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KNOWLEDGE, ATTITUDES, AND PRACTICES (KAP) TOWARD SAFE DISPOSAL OF FACE MASKS AMONG SUDANESE PUBLIC HEALTH COLLEGE STUDENTS AND HEALTH WORKERS DURING COVID-19

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Abstract

The mask is a source of contaminated biological waste. Asymptomatic individuals who wear masks can infect others due to viable microbial loads leaking from the mask's transmission can occur after touching the mask, medical masks may lead to self-contamination. This cross-sectional web-based investigation was undertaken at an enormous among students of public health and public health practitioners in Sudan, from the 5th of April to the 15th of July 2023. These multi-campus universities and multi sectors health care institutes have over 282 Responses. We distributed a structured questionnaire to participants via social media platforms like WhatsApp. Before attempting to fill out the responses, we asked each respondent for their informed consent by clicking on the consent statement. The data was analyzed descriptively using IBM SPSS version 29 (Chicago Inc., USA). Analytical statistics were calculated using cross-tabulation and the Chi square test, with $p<0.05$ considered statistically significant. **Result:** More than half of the participants are female (54.9%), and the rest (45%) are male. Half of the respondents are married, and nearly half (48%) are unmarried. Most participants are between 18 and 30 (50.7) years and between 30 and 60 years (44.3%); only 4.9% are older than 60. The overall knowledge score was high (97.8%), and nearly all participants had good knowledge (99.6%) and attitude (95.7%) of face mask use and disposal. Nearly half of respondents reported strongly agreeing (47.2%) and agreeing (45.4%) that the mask effectively prevents respiratory diseases. most of the respondents strongly agree (74.1%), followed by agree (23.8%), that the accumulation of plastic masks in the environment is a hazard to the environment. Most respondents started using face masks during the pandemic, 75%, while the rest before the pandemic. Most respondents used face masks outside the house (79.8), and few per cent used masks when contacting patients inside and at the workplace. the result showed that unmarried (55.8%) have better practices than married (48.6%), females (58.1) have better practices than males (44.9%) and those who have master's degrees (57.8%) have better practices than others. The result observed a significant relationship between sex and the practice of use and disposal of face masks. **Conclusions:** Nearly all participants had good knowledge (99.6%) and attitudes (95.7%) of face mask use and disposal. Nearly half of respondents reported strongly agreeing (47.2%) and agreeing (45.4%) that the mask effectively prevents respiratory diseases. Most of the respondents strongly agree (74.1%), followed by agree (23.8%), that the accumulation of plastic masks in the environment is a hazard to the environment. The result observed a significant relationship between gender and the practice of use and disposal of face masks.

Keywords: KAP Study, Face Masks, Safe Disposal, Pandemic, Sudan.

INTRODUCTION

The medical masks completely cover the mouth and nose. They protect healthy people and prevent onward transmission when in contact with an infected individual by reducing expiratory droplet spread [1-4]. Fabric or cloth masks trap droplets released when the person wearing the mask sneezes, coughs, or speaks. Surgical masks are also called medical masks. N95 masks provide a higher degree of protection than a surgical mask or cloth mask because they can filter out particles large and small when the wearer breathes in. Face masks with valves may make exhaling easier [5-8]. The mask is a source of contaminated biological waste. Asymptomatic individuals who wear masks can infect others due to viable microbial loads leaked from the masks. Transmission can occur after touching the mask, and the use of medical masks may lead to self-contamination [9-11]. Systematic searches of relevant articles stated that most participants had adequate knowledge of COVID-19. Despite adequate knowledge, the attitude was only sometimes positive, necessitating further education to convey the importance of forming a positive attitude and continuous preventive practice towards reducing contraction and transmission of COVID-19[12-16].

