average alveolar bone loss was found in the lower jaw canine and maxillary first molar. The distal surface of the lower canine was deeper and concave, which caused the differences in results.[22] On the distal surface, the mandibular first molar has smaller and shorter anatomy. These factors can facilitate the retention of plaque and make it difficult to clean because of the difficulty of accessing and passing instruments on its surface.[26] The results of the present study are consistent with those of Fukuda *et al*.[22] and Desai *et al*.[27]: that is, the average alveolar bone loss reduction in the distal surface of the maxillary first molar was higher than that in the mesial surface. In the present study, the average alveolar bone loss reduction in the distal surface of the maxillary first molar was 4.66 mm, while that of the mesial surface was 3.73 mm.

As shown in Table 4, most of the patients in the Dental Hospital Faculty of Dentistry, Universitas Indonesia, experienced mild periodontitis. Mild periodontitis occurred in more than half of the patients (approximately

51%). This is consistent with the results of previous studies conducted on adults and older people in the United States. In that study, two-thirds of the patients (approximately 53.1%, or 56.2 million population) experienced mild periodontitis, while the remaining population had moderate and severe periodontitis.[28] From these data, most of US patients experienced mild periodontitis. This is consistent with the result of the present study. Similarly, Susanto *et al*. revealed that patients with periodontitis in Indonesia experienced a mild course.[29]

This study is limited by the use of radiographic examination itself. Radiographs can overlook approximately 1.4 mm from the actual size in the case of interproximal bone loss and provide a less severe picture than the actual damage[30]; so, the results obtained in this study may differ from the original bone loss reduction measured using surgical techniques. Further studies are needed in the clinical setting. Studies measuring all surfaces of the teeth in the oral cavity by using 3D CBCT radiography are also warranted.

CONCLUSIONS

The mean and standard deviation of alveolar bone loss reduction in patients with chronic periodontitis was 4.87 ± 0.2 mm. In this study, the alveolar bone loss reduction in the mesial surface of the mandibular central incisors was the highest when compared with the mesial and distal surfaces of other teeth.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest concerning the research, authorship, and publication of this article.

FUNDING

The publication of this manuscript is supported by the Directorate of Research and Community Service, University of Indonesia: Publikasi Terindeks Internasional Saintekes (Contract no. NKB-2336/UN2.RST/HKP.05.00/2020).

Received: June 19, 2021 | Accepted: July 17, 2021

REFERENCES

1. Nazir MA. Prevalence of periodontal disease, its association with systemic diseases and prevention. *Int J Health Sci*. 2017;11:72–80.
2. Preshaw PM. Detection and diagnosis of periodontal conditions amenable to prevention. *BMC Oral Health*. 2015;15:S1–5.
3. Tefera A, Bekele B. Periodontal disease status and associated risk factors in patients attending a tertiary hospital in Northwest Ethiopia. *Clin Cosmet Investig Dent*. 2020;12:485–92.
4. Madiba TK, Bhayat A. Periodontal disease–risk factors and treatment options. *S Afr Dent J*. 2018;73:571–5.
5. Saberi BV, Nemati S, Malekzadeh M, Javanmard A. Assessment of digital panoramic radiography's diagnostic value in angular bony lesions with 5 mm or deeper pocket depth in mandibular molars. *Dent Res J*. 2017;14:32–6.
6. Papanou PN, Sanz M, buduneli N, Dietrich T, Feres M, Fine DH, *et al*. Periodontitis: consensus report of workgroup 2 of the 2017 World Workshop on the classification of periodontal and peri-implant diseases and conditions. *J Clin Periodontol*. 2018;45:S162–70.
7. Sanz M, D'Aiuto F, Deanfield J, Fernandez-Avilés F. European workshop in periodontal health and cardiovascular disease-scientific evidence on the association between periodontal and cardiovascular diseases: A review of the literature. *Eur Heart J Suppl*. 2010;12:B3–12.
8. Kiswanjaya B, Yustiania F, Syahraini SI. Age and sex of patients undergoing dental radiologic examinations. *J Int Dent Med Res*. 2020;13:1499–503.
9. Zaki H, Hoffmann KR, Hausmann E, Scannapieco FA. Is radiologic assessment of alveolar crest height useful to monitor periodontal disease activity? *Dent Clin North Am*. 2015;59:859–72.
10. Coli P, Sennerby L. Is peri-implant probing causing over-diagnosis and over-treatment of dental implants? *J Clin Med*. 2019;8:1–13.
11. Garcia-Garcia M, Mir-Mari J, Benic GI, Figueiredo R, Valmaseda-castellon E. Accuracy of periapical radiography in assessing bone level in implants affected by peri-implanitis: Cross-sectional study. *J Clin Periodontol*. 2015;43:85–91.
12. Kjaer I. Can the reduced level of alveolar bone in the initial stages of juvenile periodontitis anterior to the first molar be explained as arrest in alveolar bone growth? *Dent Hypotheses*. 2013;4:44–9.
13. Amado PPP, Kawamoto D, Albuquerque-Souza E, Franco DC, Sraiva L, Casarinet RCV, *et al*. Oral and fecal microbiome in molar-incisor pattern periodontitis. *Front Cell Infect Microbiol*. 2020;10:583761.
14. Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. *J Periodontol*. 2018;89:S159–72.
15. Kim H-Y. Statistical notes for clinical researchers: Evaluation of measurement error 2: Dahlberg's error, Bland-Altman method, and Kappa coefficient. *Restor Dent Endod*. 2013;38:182–5.
16. Nandiasa SR, Kiswanjaya B, Yuniastuti M. Analysis of tooth measurement method accuracy in digital periapical radiograph for personal identification. *J Int Dent Med Res*. 2017;10:9–13.
17. Persson GR. Periodontal complications with age. *Periodontol 2000*. 2018;78:185–94.
18. Sianipar NMC, Sunarto H, Masulili SLC, Kiswanjaya B. Dental radiograph evaluation of the alveolar bone in postmenopausal women. *J Int Dent Med Res*. 2017;10:644–7.

19. Botelho J, Machado V, Proença L, Alves R, Cavacas MA, Amaro L, *et al*. Study of Periodontal Health in Almada-Seixal (SoPHiAS): A cross-sectional study in the Lisbon Metropolitan Area. *Sci Rep*. 2019;9:15538.
20. Nazir M, Al-Ansari A, Al-Khalifa K, Alhareky M, Gaffar B, Almas K. Global prevalence of periodontal disease and lack of its surveillance. *Sci World J*. 2020;2020:2146160.
21. Lorenz SM, Alvarez R, Andrade E, Piccardo V, Francia A, Massa F, *et al*. Periodontal conditions and associated factors among adults and the elderly: Findings from the first National Oral Health Survey in Uruguay. *Cad Saude Publica*. 2015;31:2425–36.
22. Fukuda CT, Carneiro SRS, Alves VTE, Pustiglioni FE, De Micheli G. Radiographic alveolar bone loss in patients undergoing periodontal maintenance. *Bull Tokyo Dent Coll*. 2008;49:99–106.
23. Zhang X, Li Y, Ge Z, Zhao H, Miao L, Pan Y. The dimension and morphology of alveolar bone at maxillary anterior teeth in periodontitis: A retrospective analysis–using CBCT. *Int J Oral Sci*. 2020;12:4.
24. Toledo BEC, Barroso Em, Martins AT, Zuza EP. Prevalence of periodontal bone loss in Brazilian adolescents through interproximal radiography. *Int J Dent*. 2012;2012:357056.
25. Stokland BL. On tooth movements and associated tissue alterations related to edentulous areas and bone defects. *Swed Dent J Suppl*. 2011;214:7–84.
26. Marcaccini AM, Pavanelo A, Nogueira AVB, de Souza JAC, Porciuncula HF, Cirelli JA. Morphometric study of the root anatomy in furcation area of mandibular first molars. *J Appl Oral Sci*. 2012;20:76–81.
27. Desai SR, Shinde HH. Correlation of interdental and interradicular bone loss in patients with chronic periodontitis: A clinical and radiographic study. *Niger J Clin Pract*. 2012;15:125–31.
28. Eke PI, Dye BA, Wei L, Thornton-Evans GO, Genco RJ. Prevalence of periodontitis in adults in the United States: 2009 and 2010. *J Dent Res*. 2012;91:914–20.
29. Susanto H, Nesse W, Dijkstra PU, Agustina D, Vissink A, Abbas F. Periodontitis prevalence and severity in Indonesians with type 2 diabetes. *J Periodontol*. 2011;82:550–7.
30. Vandenberghe B, Jacobs R, Bosmans H. Modern dental imaging: A review of the current technology and clinical applications in dental practice. *Eur Radiol*. 2010;20:2637–55.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 9

8-30-2021

Comparative Analysis of Proteomics Biomarkers Associated with Residual Ridge Resorption Induced by Denture Wear

Rohana Ahmad
Center of Restorative Dentistry Studies, Faculty of Dentistry, Universiti Teknologi MARA, Selangor 47000, Malaysia, drrohana@uitm.edu.my

Ainin Sofia Mohamad Napi
Center of Restorative Dentistry Studies, Faculty of Dentistry, Universiti Teknologi MARA, Selangor 47000, Malaysia, aiiniiin91@gmail.com

Tong Wah Lim
Center of Restorative Dentistry Studies, Faculty of Dentistry, Universiti Teknologi MARA, Selangor 47000, Malaysia, limtongwah@uitm.edu.my

Su Keng Tan
Centre of Oral & Maxillofacial Surgery Studies, Faculty of Dentistry, Universiti Teknologi MARA, 47000, Selangor, Malaysia, tansukeng@uitm.edu.my

Saiful Anuar Karsani
Institute of Biological Science, Faculty of Science, Universiti Malaya, Kuala Lumpur 50603, Malaysia, saiful72@um.edu.my

See next page for additional authors

Comparative Analysis of Proteomics Biomarkers Associated with Residual Ridge Resorption Induced by Denture Wear

Authors

Rohana Ahmad, Ainin Sofia Mohamad Napi, Tong Wah Lim, Su Keng Tan, Saiful Anuar Karsani, Musalmah Mazlan, Lay Kek Teh, Steven M. Morgano, and Nadim Z. Baba

Makara J Health Res. 2021;25(2):128–135
doi: 10.7454/msk.v25i2.1273

Makara Journal of Health Research

Comparative Analysis of Proteomics Biomarkers Associated with Residual Ridge Resorption Induced by Denture Wear

Rohana Ahmad[1,2*], Ainin Sofia Mohamad Napi[1], Tong Wah Lim[1], Su Keng Tan[3], Saiful Anuar Karsani[4], Musalmah Mazlan[5], Lay Kek Teh[2], Steven M. Morgano[6], Nadim Z. Baba[7]

[1]Center of Restorative Dentistry Studies, Faculty of Dentistry, Universiti Teknologi MARA, Selangor 47000, Malaysia

[2]Integrative Pharmacogenomics Institute, Universiti Teknologi MARA, Selangor 42300, Malaysia

[3]Centre of Oral & Maxillofacial Surgery Studies, Faculty of Dentistry, Universiti Teknologi MARA, 47000, Selangor, Malaysia

[4]Institute of Biological Science, Faculty of Science, Universiti Malaya, Kuala Lumpur 50603, Malaysia

[5]Institute of Medical Molecular Biotechnology, Faculty of Medicine, Universiti Teknologi MARA, Selangor 47000, Malaysia

[6]Department of Restorative Dentistry, Rutgers School of Dental Medicine, New Jersey 07103, United States

[7]Advanced Education Program in Implant Dentistry, School of Dentistry, Loma Linda University, California 92350, United States

Abstract

Background: The biochemical bone turnover markers for residual ridge resorption (RRR) are unclear. Therefore, the present study aimed to determine the biochemical bone turnover markers associated with RRR by comparing proteomics between the compressed mucosa of denture wearers and the non-compressed mucosa of non-denture wearers.

