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## Nursing Students' Knowledge and Compliance with Precautionary Safety Measures Post COVID-19 Pandemic

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### Abstract

**Background:** Compliance with post- COVID-19 pandemic precautionary safety measures will likely vary depending on the country and local government. It is expected that precautionary safety measures will continue to be enforced in public spaces to prevent further infection spread. **Aim:** Assess nursing students' knowledge and compliance with precautionary safety measures post covid-19 pandemic. **Design:** Description study. **Setting:** Faculty of Nursing, Damanhour University. **Subjects:** A convenience sample of 1080 undergraduate nursing students from the four study levels. **Study tools:** Two tools were used. Tool (I) Nursing students' knowledge regarding COVID-19 precautionary safety measures questionnaire and Tool (II) Nursing students' compliance with precautionary safety measures post covid-19 pandemic questionnaire. **Results:** Showed that (65.7%) of studied students were female, (80.0%) had fair compliance levels, and (62.7%) had good knowledge, with a highly positive correlation between knowledge, and compliance pattern among the study group ( $p=0.025, r=-.068^*$ ). **Conclusion:** Students showed good knowledge and fair compliance level, with a statistically significant relationship with most of the students' demographic characteristics. **Recommendations:** Nursing students are a valuable source of public information and serve as a bridge between the healthcare industry and the public. Therefore, it is important to keep abreast of the latest updates with available knowledge of preventive precautionary safety measures and obtain information from reliable resources.

**Keywords:** *Compliance, COVID-19, Knowledge, Post Pandemic, Precautionary Measures & Students.*

### Introduction:

The Coronavirus disease (COVID-19) pandemic is an ongoing global pandemic caused by the novel coronavirus SARS-CoV-2 (Atzrodt et al., 2020). It has been two years since the COVID-19 pandemic was declared a global pandemic, and the world has been struggling to adjust to the new normal (Buheji & Buheji, 2020).

The impact of COVID-19 pandemic continues to affect human health around the world. With the passage of time, people's commitment to safety measures decreases due to their belief in the low number of Covid-19 cases, while at the beginning of January 2023, there have been 752,517,552 confirmed cases of COVID-19 and 6,804,491 deaths reported to the World Health Organization with, a total of 13,156,047,747 vaccine doses have been administered (WHO, 2023) which suggests that the danger still exists.

Therefore, hospitals and different other organizations must implement and make ensure they are compliant with new regulations and precautional safety measures and protocols to ensure the adequacy of knowledge, compliance, and safety for the general population (Akagbo et al., 2017).

Knowledge is an important factor in terms of

compliance with precautionary safety measures post-COVID-19 pandemic. The higher knowledge of COVID-19, the better the compliance with preventive behaviors. Post- COVID-19 pandemic compliance refers to the precautionary measures and regulations that individuals must follow to operate safely and effectively after the COVID-19 pandemic (Albaqawi et al., 2020).

These precautionary safety measures involve continuing to practice social distancing by staying at least 6 feet away from others in public spaces, wearing a mask or face covering in indoor public spaces, and when social distancing is difficult to maintain, washing hands frequently with soap and water for at least 20 seconds, avoid touching face, especially eyes, nose, and mouth. Also, stay home if feeling sick, when have been in close contact with someone who has COVID-19, or have recently traveled to an area with high rates of COVID-19, get vaccinated as soon being eligible (Deepa et al., 2022). Compliance with these measures is essential to protecting population health and safety especially as the pandemic continues. Nurses are members of health workers who are at the front line of the COVID-19 outbreak response and are exposed to different hazards that put them at different infection risks (Odikpo et al., 2022).

As well as nursing students are considered the futuristic generation in the nursing profession therefore nursing students must be well-versed in the knowledge and skills needed to ensure their and their patients' safety in all areas of nursing. Therefore, nursing students have a unique responsibility to acquire knowledge and understand the guidelines and protocols surrounding COVID-19 safety measures (Eriksson et al., 2018).

The nursing students should also have adequate knowledge related COVID-19 (nature of the disease, clinical manifestations, causes, prevention methods, transmission routes, epidemiological procedures, vaccination, safety measures, and environmental safety practices including regularly cleaning and disinfecting any surfaces, as well as properly disposing of potentially infectious materials) plays an important role in limiting the spread of the virus. As well compliance with personal precautionary safety measures is essential for the containment of the COVID-19 epidemic in the long term. (Zhou, (2020). In this regard the current study aims to assess nursing students' knowledge and compliance with precautionary safety measures post covid-19 pandemic

#### **Significant of study:**

Awareness of nursing students about scientific knowledge and their commitment to precautionary safety measures can reduce the spread of infection in their clinical workplace and among the general population. This in turn can ensure safety and maintain the wealth of health for all. Therefore, assessing knowledge and compliance with precautionary safety measures post-COVID-19 pandemic is essential and inevitable.