The Korean Centers for Disease Control and Prevention study showed a mediated relationship between knowledge and all three preventive behaviors (wearing facial masks, practicing hand hygiene, and avoiding crowded places)—the level of knowledge varied by sociodemographic characteristics. Females and individuals with higher education demonstrated higher levels of knowledge [17-18]. Systematic reviews and meta-analysis extensions for scoping reviews in sub-Saharan Africa showed that knowledge of COVID-19 is nearly universal, and uptake of COVID-19 prevention measures remains sub-optimal to defeat the pandemic. A cross-sectional study undertaken in UAE Showed that most participants agreed that wearing general medical face masks helps prevent one from contracting COVID-19[19-22].

Descriptive statistics in China were conducted to assess the public's mask-wearing behaviors; nearly all people wore a mask during the COVID-19 pandemic, with most demonstrating good compliance with face mask use. Another cross-sectional survey on all students studying at Phenikaa University regarding face masks the study found that most participants had good knowledge scores, 72.8% (530/728) had positive attitudes, 76.5% (557/728) had good practice scores [23-24]. In another study run among university students, staff, and faculty in America, Attitudes and behaviors towards mask-wearing among university students, staff, and faculty differ by race and ethnicity, wearing continues as a measure to reduce the risk of COVID-19 infection [25-26]. In a survey conducted in different regions of Sudan, approximately one-third of participants always wore a face mask during the pandemic, with age, sex, education level, family income, and face mask attitude. In another study conducted in Khartoum state in Sudan, most participants wear face masks only if it is necessary to enter a commercial store, governmental institution, or hospital. The remaining portion of the participants wore the mask only when they were with their family, friends, or at transport and parties [27-28]. In a descriptive cross-sectional study among Sudanese students enrolled in 10 universities in Khartoum state, about half of the participants had good knowledge; twenty-two percent reported a positive attitude, seventy-one percent reported a fair attitude, and only a few reported a negative attitude. Knowledge was significantly associated with age, gender, study level, and whether the participants were medical or nonmedical students [29-32]. With the global spread of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), disposable face masks (DFMs)

have caused adverse environmental impacts. During environmental degradation, disposal of face masks will release microplastics (MPs) and nano-plastics (NPs) [33-38]. Studies of face mask usage in Australia, America, the UK, Singapore, Sri Lanka, and India demonstrated that the additional enhanced face masks containing plastic contributed to micro-plastic pollution in the aqua environment and significantly impacted the soil. Most masks are treated as general waste and landfilled, generating secondary pollution, and releasing toxic gases and compounds [39-41]. Currently, studies estimate face mask usage globally, not focused on the environmental risks of face mask waste and improper disposal of used masks; therefore, the goal of this study is to assess the knowledge,attitude and practice toward using masks and disposal after usage in Sudan[42-49]

MATERIALS AND METHODS

This cross-sectional web-based investigation was undertaken at an enormous among students of public health and public health practitioners in Sudan, from the 5th of April to the 15th of July 2023. These multi-campus universities and sector healthcare institutes have over 282 Responses. Public health students and practitioners were selected for this study. An online questionnaire invitation was given to all targeted participants, along with information on the study's goal. They distributed a structured questionnaire (see Supplementary Materials) to participants via social media platforms like WhatsApp. Before attempting to fill out the responses, we asked each respondent for their informed consent by clicking on the consent statement. The data was analyzed descriptively using IBM SPSS version 29 (Chicago Inc., USA). We expressed the data in terms of the number of responses and percentages. Analytical statistics were calculated using cross-tabulation and the Chi-square test, with $p<0.05$ considered statistically significant. Limitations (methods of non-random samples and convinces samples thus led to response rate 282)

RESULT

Table 1: Shows the demographic characteristics of the participants

Variable	Frequency	Percentage
Sex	Male Female	45% 54.9%
Marital status	Married Unmarried	51% 48.9%
Age	18-30 30-60 More than 60	50.7 44.3 4.9
Degree	Dipo BSC Master Phd	1.06% 56.3% 22.6% 1.8%
Occupation	Health worker Faculty member Students	26.2 35.8 37.9

More than half of the participants are female (54.9%), and the rest (45%) are male. Half of the respondents are married, and nearly half (48%) are unmarried. Most participants are between 18 and 30 (50.7) years and between 30 and 60 years (44.3%); only 4.9% are older than 60. Regarding degrees and occupations, most respondents have a BSc degree (56.3%) followed by a master's degree (22.6%), with

few percentages observed for diploma and PhD degrees. Most participants are students (37.9%) and faculty members (35.8%); only 26.2% are health workers.