Methods: The mucosal specimens of 11 complete-denture wearers were obtained from the alveolar ridge during surgical implant exposure for implant-retained overdentures. All denture wearers had been edentulous and worn dentures for at least 5 years. The tissues of 11 non-denture wearers were taken from the ridge during minor preprosthetic surgery. The mucosal proteins were extracted, purified, precipitated, and subsequently separated by two-dimensional gel electrophoresis for comparative proteomics. Differentially expressed proteins between the groups were analyzed by ANOVA using Progenesis SameSpots software.

Results: Comparative proteomics analysis showed significant upregulation of 78 kDa glucose-regulated protein (GRP78; +2.2 fold, $p = 0.015$) and lumican (+1.8 fold, $p = 0.005$), as well as significant downregulation of heat shock protein 27 (HSP27; −1.9 fold, $p = 0.029$) in the denture group.

Conclusions: Differential expression of the biochemical bone turnover markers of GRP78, lumican, and HSP27 may occur as a result of denture pressure on the mucosa. These markers may play important roles in RRR.

Keywords: bone resorption, dentures, mouth mucosa, proteomics

INTRODUCTION

A removable denture is a successful form of treatment and will continue to be the mainstay of prosthodontic care for partially dentate and edentulous patients as the proportion of the elderly population increases worldwide.[1] Despite their clear benefits, however, dentures resting on the mucosa are often associated with increased rates of residual ridge resorption (RRR).[2–4] The biomechanics of how pressure from denture compression on the mucosa causes increased hydrostatic pressure, which, in turn, leads to hypoxia and subsequent RRR, is quite clear.[5–8] However, the biological reactions induced by mechanical stresses and the mechanobiology related to RRR are less well understood in comparison with the mechanobiology of periodontal bone resorption[9] or orthodontic tooth movement with the accompanying bone resorption and deposition.[10–12] The mechanical stimulus provided by the denture base has been shown to increase localized bone metabolism,[13–14] but the expression of the corresponding biochemical bone turnover markers has not been adequately studied.[15–17] Knowledge of the biomarkers involved in RRR is important to enhance the understanding of the mechanism of RRR and facilitate its diagnosis, improve RRR risk assessment and treatment strategies to minimize RRR, reduce the frequency of denture relines, and improve treatment outcomes.

Puri *et al*.[17] reported a significant correlation between the frequency of complete-denture relines and the concentration of serum bone turnover biomarkers of C-terminal telopeptide and osteocalcin. The authors thus proposed that serum bone turnover markers may predict individuals at risk of frequent complete-denture relines because of rapid RRR. Because RRR is essentially a

***Corresponding author:**
Rohana Ahmad
Centre of Restorative Dentistry Studies, Faculty of Dentistry, Universiti Teknologi MARA, Selangor, Malaysia
E-mail: drrohana@uitm.edu.my

localized phenomenon, the mucosa underneath the denture could be an excellent source of bone turnover markers. Cells in the underlying mucosa have been shown to secrete heat shock protein 70 (HSP70),[15] vascular endothelial growth factor (VEGF),[15] and prostaglandins in response to hypoxic stress caused by increased hydrostatic pressure from denture compression in animal models.[16] Increases in hydrostatic pressure could also cause irreversible damage to the osteocytes or a disturbance in the composition of the interstitial fluid, which, in turn, could affect osteoblastic and osteoclastic functions.[18,19] Hydrostatic pressure has been correlated with RRR,[4,6] but little is known about the differentially expressed proteins or proteomic changes resulting from RRR induced by denture compression on the mucosa.

This study was undertaken to identify differentially expressed proteins between the compressed and non-compressed mucosa of denture and non-denture wearers. This study used two-dimensional polyacrylamide gel electrophoresis (2D-PAGE) and matrix-assisted laser desorption-ionization time-of-flight mass spectrophotometry (MALDI-ToF/ToF MS) peptide mass fingerprinting for protein identification. We hypothesized that the pressure exerted by the denture on the mucosa would stimulate localized bone metabolism and cause proteins related to bone resorption and deposition to be differentially expressed. Our null hypothesis is that no difference in protein expression would be observed between compressed and non-compressed mucosa. This study could provide preliminary insights into the proteomic changes related to RRR induced by denture wearing, which may potentially be used as biomarkers for RRR.

METHODS

Ethics statement

This study was approved by the Research Ethics Committee of Universiti Teknologi MARA, Malaysia (600-RMI [5/1/6] 30 Nov. 2015). The clinical study was conducted at the Faculty of Dentistry, and the proteomic work was performed at the Institute for Medical Molecular Biotechnology, Faculty of Medicine. The participants were informed of the objectives of the study, and written consent was obtained.

Participant recruitment

In this case-control study, 11 complete-denture patients undergoing implant treatment for implant-retained overdentures were recruited as the test group. This sample size represents the total number of eligible edentulous patients attending the implant clinic within a 6-month recruitment period. The exclusion criteria were uncontrolled diabetes, irradiated jaw, medical conditions that may contraindicate surgical procedures, smoking, psychiatric treatment, or a history of substance abuse. All edentulous patients had had multiple sets of dentures and had been edentulous for at least 5 years. The control group comprised 11 partially edentulous patients who had not worn any dentures to replace their missing teeth and had come for preprosthetic surgery to remove either multiple non-restorable teeth, an impacted tooth, buried or fractured roots, a torus, or bony spicules on the ridge. Patients in this group consented to tissue specimen collection within the same recruitment period.

For the test group, mucosal tissues measuring approximately 4 mm in diameter and 1 mm in thickness were obtained from the ridge crest with a tissue punch (Tissue Punch RP, Nobel Biocare, Kloten, Switzerland)) during the surgical exposure of the implants. For the control group, mucosal tissues of a similar size were obtained from the edentulous ridge at the surgical site. The tissues were kept in mammalian protein extraction reagent (MPER) buffer in microcentrifuge tubes and stored at −80 °C until use.

Protein preparation

Proteins from the mucosal tissues were extracted using a grinder (ReadyPrep Mini Grinder, Bio-Rad Laboratories), and ultrasonically homogenized (Omni-Ruptor 4000, Omni International Inc.) in MPER buffer in an ultrasonic homogenizer. Proteins were extracted by sonication for over 4 h at 4 °C. The samples were centrifuged at ~16000 ×g for 30 min at 4 °C.

The protein concentration in the clear extract was measured by using a bicinchoninic acid protein assay kit (Thermo Scientific). First-dimension isoelectric focusing (IEF) was then performed to separate the proteins according to their isoelectric point difference by using precast 7 cm-long immobilized pH gradient (IPG) strips (Ready Strip IPG Strip 3-10 NL, Bio-Rad Laboratories). The protein specimens were loaded onto focusing trays (PROTEAN IEF Focusing Tray, Bio-Rad Laboratories) containing 300 µL of a mixture of rehydration buffer (7M urea, 2M thiourea, 4% CHAPS, 100 mM DTT, 0.2% carrier ampholyte [pH 3–10], trace of bromophenol blue), and sample buffer containing 160 µg of protein. After in-gel rehydration at 20 °C for 12 h, the proteins were focused at 250 V with a linear ramp for 20 mins, 4000 V with a linear ramp for 2 h, 8000 V with a rapid ramp for 2 h, and 10000 V with a rapid ramp for 6 h. Immediately after IEF, the IPG strips were equilibrated in the first equilibration buffer (6 M urea, 2% SDS, 375 mM Tris-HCl [pH 8.8], 20% glycerol, 2% [w/v] DTT) for 15 min and then in the second equilibration buffer (6 M urea, 2% SDS, 375 mM Tris-HCl [pH 8.8], 20% glycerol, 2.5% [w/v] iodoacetamide) for another 15 min. After rinsing with 1× Tris–glycine–SDS running buffer, the IPG strips were placed on 12% SDS-PAGE gels and sealed with 1% agarose (low-melt agarose, Sigma-Aldrich).

Second-dimension SDS-PAGE was conducted in a Mini-PROTEAN cell at 100 V for 0.5 h, followed by

electrophoresis at 200 V until the bromophenol blue front reached the bottom of the gels. The protein spots on the gels were fixed and visualized by staining with Coomassie blue R-250 and scanned using a Molecular Imager GS 800 Calibrated Densitometer (Bio-Rad Laboratories) with PD Quest software (Bio-Rad Laboratories). The gel images were analyzed using Progenesis SameSpots software (Nonlinear Dynamics). The gels of each group were pooled, and patterns reflecting differential expression were determined by spot-matching and assessed by principal component and correlation analyses. Mean differences were considered statistically significant at $P < 0.05$ and ≥ 1.5-fold variation. Significantly different protein spots were then subjected to tryptic digestion according to the protocols described by Shevchenko *et al*.[20] The gel spots were destained overnight via incubation in 50% acetonitrile and 50 mM ammonium bicarbonate. Each gel spot was then reduced using 10 mM dithiothreitol and alkylated using 55 mM iodoacetamide in 100 mM ammonium bicarbonate. Following trypsin (Promega, Thermo Fisher Scientific) digestion for 18 h at 37 °C, the peptides were recovered and extracted from the sliced gels using 5% formic acid and 50% acetonitrile. After extraction, the peptides were dehydrated with 100% acetonitrile and dried in a vacuum concentrator (SpeedVac, Thermo Scientific, Savant DNA 120) for 3 h. Trypsin (final concentration, 7 ng/μL) in 50 mM ammonium bicarbonate was digested at 37 °C for 18 h. The peptides were subsequently recovered and extracted from the sliced gels by using 5% formic acid and 50% acetonitrile. The peptides were then solubilized with 10–20 μL of 0.1% formic acid, desalted with ZipTip C18 (Millipore), and then stored at −80 °C until MALDI-ToF/ToF MS for comparative proteomics.