#### **Aim of the study:**

This study aims to assess nursing students' knowledge and compliance with precautionary safety measures post covid-19 pandemic.

#### **Research question:**

1. What is the nursing students' knowledge of precautionary safety measures post covid-19 pandemic?
2. What is the level of students' compliance regarding precautionary safety measures post covid-19 pandemic?
3. Is there a relation between nursing students' knowledge and their compliance levels regarding precautionary safety measures post covid-19 pandemic?

#### **Materials and Method:**

**Study design:** Description research design was utilized to conduct this study.

**Study Setting:** This study was conducted at the Faculty of Nursing, Damanhour University.

**Study Sample:** The study sample consisted of 1080 undergraduate nursing students who were drained from the four levels, (230 from the first level, 300 from the second level, 290 from the third level, and 260 from the fourth level) from both sexes who enrolled in faculty during the academic year (2022/2023) between October and November 2022, using an Arabic questionnaire constructed by Microsoft teams form shared to students' official groups.

The sample size was calculated by using the European Patent Institute (EPI) information, program version 7 (Epi info -7), calculating sample size at a confidence level, of 95%, a power value of 80%, percent 50%, and error 10%. The sample size was calculated to be 1080 undergraduate nursing students.

#### **Tools of the study:**

Two tools were developed by the researchers based on the review of recent related literature and translated into the Arabic language to collect the necessary data for this study.

#### **Tool I: Nursing students' Knowledge regarding COVID-19 precautionary safety measures questionnaire.**

##### **This tool included 3 parts:**

**Part I: students' Demographic data:** This part of the tool included students' demographic characteristics such as age, gender, marital status, academic degree, family income, and area of residence.

**Part II: students' previous incidence of COVID-19 infection:** This part included information related to; undergraduate nursing students' previous infection and vaccination related to Covid 19 which included information related to previous infection with covid 19, number of infections, covid 19 vaccination, reinfection after Covid 19 vaccination and relative or friends' history or deaths from covid 19 infection.

**Part III: COVID-19 precautionary safety measures Knowledge questionnaire:** This part was used to assess the baseline knowledge of undergraduate nursing students about COVID-19. It included a set of (36) questions about the following: a. Knowledge related to the nature of the Covid 19 (10 questions); b. Knowledge related to transmissions and infectiousness of COVID-19 includes (11 questions); c. knowledge related to common COVID-19 symptoms includes: (7 questions) and d. knowledge about measures to prevent the spread of the disease includes (8 questions).

A scoring system of students' knowledge was done as follows, each correct answer had one grade, while no answer or did not know was scored zero (some of the questions were reversed-scored). The scores obtained

for each set of questions that were summed to get the total scores for students' knowledge and were judged by using a scoring system as follows poor knowledge < 50%, fair knowledge 50 <75 %, and good knowledge 75% and more.

**Tool II: Nursing student's Compliance with precautionary safety measures post COVID-19 pandemic questionnaire:**

This tool was used to assess undergraduate nursing students' compliance with precautionary safety measures post-COVID-19 pandemic. It consisted of one part that measure the dimensions of nursing students' compliance in four subscales including: a. hand hygiene and breathing etiquette measures, b. wearing masks, c. healthy safety measures, and d. compliance to clean environment safety facilities precautionary measures.

The questionnaire items are a summated rating scale that included 27 items. Each item had 3 possible responses: 0 (never), 1 (sometimes), and 2 (always). The four subscale scores were obtained similarly by calculating the mean of the responses to each subscale item. Therefore, each of the four subscales scores could range from 0 to 2. Higher scores indicate a better compliance level. The total precautionary safety measures compliance score was judged by using a scoring system as follows, poor compliance < 50%, fair compliance 50 <75 %, good compliance 75%, and more.

**Validity and reliability of the tools:**

The initial version of the questionnaire was reviewed and judged by five experts in the field of medical-surgical nursing, Faculty of Nursing – Damnahour University to test its content validity, completeness, and clarity and accordingly needed modifications, correction, and clarifying of the items were done. The questionnaire's reliability testing for the study tools was estimated using Cronbach's Alpha test to measure its internal consistency to evaluate how well the tools consistently measure what they were designed to measure. It indicated that tools I, and II have a reliability  $r = 0.73$ , and  $0.84$ , respectively.

**Pilot study:**

A pilot study was conducted on 10% (108 students) of the students sample, who were not included in the study sample from the previously mentioned settings to test the clarity, feasibility, and applicability of the study tools, modifications needed were done. The data obtained from the pilot study were analyzed, and the final form of tools was reconstructed and ready for use.