Table 2: Describe Participants' knowledge, attitude and practice of face mask disposal and usage

	Good	poor	overall
Knowledge	281(99.6%)	1 (.4%)	97.8%
Attitude	270 (95.7%)	12(4.3%)	65.4%
Practice	147(52.1%)	135(47.9%)	87.9%

The overall knowledge score was high (97.8%), and nearly all participants had good knowledge (99.6%) and attitude (95.7%) of face mask use and disposal. In terms of practice nearly half of the participants (52.1%) had good practice of face mask disposal, while the rest had poor practice (47.9%). An overall score is calculated as the number of respondents with the score. higher than the average score.

Table 3: Shows participants' knowledge of COVID-19 prevention

Questions	correct	incorrect
What are the methods to prevent coronavirus disease?	280(99.3%)	2(0.7%)
What is the best method to dispose of the face mask?	277(98.2)	5(1.8%)
What kind of environmental hazard is expected when unsafe disposal of the mask?	271(96.1%)	11(3.9%)
What are the diseases that can be prevented through the face mask?	276(97.9%)	6(2.1%)

The overall knowledge of COVID-19 prevention score was high (99.3%), and nearly all participants had good knowledge of the best method to dispose of the face mask (98.2%), all participants had good knowledge of environmental hazards of unsafe disposal of the mask (96.1%), and participants had good knowledge for diseases can be prevented through using Face mask.

Table 4: Describe Attitude of face mask use and disposal among respondents in Khartoum state

Question	Disagree	Natural	Agree	Strongly agree
Do you think the mask is effective in preventing respiratory diseases?	3 (1.1%)	18(6.4%)	128 (45.4%)	33 (47.2%)
Do you think the face mask is a medical waste?	14 (5%)	17 (6%)	111(39.4%)	140 (49.6%)
Do you think the accumulation of plastic masks in the environment is a hazard to the environment?	1 0(.4%)	5 (1.8%)	67(23.8%)	209(74.1%)
Do you think the unsafe disposal of masks is a source of infection?	4(1.4%)	10(3.5%)	70(24.8%	128(70.2%)

Table observed that nearly half of respondents reported strongly agreeing (47.2%) and agreeing (45.4%) that the mask effectively prevents respiratory diseases. Only a few of them reported disagreeing and natural. Half of the respondents strongly agreed that face masks are medical waste, while a few respondents did not think that face masks are medical waste. The question of the accumulation of plastic masks in the environment is a hazard to the environment; most of the respondents strongly agree (74.1%), followed by agree (23.8%), and only a few per cent reported disagree and natural. Most respondents who think that the unsafe disposal of masks is a source of infection reported strongly agree with 70.2% and agree with 24.8%. Few respondents did not believe the unsafe disposal of masks was a source of infection.

Table 5: Shows Practice and face mask use and disposal

Factors	Response	Percentage %
Do you use a mask for the prevention of respiratory diseases?	I don't use Some time Always	2.8 58.9 38.3
What type of mask do you use	Medical mask Non-medical reuse mask Surgical mask	83 12.1 5
How often do you reuse a mask	Once More than once Never reuse	33.3 31.2 35.5
How many hours do you use the disposal face mask?	4-6h More than 6h Less than 4h	29.1 31.6 39.4
When did you start using a face mask?	During pandemic Before pandemic	75.2 24.8
Do you wash your hands after disposing of the face masks?	I don't use Some time Always	13.8% 55.0 31.2%
In which of the following circumstances do you use a mask?	At the workplace Contact with patient. Inside house In hospital Outside house	3.9 4.6 2.8 8.9 79.8