Comparative proteomics by MALDI-ToF/ToF MS

Each of the excised gel plugs, which represent an individual protein from the gels, was analyed by MALDI-ToF/ToF MS on a 5800 System (ABSciex, Framingham, USA). A matrix consisting of a saturated α-cyano-4-hydroxycinnamic acid solution (Sigma-Aldrich, Malaysia) prepared from 50% acetonitrile/0.1% trifluoroacetic acid was mixed with peptide specimens at a 1:1 ratio. Subsequently, 0.7 μL of each specimen was spotted onto the target plates. The specimens spread and evaporated rapidly. The mass spectra of the peptides were acquired in positive-ion reflector mode, and default peak calibration was implemented for the MS/MS spectra. The precursor ion was selected from the mass spectra. Fragmentation was subsequently performed for the top 20 most abundant precursor ions using high-energy collision induced dissociation (CID). The collision energy was set to 1 keV, and air was used as the collision gas. The criterion for precursor selection was a minimum signal-to-noise ratio of 5. Mass accuracy was within 50 ppm for the mass measurements and within 0.1 Da for the CID experiments.

The list of peptide masses obtained was matched with the Swiss-Prot protein database. Peaks from trypsin auto-proteolysis and known contaminants, such as keratin, were discarded in the database searches. Global Protein Server Explorer 3.6 software (Applied Biosystems), which uses an internal MASCOT (Matrix Science) program to match MS and MS/MS data against database information, was used to process and analyze the peaks generated from the protein spectra. MS profiles were used by the search engines to identify proteins from the primary sequence databases, and the data were screened against the latest human databases, which were downloaded from the Swiss-Prot/TrEMBL homepage (http://www.expasy.ch/sprot).

RESULTS

Demographic data

The participants in the denture group consisted of four males and seven females with ages ranging from 52 years to 79 years (mean, 62 years). These patients had been wearing complete dentures for at least 3 months, and some have had multiple sets of dentures. The control group comprised three males and eight females, with ages ranging from 30 years to 62 years (mean, 49 years).

Mucosal protein profile analysis

Differentially expressed protein spots were visualized by Coomassie brilliant blue staining. Figure 1 shows the difference in 2D gel maps obtained between the denture and non-denture groups. Data analysis was performed using Progenesis SameSpots software. Proteins showing statistically significant differential expression with $p \leq 0.05$ (ANOVA) as the significance threshold and minimum fold-change ≥1.5 fold were selected for in-gel trypsin digestion. MALDI-ToF/ToF MS was then conducted for protein identification. A total of 11 gels from each group were analyzed, and 1 gel was selected as the representative gel.

Comparison of the results of the control and test groups yielded a total of seven statistically significant spots: three upregulated spots and four downregulated spots. These seven spots were excised, analyzed using MALDI-ToF/ToF and identified using the MASCOT search engine against the entries of *Homo sapiens* in the Swiss-Prot database. The spots indicated by black circles in the 2D master map obtained from the analysis were developed as shown in Figure 2. In the denture group, lumican (+1.7 fold, $P = 0.026$), 78 kDa glucose-related protein (GRP78; +2.1 fold, $P = 0.024$), and serum albumin (+1.8 fold, $P = 0.028$) showed significant upregulation in the denture group (Table 1). Downregulation of the expression of hemoglobin subunit beta (HBB; +1.9 fold, $P = 0.010$), (HSP27; +1.9 fold, $P = 0.016$), and Ig gamma-1 chain C region (IGHG1) (+1.9 fold, $P = 0.036$ and +3.9 fold, $P = 0.042$) was also observed in the denture group. The two IGHG1 proteins identified in this study represent IGHG1 isoforms with different isoelectric

points and molecular masses. Lumican, GRP78, and HSP27 are known proteins associated with bone remodeling. Serum albumin, HBB, and IGHG1 are common proteins found in abundance in serum and non-target proteins from the biomarker perspective.[21]

DISCUSSION

This study compared differentially expressed proteins between the compressed and non-compressed mucosa of denture and non-denture wearers. The null hypothesis was rejected. The results revealed significant upregulation of lumican and GRP78, which are proteins involved in bone resorption, as well as significant downregulation of HSP27, a protein involved in bone deposition, in the denture group. This finding supports the hypothesis that the pressure exerted by the denture on the mucosa could cause differential expression in some proteins related to bone resorption and deposition. However, this finding should be interpreted with caution because the number of patients involved is quite small and the age groups were not similar. The dissimilarity in age groups in this study is due to the difficulty of recruiting healthy edentulous participants suitable for implant overdenture treatment. Diabetes is highly prevalent in the Malaysian population,[22] and uncontrolled diabetes is a contraindication for dental implants.[23] Difficulties in recruiting age-matched participants with healthy periodontia for the control group (diabetes is also associated with periodontitis) were also encountered;[24] thus, participants in the control group were generally younger than those in the test group. Patients with periodontitis were excluded to avoid false-positive results because some biomarkers related to bone remodeling induced by mechanical pressure are also inflammatory cytokines, such as IL-6 and TNF-α, which are similarly expressed in periodontitis.[7,25–27]

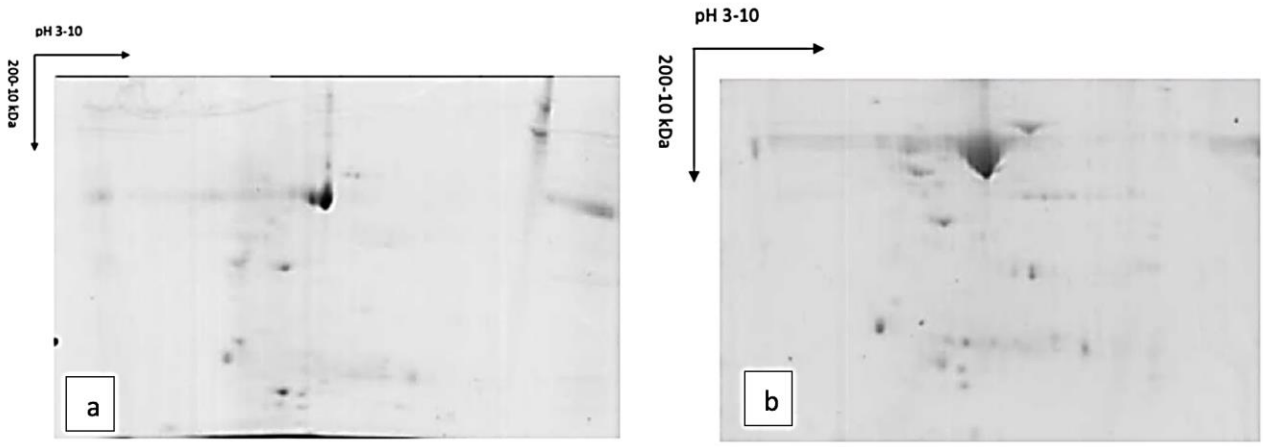


FIGURE 1. Representative 2D gels (pH 3–11) of the non-denture (a) and denture (b) groups. Approximately 160 µg of proteins was initially separated by a linear pH of 3–10, followed by separation on SDS-PAGE gels (12%) and Coomassie blue staining

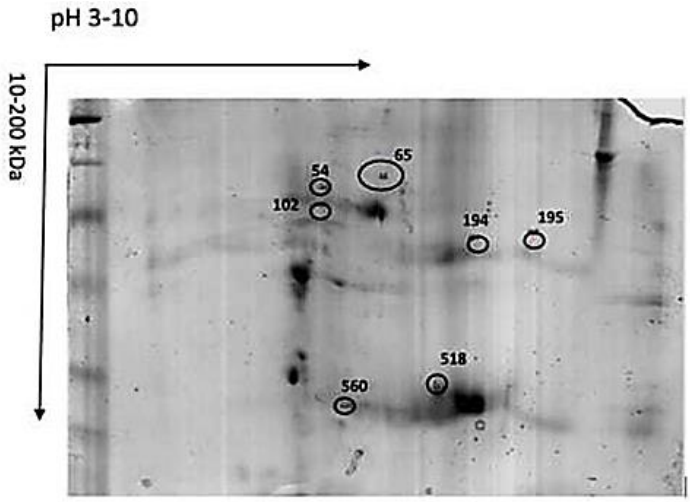


FIGURE 2. Representative 2-DE gel map of tissue proteins for spot excision and protein identification by using Progenesis SameSpots software. Black circles highlight protein spots reflecting statistically significant differences

TABLE 1. Differentially expressed tissue proteins observed among complete-denture wearers

Spot No	Identified Protein	Accession Number	Calculated pI value	Nominal Mass (Mr)	Number of Matched Peptides	Sequence Coverage (%)	Fold Change	Mascot Score	*p*	General Function
518	Hemoglobin subunit beta	HBB_HUMAN	6.75	16102	11	62	1.9	471	0.010	Oxygen transport
560	Heat Shock Protein 27	HSPB1_HUMAN	5.98	22826	11	34	1.9	323	0.016	Molecular chaperone
54	78 kDa glucose-related protein	GRP78_HUMAN	5.07	72402	21	21	2.1	355	0.024	Protein folding
102	Lumican	LUM_HUMAN	6.16	38747	4	6	1.7	104	0.026	Collagen binding
65	Serum albumin	ALBU_HUMAN	5.92	71317	7	6	1.8	208	0.028	Blood colloidal osmotic pressure regulation
194	Ig gamma-1 chain C region	IGHG1_HUMAN	8.46	36596	6	10	1.9	128	0.036	Immune response
195	Ig gamma-1 chain C region	IGHG1_HUMAN	8.46	36596	2	3	3.9	73	0.041	Immune response

Lumican belongs to the family of small leucine-rich proteoglycans known to regulate collagen fibril organization to promote tissue healing,[28] maintain extracellular bone matrix homeostasis, and enrich bone mineralization.[29] Lumican promotes collagen organization when induced by pressure[30] and stimulates the expression of transforming growth factor-β, which has been shown to be highly expressed under mechanical loading.[31,32] We believe that a similar phenomenon occurs in the mucosal tissue underneath the denture due to pressure from denture loading, resulting in the high expression of lumican observed in the current study. Lumican has been shown to mediate cartilage destruction and upregulate macrophages and inflammation;[33] it is also known to be highly expressed in degenerative changes of the temporomandibular joint.[34] The protein has been reported to play an osteoprotective role during bone metabolism and represents a dual-action therapeutic target for osteoporosis.[35] Lumican inhibits osteoclast differentiation and in vitro bone resorption and could affect most stages of osteoclastogenesis by suppressing Akt activity. In our study, lumican was upregulated in denture-wearing patients. We thus hypothesize that changes in lumican may represent a form of feedback to increases in bone formation and decreases in bone resorption.