The table showed that half (58.9 %) of respondents used the mask sometimes to prevent respiratory diseases, followed by 38.3% wearing the mask always to prevent respiratory diseases. In comparison, only 2.8% did not use the mask. Most respondents (83%) used medical masks, 12.1% used Non-medical masks, and only 5% of respondents used surgical masks. Regarding reusing the mask, 35.5% of respondents never reuse the mask, followed by 33.3%, who reuse the mask once, and 31%, who reuse the mask more than once. Most of the respondents (39.4%) use the disposal mask for less than four while the rest use the mask for 4-6 hours (29.6%) and more than six hours (31.4%). Half of the respondents reported that they sometimes washed their hands after disposing of the mask, only 31.2% always washed their hands after disposing of the face mask and the rest 13.8% did not wash their hands. Most respondents started using face masks during the pandemic, 75%, while the rest before the pandemic. Most respondents used face masks outside the house (79.8), and few per cent used masks when contacting patients inside and at the workplace.

Table 6: Association between demographic variables and Knowledge, and practice of face mask disposal

Variable	Knowledge level			Practices level		
	poor	good	sig	poor	good	sig
Married	0	144(100%)	0.306	74(51.4%)	70(48.6%)	0.227
Unmarried	1(0.7%)	137(99.3%)		61(44.2%)	77(55.8%)	
18-30years old	7%(1)	99%(142)	0.614	71(49.7%)	72(50.3%)	0.567
30-60	0%(0)	100%(125)		56(44.8)	69(55.8%)	
60 more	0%(0)	100%(14)		8(57.1%)	6(42.9%)	
diploma	0	3	0.855	3(100%)	0(0%)	0.226
BSC	1(0.6%)	158(99%)		79(49.7%)	80(50.3%)	
Master	0	64(100%)		27(42.2%)	37(57.8%)	
PHD	0	56(100%)		26(46.4%)	30(53.6%)	
Student	0	107(100%)	0.244	58(54%)	49(45%)	0.227
Health worker	1(1.4%)	73(98.6%)		34(45.1%)	40(54.9%)	
Faculty member	0	101		43(42.6%)	58(57.4%)	
Male	1(0.8%)	126(99.2%)	0.268	70(55.1%)	57(44.9%)	0.027
Female	0(0%)	155(100%)		65(41.9%)	90(58.1%)	

The table shows that the participants demonstrated good knowledge and practices of facemask disposal; the result observed that unmarried (55.8%) have better practices than married (48.6%), females (58.1)have better practices than males(44.9%) and those who have master's degrees (57.8%) have better practices than others. The result observed a significant relationship between sex and the practice of use and disposal of face masks, regarding the rest of the demographic factors, degree level, marital status, and age, no statistically significant difference is shown between these factors and the knowledge and practice of faces mask use and disposal.

Table 7: Correlation between facemask disposal knowledge and practices

	Practice	
Knowledge	**R**	**Sig**
	-.035	.557

The results of the correlation between knowledge and practices are shown in Table (7). The knowledge on facemask disposal was non significantly negatively related to ($r = -035$, $p < 0.05$) to the practices, increased knowledge associated with a decrease in practices or not associated with better practices.

DISCUSSION

Knowledge: the participant's knowledge is very high regarding methods to prevent coronavirus disease 280(99.3%), the method to dispose of the face mask is 277(98.2%), the environmental hazard is expected for unsafe disposal of the mask is 271(96.1%) and the diseases that can be prevented through the face mask is 276(97.9%), the knowledge is very high because the participants in the public health field, and their educations level high, this finding matches with studies done in South Korea, India, Malawi and South Africa showing that (86.7%) of participants wore a mask to prevent COVID-19. On July 31, 2020, the number of face masks used was estimated at 2,228,170,832 in 41 Asian countries. Improper disposal of face masks has a negative impact on health [12،6،17and18].