GRP78 belongs to the family of high-molecular weight HSP70. HSP70 is also known as endoplasmic reticulum (ER) chaperone binding immunoglobulin protein (BiP) and heat shock 70 kDa protein 5 (HSPA5). GRP78/BiP is a major Ca^{2+}-binding protein in the ER, modulates the unfolding protein response (UPR), facilitates protein assembly in the ER, regulates calcium homeostasis, and protects cells from ER stress.[36–40] ER stress is a condition caused by the accumulation of unfolded proteins in the ER lumen as a result of endogenous and exogenous factors, such as hypoxia, starvation, oxidative stress, and protein synthesis overload.[41] The increased GRP78 expression observed in the current study may be attributed to hypoxia resulting from tissue compression underneath the denture, which could cause ER stress. Sensing stress, ER activates UPR through the activation of transcription factor 6, pancreatic ER kinase, and serine/threonine-protein kinase/endoribonuclease inositol-requiring protein-1α pathways.[42,43] These pathways upregulate GRP78, induce RANKL, and activate osteoclastogenesis.[44] Bone destruction that occurs during periodontitis could be caused by the excessive activation of osteoclasts or osteoclastogenesis. Osteoclastogenesis is regulated by RANKL-produced osteoblasts and osteocytes, and activation of this process causes bone resorption, as observed by the upregulated expression of GRP78 in denture wearers in this study.

HSPs are major proteins expressed in various tissues and organs as a result of mechanical load[15] and cytotoxic stress.[45] HSP's are induced not only by heat shock but also by various pathological changes, such as ischemia, infection, and inflammation.[46,47] HSP's are involved in the regulation of cell function and defense and responses to cell injury.[48,49] HSP27, HSP70, and HSP90 have been

reported to induce bone resorption, but their mechanisms of action have yet to be established.[15,50,51] During orthodontic treatment, significant expression of HSP27 may be triggered on the tension side after induction of a mechanical load; the protein then acts as a molecular chaperone for osteoblastic activation. Bone is formed on the tension side in the presence of active osteoblasts and resorbed on the compressive side where osteoblasts are unstimulated, thus creating progressive tooth movement.[12] These findings are in agreement with the downregulation of HSP27 observed in the present study. Because the tissue underneath dentures is in a compressive state, the pressure exerted by the prosthetic may lead to the resorption of bones observed in the patients.

Other than HSP27, which belongs to the same family of HSP70 that was previously found in the compressed mucosa of a rat model,[15] other proteins previously reported in bone resorption associated with denture wear, such as VEGF,[15] prostaglandin,[16] osteocalcin,[17] and C-terminal telopeptide,[17] were not observed to be differentially expressed in this work. This finding may be the result of differences in the specimens used for analysis (e.g., tissues versus serum) and sampling time points, which may represent different stages of inflammation. In addition, because pooled specimens were used in this study, dilution of low-abundance proteins in the specimens may have occurred. Validation of the identified proteins and specificity/sensitivity analyses could not be performed because of the limited amount of specimens collected from each patient. Future studies may collect larger amounts of specimens and perform individual analysis to allow identification of specific proteins as biomarkers. Specificity and sensitivity tests and receiver operating characteristic curves should also be analyzed to ensure the accuracy and replicability of the method used in the current study.

CONCLUSIONS

The results of our proteomics analyses suggest that soft-tissue proteomic profiling may potentially differentiate between non-compressed and compressed tissues; therefore, studying tissue proteins based on these profiles may provide some insights into the bone resorption mechanism of denture wear. The observation of differentially expressed proteins, such as lumican, GRP78, and HSP27, in the mucosa is likely a result of hypoxia and ER stress originating from tissue compression due to wearing mucosal-borne removable dentures.

CONFLICT OF INTEREST

None declared.

FUNDING

This work was supported by the Universiti Teknologi MARA Malaysia under REI Grant No. 600-RMI/DANA 5/3 REI (11/2015).

Received: May 30, 2021 | Accepted: July 1, 2021

REFERENCES

1. United Nations Population Division. *The 2019 Revision of World Population Prospects*. New York: United Nations Population Division, 2019.
2. Ahmad R, Abu-Hassan MI, Li Q, Swain MV. Three-dimensional quantification of mandibular bone remodeling using Standard Tessellation Language registration-based superimposition. *Clin Oral Implants Res*. 2013;24:1273–9.
3. Alsrouji MS, Ahmad R, Rajali A, Mustafa N, Ibrahim N, Baba N. Mandibular implant-retained overdentures: Potential accelerator of bone loss in the anterior maxilla? *J Prosthodont*. 2019;28:764–70.
4. Alsrouji MS, Ahmad R, Razak NHA, Shuib S, Kuntjoro W, Baba N. Premaxilla stress distribution and bone resorption induced by implant overdenture and conventional denture. *J Prosthodont*. 2019;28:131–7.
5. Chen J, Ahmad R, Swain MV, Suenaga H, Li W, Li Q. A comparative study on complete and implant retained denture treatments: A biomechanics perspective. *J Biomech*. 2015;48:512–19.
6. Chen J, Ahmad R, Li W, Swain MV, Li Q. Biomechanics of oral mucosa. *J R Soc Interface*. 2015;12:1–20.
7. Ahmad R, Chen J, Abu-Hassan MI, Li Q, Swain MV. Investigation of mucosa-induced residual ridge resorption between implant-retained overdenture and complete denture. *Int J Oral Maxillofac Implants*. 2015;30:657–66.
8. Alsrouji MS, Ahmad R, Kuntjoro W, Ibrahim N, Al-Harbi FA, Baba N. Blood flow alterations in the anterior maxillary mucosa as induced by implant-retained overdenture. *J Prosthodont*. 2019;28:373–8.
9. Kook SH, Son YO, Choe Y, Kim JH, Jeon YM, Heo JS, *et al*. Mechanical force augments the anti-osteoclastogenic potential of human gingival fibroblasts in vitro. *J Periodontal Res*. 2009;44:402–10.
10. Krishnan V, Davidovitch Z. Cellular, molecular, and tissue - level reactions to orthodontic force. *Am J Orthod Dentofacial Orthop*. 2006;129:469.e1–32.
11. Alfaqeeh SA, Anil S. Osteocalcin and N‐telopeptides of type I collagen marker levels in gingival crevicular fluid during different stages of orthodontic tooth movement. *Am J Orthod Dentofacial Orthop*. 2011;139:e553–9.
12. Muraoka R, Nakano K, Kurihara S, Yamada K, Kawakami T. Immunohistochemical expression of heat shock proteins in the mouse periodontal tissues due to orthodontic mechanical stress. *Eur J Med Res*. 2010;15:475.
13. Suenaga H, Chen J, Yamaguchi K, Sugazaki M, Li W, Swain MV, *et al*. Bone metabolism induced by denture insertion

in positron emission tomography. *J Oral Rehabil*. 2016;43:198–204.
14. Suenaga H, Chen J, Yamaguchi K, Li W, Sasaki K, Swain MV, *et al*. Mechanobiological bone reaction quantified by positron emission tomography. *J Dent Res*. 2015;94:738–44.
15. Tsuruoka M, Ishizaki K, Sakurai K, Matsuzaka K, Inoue T. Morphological and molecular changes in denture-supporting tissues under persistent mechanical stress in rats. *J Oral Rehabil*. 2008;35:889–97.
16. Nishimura I, Szabo G, Flynn E, Atwood DA. A local pathophysiologic mechanism of the resorption of residual ridges: Prostaglandin as a mediator of bone resorption. *J Prosthet Dent*. 1988;60:381–8.
17. Puri S, Kattadiyil MT, Puri N, Hall SL. Evaluation of correlations between frequencies of complete denture relines and serum levels of 3 bone metabolic markers: A cross-sectional pilot study. *J Prosthet Dent*. 2016;116:867–73.
18. Klein-Nulend J, Bakker AD, Bacabac RG, Vatsa A, Weinbaum S. Mechanosensation and transduction in osteocytes. *Bone*. 2013;54:182–90.
19. Burger EH, Klein-Nulend J. Responses of bone cells to biomechanical forces in vitro. *Adv Dent Res*. 1999;13:93–8.
20. Shevchenko A, Tomas H, Havliš J, Olsen JV, Mann M. In-gel digestion for mass spectrometric characterization of proteins and proteomes. *Nat Protoc*. 2007;1:2856–60.
21. Kraus, V.B. Biomarkers as drug development tools: discovery, validation, qualification and use. *Nat Rev Rheumatol*. 2018;14:354–62.
22. Hussein Z, Taher SW, Gilcharan Singh HK, Chee Siew Swee W. Diabetes care in Malaysia: problems, new models, and solutions. *Ann Glob Health*. 2015;81:851–62.
23. Naujokat H, Kunzendorf B, Wiltfang J. Dental implants and diabetes mellitus–A systematic review. *Int J Implant Dent*. 2016;2:5.
24. Wu CZ, Yuan YH, Liu HH, Li SS, Zhang BW, Chen W, *et al*. Epidemiologic relationship between periodontitis and type 2 diabetes mellitus. *BMC Oral Health*. 2020;20:204.
25. Sanuki R, Mitsui N, Suzuki N, Koyama Y, Yamaguchi A, Isokawa K, *et al*. Effect of compressive force on the production of prostaglandin E (2) and its receptors in osteoblastic Saos-2 cells. *Connect Tissue Res*. 2007;48:246–53.
26. Maeda A, Soejima K, Bandow K, Kuroe K, Kakimoto K, Miyawaki S, *et al*. Force-induced IL-8 from periodontal ligament cells requires IL-1beta. *J Dent Res*. 2007;86:629–34.
27. Yamamoto T, Kita M, Kimura I, Oseko F, Terauchi R, Takahashi K, *et al*. Mechanical stress induces expression of cytokines in human periodontal ligament cells. *Oral Dis*. 2006;12:171–5.
28. Neame PJ, Kay CJ, McQuillan DJ, Beales MP, Hassell JR. Independent modulation of collagen fibrillogenesis by decorin and lumican. *Cell Mol Life Sci*. 2000;57:859–63.
29. Florencio-Silva R, Sasso GRDS, Sasso-Cerri E, Simões MJ, Cerri PS. Biology of bone tissue: Structure, function, and factors that influence bone cells. *BioMed Res Int*. 2015:421746.
30. Engebretsen KVT, Lunde IG, Strand ME, Waehre A, Sjaastad I, Marstein HS, *et al*. Lumican is increased in experimental and clinical heart failure, and its production by cardiac fibroblasts is induced by mechanical and proinflammatory stimuli. *FEBS J*. 2013;280:2382–98.
31. Klein-Nulend J, Roelofsen J, Sterck JG, Semeins CM, Burger EH. Mechanical loading stimulates the release of transforming growth factor-beta activity by cultured mouse calvariae and periosteal cells. *J Cell Physiol*. 1995;163:115–9.
32. Utsunomiya T, Ishibazawa A, Nagaoka T, Hanada K, Yokota H, Ishii N, *et al*. Transforming growth factor-β signaling cascade induced by mechanical stimulation of fluid shear stress in cultured corneal epithelial cells. *Invest Opthalmol Vis Sci*. 2016;57:6382.
33. Clements DN, Fitzpatrick N, Carter SD, Day PJR. Cartilage gene expression correlates with radiographic severity of canine elbow osteoarthritis. *Vet J*. 2009;179:211–8.
34. Ernberg M. The role of molecular pain biomarkers in temporomandibular joint internal derangement. *J Oral Rehabil*. 2017;44:481–91.
35. Lee JY, Kim DA, Kim EY, Chang EJ, Park SJ, Kim BJ. Lumican Inhibits Osteoclastogenesis and Bone Resorption by Suppressing Akt Activity. *Int J Mol Sci*. 2021;22:4717.
36. Kim JH, Kim K, Kim I, Seong S, Nam KI, Kim KK, *et al*. Endoplasmic reticulum-bound transcription factor CREBH stimulates RANKL-induced osteoclastogenesis. *J Immunol*. 2018;200:1661–70.
37. Cuevas EP, Eraso P, Mazón MJ, Santos V, Moreno-Bueno G, Cano A, *et al*. LOXL2 drives epithelial-mesenchymal transition via activation of IRE1-XBP1 signalling pathway. Scientific Reports. 2017;7:44988.
38. Dana RC, Welch WJ, Deftos LJ. Heat shock proteins bind calcitonin. *Endocrinology*. 1990;126:672–4.
39. Evensen NA, Kuscu C, Nguyen HL, Zarrabi K, Dufour A, Kadam P, *et al*. Unraveling the role of KIAA1199, a novel endoplasmic reticulum protein, in cancer cell migration. *J Natl Cancer Inst*. 2013;105:1402–16.
40. Oka OB, Pringle MA, Schopp IM, Braakman I, Bulleid NJ. ERdj5 is the ER reductase that catalyzes the removal of non-native disulfides and correct folding of the LDL receptor. *Mol Cell*. 2013;50:793–804.
41. Rashid HO, Yadav RK, Kim HR, Chae HJ. ER stress: Autophagy induction, inhibition and selection. *Autophagy*. 2015;11:1956–77.
42. Tohmonda T, Yoda M, Iwawaki T, Matsumoto M, Nakamura M, Mikoshiba K, *et al*. IRE1α/XBP1-mediated branch of the unfolded protein response regulates osteoclastogenesis. *J Clin Invest*. 2015;125:3269–79.
43. Mahdi AA, Rizvi SHM, Parveen A. Role of endoplasmic reticulum stress and unfolded protein responses in health and diseases. *Indian J Clin Biochem*. 2016;31:127–37.
44. Wang K, Niu J, Kim H, Kolattukudy PE. Osteoclast precursor differentiation by MCPIP via oxidative stress, endoplasmic reticulum stress, and autophagy. *J Mol Cell Biol*. 2011;3:360–8.
45. Dubey A, Prajapati KS, Swamy M, Pachauri V. Heat shock proteins: a therapeutic target worth to consider. *Vet World*. 2015;8:46–51.

46. Maeda T, Kameda T, Kameda A. Loading of continuously applied compressive force enhances production of heat shock protein 60, 70 and 90 in human periodontal ligament-derived fibroblast-like cells. *J Jpn Orthod Soc*.1997;56:296–302.
47. Okazaki M, Shimizu Y, Chiba M and Mitani H. Expression of heat shock proteins induced by cyclical stretching stress in human periodontal ligament fibroblasts. *Tohoku Univ Dent J*. 2000;19:108–15.
48. Ranek MJ, Stachowski MJ, Kirk JA, Willis MS. The role of heat shock proteins and co-chaperones in heart failure. *Philos Trans R Soc Lond B Biol Sci*. 2018;373:20160530.
49. Arrigo AP, Landry J. Expression and function of the low molecular weight heat shock proteins. In Morimoto RI, Tissières A, Georgopoulos C. Eds. *The Biology of Heat Shock Proteins and Molecular chaperones*. Cold Spring Harbor Laboratory Press; 1994. P.335–73.
50. Dubrez L, Causse S, Borges Bonan N, Dumétier B, Garrido C. Heat-shock proteins: Chaperoning DNA repair. *Oncogene*. 2020;39:516–29.
51. Nair SP, Meghji S, Reddi K, Poole S, Miller AD, Henderson B. Molecular chaperones stimulate bone resorption. *Calcified Tissue Int*. 1999;64:214–8.

Makara Journal of Health Research

Volume 25
Issue 2 *August*

Article 10

8-31-2021

A Convergent Parallel Study on Knowledge, Perceptions, and Attitudes of Mainstream Workers during COVID-19

Farhan Alshammari
College of Nursing, University of Hail, Hail City 2240, Saudi Arabia, f.alshammari@uoh.edu.sa

Romeo Mostoles Jr
College of Nursing, University of Hail, Hail City 2240, Saudi Arabia, r.mostoles@uoh.edu.sa

Eddieson Pasay-an
College of Nursing, University of Hail, Hail City 2240, Saudi Arabia, edspasayan@yahoo.com

Sultan Alshammari
Ministry of Health, Hail City, Kingdom of Saudi Arabia, s.alshammari@moh.sa

Makara J Health Res. 2021;25(2):136–145
doi: 10.7454/msk.v25i2.1276

Makara Journal of Health Research

A Convergent Parallel Study on Knowledge, Perceptions, and Attitudes of Mainstream Workers during COVID-19

Farhan Alshammari[1], Romeo Mostoles Jr.[1], Eddieson Pasay-an[1*], Sultan Alshammari[2]

[1]College of Nursing, University of Hail, Hail City 2240, Saudi Arabia

[2]Ministry of Health, Hail City, Kingdom of Saudi Arabia

Abstract

Background: This study explores and assesses the knowledge, perceptions, and attitudes of mainstream workers during the COVID-19 pandemic in the Ha'il Region, Kingdom of Saudi Arabia.

Methods: Using convergent parallel mixed-methods design, 502 frontline workers were enlisted via snowball and purposive sampling. Descriptive statistics and thematic analysis were used to analyze the quantitative and qualitative data, respectively.

Results: There is a well-prepared response to COVID-19, namely, a commendable knowledge, attitude, and practices (KAP) gap documented in reliable information concerning the virus, specifically, awareness that COVID-19 can be a potentially fatal disease (100%); that droplets from infected people (29.8%) can spread the disease; and taking actions to prevent the spread of COVID-19 in the community can save their lives. Four themes and three subthemes yielded: (1) actual, tangible knowledge with subtheme pieces of information; (2) the extent of danger with subtheme uncertainties; (3) precautionary measures; and (4) a yearning to know more, with the subtheme of novel information.

Conclusions: Communication among health authorities and at-risk individuals in response to COVID-19 must be facilitated. This is to support those in the healthcare industry in shaping an intervention strategy that emphasizes both preparation and protection.

Keywords: attitudes, communication, COVID-19, pandemic, perceptions, Saudi Arabia

INTRODUCTION

In March 2020, the World Health Organization (WHO) announced that 282 individuals in four countries were diagnosed with COVID-19: 278 in China, two in Thailand, one in Japan, and one in the Republic of Korea.[1] The outbreak spread to neighboring Asian countries, and as far as Australia, the US, and Europe.[2] The WHO continuously monitored and maintained communication with the affected countries. There were also developments in case investigations for infected individuals.[3] Yet, despite the information and support provided, the number of COVID-19 cases increased exponentially. To this end, the WHO assessed the outbreak's alarming level of proliferation and severity. With the numbers of affected people increasing all over the world, the disease outbreak was proclaimed by the World Health Organization a public health emergency of international concern,[4] and in March 11 of 2020, it was declared a pandemic.[5]

One country after the other responded to the shocking increase in COVID-19 cases. China started broadcasting public educational messages for the prevention of the disease and the strengthening of environmental hygiene in public places. In Thailand, the public was made aware of the establishment of risk communication guidance. The Department of Disease Control created a hotline to inform people with related symptoms returning from China, especially from those areas affected by the outbreak.[1] As the problems persisted, contact tracing was introduced—a typical response to this kind of international public health concern. The Republic of Korea, for instance, steered the same kinds of contact tracing and other epidemiological investigations as those conducted by authorities in Japan. According to WHO, there has been a considerable decline in the number of COVID-19 cases in March 11, 2020.[3] Some countries—such as Hong Kong, Singapore, and Taiwan—appeared to contain the spread of the virus.[6] Then, another wave of COVID-19 surged in March 17, 2020,[7] alarming government authorities, who suggested containment of the virus through quarantine.[8]

The enforcement of community and home quarantine by government authorities was adopted by Gulf countries, such as Saudi Arabia. Free of the virus for the first three months following the initial outbreak in China, Saudi Arabia confirmed its first case on March 02, 2020.[9] The fast growth rate of confirmed cases has since piled up, increasing to 171 cases by March 17.[10] As a result of the increasing numbers of COVID-19 cases, the Saudi authorities responded quickly to establish programs to

***Corresponding author:**
Eddieson Pasay-an
College of Nursing, University of Hail,
Hail City, Saudi Arabia
E-mail: e.pasayan@uoh.edu.sa

contain the problem. These included the creation of the health ministry's COVID-19 follow-up committee to implement and address measures.[11] These included suspending all international flights to and from the Kingdom,[12] the dissemination of COVID-19 prevention information by the Ministry of Health (MOH) through social media, government websites, and advertisements,[13] and the suspension of sports activities, conferences, and large gatherings.[14]

This study, conducted between March and June 2020 is of paramount importance in its support of Saudi government efforts to reduce, if not eliminate entirely, the number of COVID-19 cases. In this context, assessing COVID-19 gap of knowledge, attitudes, and perceptions of the workers in the mainstream community will identify communication flaws and help to engage staff and responders working with national health authorities to create an action plan. The KAP gap in this study refers the difference between what people know and what people do in relation to Corona Virus Disease.

This study assesses the knowledge, perceptions, and attitudes of mainstream workers during the COVID-19 pandemic in the Ha'il Region, Kingdom of Saudi Arabia. In this study, the KAP gap refers to what people know to be true regarding the disease. Most importantly, the results of this study will serve to inform the health authorities or the policymakers on the actual knowledge, attitudes, and perceptions of the stakeholders so that they will be able to reach the people that they intend to reach with the right information at the right time. As such, having been apprised of the current status of the situation, policy makers can assess and strengthen their ongoing programs at both national and local levels, helping the community to engage and involve itself in response to the challenges of COVID-19. Exploring such problems promotes the engagement and cooperation of stakeholders, policymakers, and the community as a whole to strengthen public health. The results of this study are tailor made for a strategy that will prepare and protect individuals, families, and communities as a whole.