Attitude: according to the literature Wearing a facemask is the most effective intervention for preventing COVID-19 infection and controlling the spread of the virus, This study demonstrated that a significant of participants strongly agreeing and agreeing that the mask effectively prevents respiratory diseases while only a few of them reported disagreeing and natural while compared with study in KSA found same finding .The Saudi community is convinced about the face masks and believes that face masks play a predominant role in limiting the spread of SARS-CoV-2[12‘16‘ and 50]. This is observed as inconsistent between high knowledge about the importance of wearing a mask and attitude. The attitude about importance of wearing mask in preventing Covid-19 spread is not satisfactory compared with high knowledge of participants. This study is in line with the study conducted in India about KAP toward masks found the same inconsistency difference between knowledge and attitude [23،24،25 and 26]· This study found that half of the respondents strongly agreed and believed that face masks are medical waste, while a few respondents did not think that face masks are medical waste; this means the rest who do not believe the face masks are medical waste indicate they can throw it at the ground without proper disposal. Much literature highlighted the environmental effects of plastic and plastic particles due to the inappropriate disposal of facemasks; in this study, most respondents strongly agree and agree that the accumulation of plastic masks in the environment is

a hazard, and only a few per cent reported disagreement and that it is natural. According to the theory of Planned Behavior (TPB), the first determinant of an individual's intention to perform specific behavior is their attitude (ATT) towards that behavior. In a particular meaning, an attitude indicates the positive or negative evaluation of the behaviors [33-38]. The manner of usage and disposal of healthcare materials may raise the risk of infectious diseases. According to [9-11] our study revealed that most respondents strongly agree and agree that the unsafe disposal of masks is a source of infection. This finding indicates that participants had good intentions to perform good behavior toward using a face mask. Mask waste is increasing worldwide as people must follow the appropriate disposal methods for their masks. Thus, it creates a new environmental challenge [51,52and 53]. The amount of medical waste generated from COVID-19 since the outbreak is estimated to be 2.6 million tons/day worldwide. There are no suitable mask or plastic waste collecting methods in whole countries or parts of the region in Sri Lanka, India, Pakistan, and China [39-41]. Sudan, like other low-income countries, suffers from inappropriate mask disposal.

Practices: Half of the respondents (58.9 %) used the mask sometimes to prevent respiratory diseases, followed by 38.3% wearing the mask always to avoid respiratory diseases. Most respondents (83%) used medical masks, 12.1% used non-medical masks, and only 5% of respondents used surgical masks. Although the percentage of knowledge among participants is very high the practices are low this may be due to the shortage of face masks in Sudan and this agrees with [12-16] Despite adequate knowledge, the attitude was only sometimes positive, necessitating further education to convey the importance of forming a positive attitude and continuous preventive practice towards reducing contraction and transmission of COVID-19.

Regarding reusing the mask (35.5%) of respondents never reuse the mask, followed by (33.3%) who reuse the mask once, and (31%), who reuse the mask more than once. Most of the respondents (39.4%) use the disposal mask for less than four while the rest use the mask for 4-6 hours (29.6%) and more than six hours (31.4%). Half of the respondents reported sometimes washing their hands after disposing of the mask, only 31.2% always washed their hands after disposing of the face mask and the rest 13.8% did not wash their hand. This indicates many participants misused disposable face masks this agrees with [54] Good hand hygiene and face mask use were reported in less than one-third of the study participants. Most respondents started using face masks during the pandemic, 75%, while the rest before the pandemic. Most respondents used face masks outside the house (79.8), and few per cent used masks when contacting patients inside and at the workplace. This agrees with the statement by [27-28]. In a survey conducted in different regions of Sudan, approximately one-third of participants always wore a face mask during the pandemic,

CONCLUSIONS

Nearly all participants had good knowledge (99.6%) and attitudes (95.7%) of face mask use and disposal. Nearly half of respondents reported strongly agreeing (47.2%) and agreeing (45.4%) that the mask effectively prevents respiratory diseases. Most of the respondents strongly agree (74.1%), followed by agree (23.8%), that the accumulation of plastic masks in the environment is a hazard to the environment. The result observed a significant relationship between sex and the practice of use and disposal of face masks.

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