METHODS

The study used a convergent parallel mixed-methods design. The samples comprised 502 mainstream workers employed in different establishments (e.g., restaurants, spas/salons, pharmacies, and banks) in the capital of Ha'il. "Mainstream workers" refers to persons working in establishments who have constant interactions with customers, such as salesmen, janitors, security guards, salon staff, and food handlers. These mainstream workers cater to the needs of the customers or their clients during the surge of pandemic. Snowball sampling was used to collect the data in the quantitative aspect, while purposive sampling was used for the qualitative part. Participating frontline workers expressed their willingness to participate, their ability to speak and comprehend English, directly interact with customers, and make themselves available for the scheduled interviews.

A survey using a self-administered questionnaire on a Google Form was used to collect the data. The link was shared with contact persons within different units of the participating establishments (banks, salons/spas, and malls) and then with other mainstream workers. Answering the Google survey questionnaire indicated that the participants had waived their informed consent to sign in person before a researcher.

Regarding the qualitative aspect, the researchers scheduled dates for face-to-face interviews with subjects, taking social distancing requirements into consideration. The participants for the qualitative phase were those mainstream workers who had participated in the quantitative phase. The researchers originally invited 20 participants but saturation was reach on the 12th participant. These frontline workers, comprising three food handlers, one spa salon attendant, two pharmacy assistants, three janitors, two market salesmen, and one security guard. The interviews were conducted at a time and place most convenient for the participants. Each interview took 20–25 minutes to complete.

The questionnaire was adapted from the Risk Communication and Community Engagement (RCCE).[15] The RCCE developed the tool purposely to guide the policy makers in developing a plan comprising a basic evidence-based source for engaging and communicating effectively with the stakeholders. According to RCCE,[15] "The tool is designed to support risk communication, community engagement of staff and responders working with national health authorities, and other partners to develop, implement, and monitor an effective action plan for communicating effectively with the public, engaging with communities, local partners, and other stakeholders to help prepare and protect individuals, families, and the public's health during the early response to COVID-19." (p. 2)

The RCCE suggests that some dimensions of the action program that was developed as a guide may vary across countries. This depended upon their risk levels, how people perceive the needs and local capacities, as well as their current scenarios; thus, the need to modify was imperative. The researchers therefore modified the questionnaire slightly to align it with the Saudi Arabian context. Three items were removed from the 20-item original question since it only asked general information about demographics. These three items were included in the demographic characteristics questionnaire (Part I). The 17-item question in the quantitative phase focused on the various questions concerning information about knowledge, attitudes, and perceptions, the most at-risk

populations, communication patterns and channels, health services, and the participant situations during COVID-19 (Part II). Examples of questionnaire items include: "Have you heard about COVID-19?" "Where do you receive news about COVID-19?" and "What is your source, or channel?" Three panels of experts validated the questionnaire. Two were policy makers from the MOH, and one was a psychometrician. The quantitative questionnaire yielded a Cronbach's alpha of 0.89.

The qualitative questions served as a guide for the interviewers. The original developer of the quantitative instrument suggested that the same questions used in the quantitative tool may be used in the interview. However, some of the questions were rephrased to further explore participant answers. Follow-up questions were asked to clarify the participant answers, such as "What do you mean?" and "Can you expand further?"

The study protocol was approved by the Institutional Review Board (IRB) of the University of Ha'il with IRB number H-2020-114. In this study, the researchers were required to fully inform potential subjects that participation was not mandatory and that they could drop out at any time. This information was provided in a cover letter attached to the research questionnaire (Google Form) and the letter inviting respondents to participate (qualitative data gathering).

An Excel sheet was used to analyze the data. The frequency and percentage were employed to determine the demographic characteristics of front liners. Conversely, thematic analysis was used to analyze the qualitative data. The researchers generated the theme using the four phases of initialization, construction, rectification, and finalization.

RESULTS

Quantitative results

The majority of the participants were aged 26–30 (29.9%), and almost all were females (89.6%). The participants had limited work experience, 1–5 years for most (46.8%). The majority (86%) were from the sales department, followed by restaurant waiters at 3.9% (Table 1).

Table 2 presents information about the knowledge, attitudes and perceptions, communication patterns and channels, health services, and situations of the participants regarding COVID-19. The participants possessed a commendable amount of good information about COVID-19, and were aware that it could cause disease (100%). Of the 502 participants, 423 reported that the information they had most commonly heard about COVID-19 concerned its symptoms (20.6%), how to protect themselves from the disease (20.5%), and how the disease is transmitted (20.1%). Interestingly, 36% claimed that their sources of information about this disease were the MOH (36%) and the internet (27.3%). Indeed, they most trusted the information they obtained from the MOH (56.7%).

TABLE 1. Demographic information of the participants (N = 502)

Sociodemographic	Frequency (N)	Percentage (%)
Age		
20–25	140	27.9
26–30	150	29.9
31–35	145	28.9
36 and above	67	13.3
Sex		
Male	52	10.4
Female	450	89.6
Years of Experience		
1–5	235	46.8
6–10	220	43.8
11 and above	47	9.4
Type of personnel		
Janitorial	12	2.4
Sales department	432	86.0
Laborer	10	1.9
Restaurant waiter	20	3.9
Food handler	13	2.6
Pharmacy assistant	15	2.9

Most of the participants believed that risk from COVID-19 was very dangerous (74.5%), and they thought that the elderly were at greatest risk to become infected (38.6%). Of note, while 42.6% of the participants thought that they would likely become sick with the new disease, 31.7% claimed that they did not know if they would become infected. The frontline workers recognized that droplets from infected people (29.8%) and direct contact with infected people (28.3%) were the means by which COVID-19 is spread. However, 19.8% believed that COVID-19 could be spread through the air. The frontline workers identified fever as the main symptom (27.7%), followed by shortness of breath and breathing difficulties (25.7%). They understood that the disease could be prevented by regular handwashing with alcohol and/or soap and water (32.6%), by avoiding close contact (31.3%), and by covering the mouth and nose when coughing or sneezing (31.3%).

As for the perceptions of frontline workers and their families regarding the prevention of illness from COVID-19, 35.3% reported washing their hands regularly with an alcohol-based cleaner or soap and water, covering their mouths and noses when coughing and sneezing (33.7%), and avoiding close contact with others. As such, all of the frontline workers (100%) believed in the importance of taking actions to prevent the spread of COVID-19 in the community. Hypothetically, the participants would go to

the hospital/health unit (55.4%) should they develop symptoms, and 44.6% would stay in quarantine. The frontline workers would like to learn more about protecting themselves from the disease (29.5%), the symptoms of the COVID-19 (27.2%), how it is transmitted (23.9%), and the most at-risk groups (19.5%). Remarkably, all of the participants (100%) claimed that COVID-19 generates stigmas and that they stayed away from those with the virus. Regarding the practices of the frontline workers when they have the flu, 39.6% usually wore a mask and 31.7% claimed to stay at home. The participants usually received information about the flu and other diseases from MOH (66.2%) and the internet (31.5%).

TABLE 2. Information on knowledge, attitudes and perceptions, communication patterns and channels, health services, and situations of the participants on COVID-19 (N = 502)

Questions	Frequency (N)	Percentage (%)
What do you know about the new coronavirus disease?		
It's a virus that can cause a disease	502	100
What kind of information have you received about the disease?		
How to protect yourself from the disease?	422	20.5
Symptoms of the new coronavirus disease	423	20.6
How it is transmitted	413	20.1
What to do if you have the symptoms	405	19.7
Risks and complications	391	19.0
	2054*	
Where did you hear about the new coronavirus from? What channels or sources?		
Radio	21	1.9
TV	96	8.8
Social Media (twitter, Facebook)	120	11.1
Internet	295	27.3
Ministry of Health	389	36.0
Community health workers	130	12.0
Red Cross Red Crescent volunteers	31	2.9
	1082*	100
Which channel/who do you trust the most to receive information related to coronavirus?		
Radio	13	1.8
TV	129	17.6
Social Media (WhatsApp, twitter, Facebook)	171	23.4
Ministry of Health (MOH)	415	56.7
Red Cross Red Crescent volunteers	4	0.6
	732*	
How dangerous do you think the new coronavirus risk is?		
Very dangerous	374	74.5
More or less dangerous	128	25.5
	502	100
Who do you think is at highest risk to get the coronavirus?		
Children under 5 years old	316	27.8
Elderly persons	438	38.6
Pregnant women	246	21.7
Health workers	136	12.0
	1136*	100
Do you think you are likely to become sick with the new coronavirus?		
Yes	214	42.6
No	129	25.7
Don't know	159	31.7
	502	100
How does the coronavirus spread?		
Droplets from infected people	436	29.8
Airborne	290	19.8
Direct contact with infected people.	414	28.3
Touching contaminated objects/surfaces	324	22.0
	1464*	100
What are the main symptoms?		
Fever	485	27.7
Cough	400	22.9

Table 2. continue

Questions	Frequency (N)	Percentage (%)
Shortness of breath and breathing difficulties	449	25.7
Diarrhea	416	23.8
	1750*	100
Do you know how to prevent it?		
Wash your hands regularly using alcohol or soap and water	453	32.6
Drink only treated water	67	4.8
Cover your mouth and nose when coughing or sneezing	435	31.3
Avoid close contact with anyone who has a fever and cough	436	31.3
	1391*	100
What have you and your family done to prevent becoming sick with coronavirus in the recent days?		
Washing hands regularly using alcohol-based cleaner or soap / water	469	35.3
Covering mouth and nose when coughing or sneezing	449	33.7
Avoid close contact with anyone who has a fever and cough	413	31.0
	1331*	100
Do you consider important to take actions to prevent the spread of coronavirus in your community?		
Yes	502	100
What to do if you or someone from your family has symptoms of this disease?		
I will go to the hospital / health unit	399	55.4
I would stay in quarantine	321	44.6
	720*	100
What more would you like to know about the disease?		
How to protect yourself from the disease?	307	29.5
Symptoms of the new coronavirus disease	283	27.2
How it is transmitted	249	23.9
Most at risk groups	203	19.5
	1042*	100
What do you usually do if you have a regular flu?		
I have never had the flu	56	7.4
Nothing, I continue with my normal life. After some time the flu goes away	118	15.6
I stay at home, so I don't infect others	240	31.7
I wear a mask	300	39.6
I drink tea until I recover	34	4.5
I seek advice from my neighbors	10	1.3
	758*	100
From where/who do you usually receive information on flu and other diseases?		
TV	14	2.2
Internet	200	31.5
MOH	420	66.2
	634*	100

*Multiple responses

Qualitative results

The results of the one-on-one interviews yielded four themes and three subthemes, including (1) tangible knowledge with subtheme pieces of information, (2) extent of the danger with subtheme uncertainties, (3) precautionary measures, and (4) a desire to know more, with the subtheme novelty of information.

Theme 1: Tangible knowledge

This theme refers to participant understanding of the COVID-19, specifically knowledge used by the participants to protect themselves from getting the infection. When asked if they had heard about the COVID-19, all participants responded affirmatively, and knew that the virus can cause disease. Asked about the kinds of information they received and where they had heard information about the disease, the participants responded:

P2: "I read from the internet that COVID-19 is a virus that is typically transmitted from person to person through the exhalation of respiratory droplets." (P2 is a male Indian food handler).

P4: "If a person has a runny nose, fever, and sore throat, they will say you are a positive, but with the constant phone messages I got from the Ministry of Health, I

learned that runny nose and fever are just symptoms." (P4 is a Saudi security guard in one of the banks).

P7: "It is caused by mild respiratory infections like the common cold but also more severe infections. That is what my friend who is working in the hospital [healthcare personnel] told me." (P7 is a male Indian working as a market salesman in a grocery).

P11: "It is caused by mild respiratory infections like the common cold but also more severe infections." (P11 is a Pakistani national who served as an assistant pharmacist in a pharmacy boutique in the center of the city).

Some participants had a full grasp of the information about COVID-19, which was acquired from a variety of sources, such as the health authorities, the internet, and social media. This is Pieces of information (Subtheme 1), which was based on their first-hand experiences and supplementary facts about COVID-19. Some of the frontline workers claimed that the information they received about the virus pertained to transmission and early signs:

P12: "Before the virus spread, I just knew that it is a virus like tuberculosis, SARS, and MERSCOV … but this is only my opinion. I am not so sure yet because I do not really know the full story of COVID, but what I believe is that COVID-19 can be transmitted through drinking unclean water." (P12 is a male Egyptian food handler in a restaurant).

P10: "I don't know about the virus, but from what I know this virus can be acquired from persons in hospitals [nurses]. Although, based on my observations, not only those from the hospital [healthcare personnel] but any person can have the virus. From what I heard from the advertisement of the Ministry of Health, this virus can be transmitted from one person to another person." (P10 is a female Saudi pharmacy assistant in one of the hospitals in the region).

P3: "An employee from the Ministry of Health came to the store and said that we need to wear a mask, and we should not remove it while we are at work. That is why I believe that it is transmitted from one person to another, so I agree with P10. But please don't take this as a definite answer because the information on Facebook said that transmission is from a droplet of saliva and touching contaminated objects." (P3 is a female Filipino janitor in one of the hospitals).

P5: "It could be airborne. I believe this because of the fast spread. Like tuberculosis, the virus is suspended in the air." (P5 is a male Indian serving as a food handler).

Theme 2: Extent of danger

This theme pertains to the perceptions of mainstream frontline workers as to the effects of acquiring the disease. The recognition of this perceived danger captures not only their health concerns but also its impact on their work. Asked about their perceptions regarding the hazards of the COVID-19, the participants said:

P1: "The COVID-19 is very dangerous as it can lead to death right away. On the other hand, it is dangerous because if you test positive you will be quarantined and no one will be there for you. If you come into contact with someone who has the disease and you have a high temperature, they will quarantine you." (P1 is a male Filipino janitor working in a hospital).

P6: "I do not how dangerous it would be. However, one thing is for sure: once you acquire the disease then your work is also in danger." (P6 is a male Egyptian salesperson working in one of the malls).

P9: "It is highly dangerous because if you have a runny nose, fever, and sore throat, people will tell you that you are positive and that you need to self-isolate, even it is not COVID-19…they always tell you to go for self-quarantine. How about your daily income?"

P12: "It is a dangerous respiratory infection because even if you have the common cold you need to be quarantined. I consider it a very dangerous disease because it is transmitted from person to person through exhalation of respiratory droplets from the nose and mouth and close contact, and maybe I can no longer attend to my job."

When asked about the risk of getting sick with the new COVID-19, most of the participants described uncertainties (subtheme 2). This involves not knowing what is to come while they are working as mainstream frontline workers. This was articulated by P3, P4, P5, P9, and P11:

P3: "In my own opinion, I believe that I am at risk of getting sick from the new COVID-19 because I am exposed. Like those healthcare workers in our hospital, we are also at risk because we are exposed every day."

P4: "Of course, yes, because COVID-19 is everywhere and I am always dealing with customers. We even have the face shield but having a face shield is not a guarantee that you won't get the disease."

P5: "Yes, this is actually my worry because anyone could have COVID-19 when you are outside; you are not safe. Merely taking an order from a customer means that I could already have contracted the disease."

P9: "I am just concerned, you know, because anyone can get sick with COVID-19 if you are not wearing a mask and

washing your hands, especially before and after going to the public toilet. With this, I think I am overthinking that I can get the disease anytime." (P9 is a female Filipina working in a women's spa).

P11: "Very risky for me and I am afraid that I will get it because my work deals with talking to people when they need something. Maybe these customers already have this COVID-19."

Theme 3: Precautionary measures
The precautionary measures theme refers to participant interventions in protecting their health against COVID-19. It emphasizes the safeguards they take while on the frontline catering to the needs of the people. To some extent, the participants demonstrated their understanding of the measures suggested by the health authorities.

Asked about the measures they or their families regularly took to prevent COVID-19, the participants shared that:

P3: "I always uses alcohol every time before I eat."

P5: "I do not know but I always eat healthy foods that are rich in vitamin C. "

P7: "I avoid unprotected direct contact with live animals and surfaces in contact with animals."

P9: "I do not eat contaminated foods and eliminate standing water."

P10: "I take a bath every day, take my vitamins, eat fruits and vegetables, and sleep 6 to 8 hours."

The participants verbalized that important actions must be considered to prevent the spread of the COVID-19 in their communities. Three participants voiced their concerns emphatically:

P1: "I strongly agree that actions to prevent the spread of the disease in the community must be considered. Although I know that people in the community have already been informed of the preventive measures, we still have to take our own actions to prevent further spread."

P8: "My idea is to have information dissemination for people in the community. It is important that people in the community seriously follow the regulations given by the government. " (P8 is a male Filipino janitor working in a hospital).

P7: "Absolutely, to be able …umhhh…to be aware and prevent the spread of the COVID-19. "

P2: "In my opinion, if we all take precautions, I think we can get over the spread of the virus. "

Theme 4: The desire to know more
The theme of knowing what is true involves the act of discerning more about COVID-19. It is the articulation of the participants' desire to seek additional information about COVID-19, in addition to what they have learned from health authorities. The participants were actively engaged in offering their opinions as to what additional information they need to have about COVID-19:

P7: "I really want to know more about how to protect myself because I want my family to be protected from acquiring the virus in case I have it."

P11: "What is the exact cause of the virus? That is what I really want to understand. If I am reading about it on the internet, most of the terms used are medical, so that is why I do not understand."

P9: "I appreciate that we were given more information on necessary precautionary measures to avoid the spread of the disease in my workplace and in my home."

P10: "For me, I want to know if there is already a medicine for the disease."

While the health authorities were proactive in disseminating information, some participants were concerned about the novelty of information (subtheme 3) given to them. For example, three participants expressed their concerns about the reliability of new information regarding transmission of the virus:

P8: "I just want it made clear whether the virus can be transmitted through the air. Although more information is coming, I am not sure what is true and what is not."

P4: "I understand that there may be airborne transmission because it spreads very fast. This is what I really want to know. If yes, what should we do? Is there another preventive measure?"

P5: "I heard from a friend that airborne is really a way to spread the disease. However, on the internet, I cannot find out if it is true."

DISCUSSION

This study assesses and explores the knowledge, perceptions, and attitudes of mainstream workers during the COVID-19 pandemic. In the quantitative phase, the mainstream workers were knowledgeable and possessed different information about the COVID-19. Indeed, most of their information about COVID-19 was correct. It is important to note that this information came mostly from the MOH, which means that the MOH's information

campaign has been effective. In fact, that there has been a substantial effort by all levels of government, including through their public awareness campaigns. As a result, there has been an increase in early measures to engage the public in prevention and to act on misleading information.[16] It is worth stating that the KSA is in the unique position to successfully deal with two outbreaks of viral origin.[17] As such, it is assumed that KSA can win the battle against this pandemic.

While the quantitative results revealed that participants were knowledgeable and possessed different information about COVID-19, it was also noted in the qualitative result that participants had a tangible knowledge. Both the qualitative and quantitative results implied that participants had a good grasp of the information they received from the health authorities and used it to protect themselves. In fact, the intensive efforts of the MOH have led to considerable improvements in infection control procedures in healthcare services.[18] Notably, the information conveyed by the mainstream workers in this study suggests that they have a good understanding of the COVID-19—likely a result of the MOH's exhaustive awareness campaign, communicated via its website, television broadcasts, and various social media. This has shaped a guide to COVID-19 that has been translated into 10 languages.[18] Other researchers believe that the number of cases would be higher if these precautionary measures and restrictions had not been considered.[19] These most recent results may be useful to inform policymakers on further public health interventions, awareness-raising campaigns, policies, and health education programs.

Most of the mainstream workers believed that the virus is dangerous, and this was apparent in the quantitative results. Further, they knew that the elderly is the most at-risk group, which could be due to weakened immune systems, and they were considered likely to contract the new COVID-19. Moreover, the workers in the mainstream understood the modes of transmission, symptoms, and prevention of the disease. This information, conveyed by frontline workers, suggests that they are mindful about the factors associated with the risks of contracting COVID-19. The awareness of general population about risk perception concerning contraction and complications from the high infectivity of COVID-19—that it can be transmitted between individuals through unseen respiratory droplets—has been noted in recent studies.[20,21] The results of this study show that both mainstream workers are knowledgeable about the incubation period of COVID-19.[22] In this study, the mainstream workers recognized the extent of the danger of COVID-19. It was observed that the participants were anxious about the possibility of becoming infected with COVID-19. This study's findings support those of several other studies.[20,23] The uncertainties expressed by the participants in this study show that, while they are cautious enough of their movements and practices, they still feel uncertain about the situation. As such, most of their preventive practices involve continuing to wearing facemask and shields, and to practice hand hygiene, social distancing, and cough etiquette. As a result of their uncertainties about the situation, the participants expressed a growing concern regarding the protective and personal hygienic measures required to avoid COVID-19 infection. This finding is true of most participants in other recent studies, as they took precautions such as avoiding crowded places, practicing proper hand hygiene, and wearing masks.[20,21] This indicates a general willingness among participants to make behavioral changes in the face of the COVID-19 pandemic. This is also true for healthcare workers.[24] These practices are critical in preventing the transfer of COVID-19 from individual to individual. Indeed, it is commonly known among the public that the main transmission routes of COVID-19 are droplets and contact,[25] which means that personal protective equipment is crucial for controlling the spread of COVID-19. In fact, one of the ways to control new life-threatening epidemics in their early stages involves optimal infection prevention and control actions, as well as maximal protection, such as masks, gloves, gowns, and eye protection.[26] This means that it is important to provide people with health education about COVID-19 infection to prevent the spread of the disease.

Both the quantitative and qualitative results found that mainstream workers and their families practice regular hand washing using alcohol-based cleaners or soapy water. Further, the participants considered it important to take actions to prevent the spread of COVID-19 in their communities, and that they would go to the nearest hospital should they develop symptoms. These findings imply that the participants are cognizant of the recommended procedures and that they were willing to follow them. This finding is similar to the recent study in which participants made frequent use of sanitizers, washed their hands often, and wore masks to protect themselves from infection.[27] This provides specific evidence regarding the increasing attention participants pay to personal hygienic measures to avoid COVID-19 infection. Good hand hygiene is recognized as an effective defense against COVID-19 among the general population[20,21,23] and healthcare workers.[28] In fact, hand hygiene is accepted globally as a principal means of infection prevention and control, and it has been demonstrated as an efficient method of reducing the transmission of common respiratory viruses, including human COVID-19.5[25] Frequent hand washing can aid in the prevention of COVID-19 transmission from suspected or identified patients. Moreover, eating vegetables and fruits, wearing a mask, following preventive sneezing and cough etiquette, and avoiding hand shaking are all well-accepted means of preventing infectious respiratory diseases.[26] This finding suggests that health authorities should continue to raise public awareness of the burden

on health systems and the calculated allocation of measures for health professionals with underlying health conditions to minimize their risk. As a result of the participants' views, the virus prevention practices of the mainstream workers were included in the precautionary measures. This suggests that the respondents were cognizant of the virus's mode of transmission and its symptoms, and had developed an adequate awareness of preventive measures. This was possibly due to the government and media emphasis on preventive measures. As noted above, the MOH began taking precautionary measures prior to the reporting of all cases and before the WHO declared COVID-19 an epidemic. This was due to the idea that starting earlier would prevent a severe increase in the number of cases in Saudi Arabia and avert a COVID-19 epidemic within the kingdom.[19] While there are new cases of COVID-19 every day, these numbers vary. The data are considered reasonable as a result of the precautions and restrictions established by the MOH.[19] It is interesting to note that the frontline workers in the mainstream would like to know more about the disease. This suggests that there is a need for more wide-ranging government and health authority education programs with an emphasis on uniformity of data. COVID-19 educators should take a preemptive approach and focus on dispelling misinformation—inconsistent ideas and incorrect information.[20] To reduce distress, interventions need to be in place to tackle knowledge gaps among the public.[29] This has been seen in China, where reduction of distress is partly attributed to the government's effective prevention and control measures.[30] Further, the mainstream workers articulated their desires to know more about the novelty of information surrounding COVID-19. While the MOH has proven to be a strong communication system,[19] amalgamated clinical information could be circulated via a knowledge synthesis procedure instituted by the government. Given the dynamic nature of the pandemic, public health journalists and health correspondents should work with government to ensure the distribution of precise, non-sensational, timely, regular, and specific information.[31]

Because health authorities are expected to deliver solutions to the public within a vacuum of improbability in the face of a new pandemic, the government ought to handle pandemic-related ambiguities efficiently and pro-actively at the policy level. Governmental and health care agencies, institutions, and professional societies can help by contributing to and constantly updating information and resources. Information from reliable sources must be disseminated at all levels as it becomes available. Communication that is concise, clear, transparent, timely, and considerate will help develop a sense of control among health care providers.[29] While it is commendable that the MOH has done its part to train healthcare workers and provide sufficient infrastructure/spaces and protocols for COVID-19 health system improvement strategies must involve the community.[19] Involving the community promotes engagement and cooperation of stakeholders, policymakers, and the community as a whole to strengthen the public health. Moreover, a tailor-fitted guideline needs to be considered[32] while engaging the community.

While this study makes important contributions to policymaking information, we recognize that limitations may affect generalization of the results. For example, we purposely included only those mainstream workers who could speak and comprehend English. We suggest therefore that similar studies in the future include the general population, regardless of their language. Additionally, the study's results can be made more generalizable by clustering by locality.

CONCLUSIONS

Given the informed predisposition of the frontline workers in the mainstream of the Ha'il Region, two-way communication between health authorities and at-risk populations in response to COVID-19 can be facilitated with consideration in multiple languages. This is to support individuals shaping an intervention strategy that will prepare and protect the health of the workers, their families, and the public during the early response to COVID-19.

ACKNOWLEDGMENT

The authors would like to extend their gratitude to Scientific Research Deanship of the University of Ha'il, Saudi Arabia through project number of COVID-1919 in supporting this study.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

FUNDING

This research was funded by the Scientific Research Deanship of the University of Ha'il, Saudi Arabia through project number of COVID-1919.

Received: June 8, 2021 | Accepted: August 30, 2021

REFERENCES

1. World Health Organization. *Situation Report 1: Novel Coronavirus (2019-nCoV)*. New York: World Health Organization, 2020.
2. Nawrat A. *Coronavirus outbreak: the story so far*. U.K.: Pharmaceutical Technology, 2020.
3. World Health Organization. *WHO Director-General's opening remarks at the media briefing on COVID-19*. New York: World Health Organization, 2020.

4. World Health Organization. *Rolling updates on coronavirus disease (COVID-19)*. New York: World Health Organization, 2020.
5. World Health Organization. *Novel Coronavirus (2019-nCoV) Situation Report–3*. New York: World Health Organization, 2020.
6. Beaubien J. *Hong Kong has contained coronavirus so far—But at a significant cost*. NPR, 2020.
7. Lin L, Wang J. *Singapore, Taiwan, and Hong Kong Face Second Wave of Coronavirus Cases*. New York: The Wall Street Journal, 2020.
8. Nair C. *What all the countries that contained coronavirus have in common*. Global Institute for Tomorrow and author: The Sustainable State, 2020.
9. Arab News. *Saudi Arabia announces the first case of coronavirus*. Saudi Arabia: Arab News, 2020.
10. Saudi Gazette. *Saudi Arabia reports 38 new cases of coronavirus, bringing total to 171*. Saudi Arabia: Saudi Gazette, 2020.
11. Saudi Press Agency. *Novel coronavirus COVID-19 follow-up committee holds its 9th meeting*. Saudi Arabia: Saudi Press Agency, 2020.
12. Arab News. *Saudi Arabia suspends international flights starting Sunday to prevent the spread of coronavirus*. Saudi Arabia: Arab News, 2020.
13. Saudi Press Agency. *Kingdom's government decides to suspend attendance at workplaces in all government agencies for a period of (16) days except for health, security, military, and electronic security*. Saudi Arabia: Saudi Press Agency, 2020.
14. Saudi Press Agency. *Ministry of Sports: Suspending all sport activities in the Kingdom and closing of private sports halls and centers*. Saudi Arabia: Saudi Press Agency, 2020.
15. World Health Organization. *Risk Communication and Community Engagement (RCCE)*. New York: World Health Organization, 2020.
16. World Health Organization. *Saudi Arabia join forces to fight COVID-19 nationally, regionally and globally*. New York: World Health Organization, 2020.
17. Barry M, Al Amri M, Memish ZA. COVID-19 in the Shadows of MERS-CoV in the Kingdom of Saudi Arabia. *J Epidemiol Glob Health*. 2020;10:1–3.
18. Al-Hanawi MK, Angawi K, Alshareef N, Qattan AMN, Helmy HZ, Abudawood Y, *et al*. Knowledge, attitude and practice toward COVID-19 among the public in the Kingdom of Saudi Arabia: A cross-sectional study. *Front Public Health*. 2020;8:217.
19. Alshammari TM, Altebainawi AF, Alenzi KA. Importance of early precautionary actions in avoiding the spread of COVID-19: Saudi Arabia as an Example. *Saudi Pharm J*. 2020;28:898–902.
20. Huynh G, Nguyen TNH, Tran VK, Vo KN, Pham LA. Knowledge and attitude toward COVID-19 among healthcare workers at District 2 Hospital, Ho Chi Minh City. *Asian Pac J Trop Med*. 2020;13:260–5.
21. Taghrir MH, Borazjani R, Shiraly R. COVID-19 and Iranian medical students; A survey on their related-knowledge, preventive behaviors and risk perception. *Arch Iran Med*. 2020;23:249–54.
22. Khader Y, Al Nsour M, Al-Batayneh OB, Saadeh R, Bashier H, Alfaqih M, *et al*. Dentists' awareness, perception, and attitude regarding COVID-19 and infection control: Cross-sectional study among Jordanian dentists. *JMIR Public Health Surveill*. 2020;6:e18798.
23. Minhas S, Chaudhry RM, Sajjad A, Manzoor I, Masood A, Kashif M. Corona pandemic: Awareness of health care providers in Pakistan. *AIMS Public Health*. 2020;7:548–61.
24. Zhang M, Zhou M, Tang F, Wang Y, Nie H, Zhang L, You G. Knowledge, attitude, and practice regarding COVID-19 among healthcare workers in Henan, China. *J Hosp Infect*. 2020;105:183–7.
25. Wenzel RP, Bearman G, Edmond MB. Lessons from severe acute respiratory syndrome (SARS): Implications for infection control. *Arch Med Res*. 2005;36:610–6.
26. Pellegrinelli L, Galli C, Bubba L, Cereda D, Anselmi G, Binda S, *et al*. Respiratory syncytial virus in influenza-like illness cases: Epidemiology and molecular analyses of four consecutive winter seasons (2014-2015/2017-2018) in Lombardy (Northern Italy). *J Med Virol*. 2020;92:2999–3006.
27. Lai X, Wang X, Yang Q, Xu X, Tang Y, Liu C, *et al*. Will healthcare workers improve infection prevention and control behaviors as COVID-19 risk emerges and increases, in China? *Antimicrob Resist Infect Control*. 2020;9:83.
28. Azlan AA, Hamzah MR, Sern TJ, Ayub SH, Mohamad E. Public knowledge, attitudes and practices towards COVID-19: A cross-sectional study in Malaysia. *PLoS One*. 2020;15:e0233668.
29. Sukeri S, Idris Z, Zahiruddin WM, Shafei MN, Idris N, Hamat RA, *et al*. A qualitative exploration of the misconceptions, knowledge gaps and constructs of leptospirosis among rural and urban communities in Malaysia. *PLoS One*. 2018;13:e0200871.
30. Bansal P, Bingemann TA, Greenhawt M, Mosnaim G, Nanda A, Oppenheimer J, *et al*. Clinician wellness during the COVID-19 pandemic: Extraordinary times and unusual challenges for the allergist/immunologist. *J Allergy Clin Immunol Pract*. 2020;8:1781–90.e3.
31. Reddy P. *Front line talk: South Africa health care workers' response to the Coronavirus (COVID-19) pandemic*. Paper presented at: National Joint Operational and Intelligence Structure (NATJOINTS); 2020 July 12:11421.
32. Albaqawi HM, Pasay-An E, Mostoles R Jr, Villareal S. Risk assessment and management among frontline nurses in the context of the COVID-19 virus in the northern region of the Kingdom of Saudi Arabia. *Appl Nurs Res*. 2021;58:151410.