**Fieldwork:**

The study was conducted from October 2022 to November 2022. The questionnaire link was posted to students' official groups. The researchers explained the aim of the study, the different parts and components

of the tools used, and student's oral instructions were given. The time needed to accomplish the questionnaire ranges from 7 to 10 minutes.

**Ethical consideration:**

Written approval to carry out the study was obtained from the ethical committee of the faculty of nursing, at Damanhour University on 15 September 2022. As well official permission to conduct the study was obtained from the Dean of the Faculty of Nursing, at Damanhour University. Each student enrolled in the study after providing comprehensive information about the nature of the study, its aim, and its benefits and voluntarily submitted their responses. Participants were informed that they have the right to refuse participation in the study and withdraw at any time. The privacy of the participants was maintained, and the confidentiality and anonymity of the obtained data were guaranteed.

**Statically analysis:**

After data collection, data were coded and transformed into specially designed forms to be suitable for computer feeding. All entered data were verified for any errors. The Statistical Package for Social Sciences (SPSS) program version 28.0 was used for the analysis of the data. Descriptive statistics (frequencies, percentages, and cross-tabulations) were performed. The differences between the studied variables were analyzed using chi-square tests for qualitative variables. The correlation was determined by Pearson's correlation coefficient. Regarding the P value, it was considered non-significant (NS) if  $P > 0.05$ , Significant (S) if  $P < 0.05$ , and Highly Significant (HS) if  $P < 0.01$ .

**Results:****Table (1): Frequency distribution of the studied students' demographic characteristics**

Students, Demographic characteristics	N= (1080)	%
<b>Age (in years)</b>		
▪ 18 –<20	427	39.5
▪ 20 –<23	611	56.6
▪ ≥23	42	3.9
<b>Mean ± SD</b>	20.13 ± 3.351	
<b>Gender</b>		
▪ Male	370	34.3
▪ Female	710	65.7
<b>Social status</b>		
▪ Single	976	90.4
▪ Married	103	9.5
▪ Divorced	0	0
▪ Widower	1	.1
<b>Academic level</b>		
▪ First level	230	21.3
▪ Second level	300	27.8
▪ Third level	290	26.9
▪ Fourth level	260	24.1
<b>Area of residence</b>		
▪ Rural	779	72.1
▪ Urban	301	27.9
<b>Family income</b>		
▪ Enough	761	70.5
▪ Not enough	319	29.5

**Table (2): Frequency distribution of the studied students in relation to previous incidence of COVID-19 infection:**

Previous incidence of COVID-19 infection:	N=	%
<b>Previous infection: have you had corona (COVID-19) infection before?</b>		
▪ No	700	64.8
▪ Yes Once	262	24.3
▪ Yes Recurrent	118	10.9
<b>Vaccination: Did you receive Covid 19 virus vaccine?</b>		
▪ Yes	969	89.7
▪ No	111	10.3
<b>If yes, did you have Covid 19 infection after vaccination?</b>	969	100
▪ Yes	45	4.6
▪ No	924	95.4
<b>Has any of your relatives or friends been infected with corona (COVID-19)?</b>		
▪ Yes	828	76.7
▪ No	252	23.3
<b>Did any of your relatives or friends die of corona (COVID-19)?</b>		
▪ Yes	489	45.3
▪ No	591	54.7

**Table (3): The means of nursing students' knowledge regarding COVID-19 safety measures:**

Knowledge domain	Mean ±SD
A.Nature of covid 19.	8.3167±1.6634
B.Mode of transmission of covid 19.	5.6944±2.4625
C.Clinical manifestation of covid 19.	5.7139±1.9231
D.Measures to prevent spread of the disease include of covid 19.	5.3565±2.1431
<b>Knowledge total scores</b>	<b>25.0815±6.1605</b>

Table (4): Frequency distribution of the students, according to domains of knowledge level percent scores with their academic level:

Knowledge domains	First level		Second level		Third level		Fourth level		Total		X <sup>2</sup> (P)
	N= 230	%	N= 300	%	N= 290	%	N= 260	%	N= 1080	%	
<b>Nature of the disease:</b>											
▪ Poor	8	0.70%	7	0.60%	3	0.30%	2	0.20%	20	1.9	<b>18.999<sup>a</sup> .004*</b>
▪ Fair	16	1.50%	47	4.40%	26	2.40%	25	2.30%	114	10.6	
▪ Good	206	19.1%	246	22.80%	261	24.20%	233	21.60%	946	87.6	
<b>Mode of transmission of COVID 19:</b>											
▪ Poor	85	7.90%	24	2.20%	73	6.80%	54	5.00%	236	21.90%	<b>99.589a &lt;.001**</b>
▪ Fair	84	7.80%	160	14.80%	172	15.90%	149	13.80%	565	52.30%	
▪ Good	61	5.60%	116	10.70%	45	4.20%	57	5.30%	279	25.80%	
<b>Clinical manifestation of COVID 19:</b>											
▪ Poor	45	4.20%	41	3.80%	17	1.60%	18	1.70%	121	11.20%	<b>34.357a &lt;.001**</b>
▪ Fair	5	0.50%	4	0.40%	11	1.00%	6	0.60%	26	2.40%	
▪ Good	180	16.7%	255	23.60%	262	24.30%	236	21.90%	933	86.40%	
<b>Measures to prevent the spread of the of COVID 19 include:</b>											
▪ Poor	29	2.70%	43	4.00%	17	1.60%	16	1.50%	105	9.70%	<b>23.369<sup>a</sup> &lt;.001**</b>
▪ Fair	109	10.10%	146	13.50%	171	15.80%	153	14.20%	579	53.60%	
▪ Good	92	8.50%	111	10.30%	102	9.40%	91	8.40%	396	36.70%	
<b>Knowledge total scores:</b>											
▪ Poor	26	2.40%	6	0.60%	0	0.00%	4	0.40%	36	3.30%	<b>68.465<sup>a</sup> &lt;.001**</b>
▪ Fair	74	6.90%	96	8.90%	108	10.00%	67	6.20%	345	31.90%	
▪ Good	130	12.00%	198	18.30%	182	16.90%	189	17.50%	699	64.70%	

Table (5): The relation between demographic characteristics of nursing students and their total knowledge scores:

Demographic data		Knowledge levels						$\chi^2$ P
		Poor		Fair		Good		
		N	%	N	%	N	%	
Gender	Male	18	1.7%	104	9.6%	248	23.0%	$\chi^2=7.015a$ P=.030*
	Female	18	1.7%	241	22.3%	451	41.8%	
Age	18 <20	28	2.60%	136	12.60%	263	24.4%	23.531a <.001**
	20 <23	8	0.70%	194	18.00%	244	22.6%	
	≥23	0	0.00%	15	1.40%	27	2.50%	
Academic level	First	26	2.40%	74	6.90%	130	12.0%	68.465a <.001**
	Second	6	0.60%	96	8.90%	198	18.3%	
	Third	0	0.00%	108	10.00%	182	16.90%	
	Fourth	4	0.40%	67	6.20%	189	17.50%	
Area of residence	Rural	27	2.50%	238	22.00%	514	47.60%	2.529a .282
	Urban	9	0.80%	107	9.90%	185	17.10%	
Marital Status	Single	36	3.30%	314	29.10%	626	58.00%	6.859a .144
	Married	0	0.00%	30	2.80%	73	6.80%	
	Widow	0	0.00%	1	0.10%	0	0.00%	
Average family income	Enough	27	2.50%	237	21.90%	497	46.00%	1.011a .603
	Not Enough	9	0.80%	108	10.00%	202	18.70%	
Total		36	3.30%	345	31.90%	699	64.70%	

**Table (6): Frequency distribution of the students, according to domains of compliance with precautionary Safety Measures Post COVID-19 Pandemic percent scores:**

A. Compliance with Hand hygiene and breathing etiquette measures	Never		Sometimes		Always	
	N=	%	N=	%	N=	%
1. Washing your hands frequently with soap and water for 20 sec at least?	0	0.00	886	82.0	194	18.0
2. If soap and water are not easily available, I use a hand sanitizer containing at least 60% alcohol.	0	0.00	921	85.3	159	14.7
3. The approximate number of times hands were washed, or hand sanitizer used the past day more than 10 times at least.	40	3.7	384	35.6	656	60.7
4. Are you using antiseptics?	0	0.00	669	61.9	411	38.1
5. How many times did you use antiseptics on the last day more than 10 times at least?	84	7.8	698	64.6	298	27.6
6. Cover mouth and nose when coughing, sneezing with a tissue, or using the inside of the elbow	46	4.3	148	13.7	886	82.0
7. Use the nearest waste receptacle to dispose of the tissue after use and wash your hand.	56	5.2	339	31.4	685	63.4
<b>Mean <math>\pm</math>SD 9.8361<math>\pm</math>1.405</b>						
<b>B. Compliance with wearing Mask.</b>						
8. Remember to wear a mask in closed places	0	0.00	873	80.8	207	19.2
9. Avoid touching the face mask and wash their hands frequently	0	0.00	969	89.7	111	10.3
<b>Mean <math>\pm</math>SD 2.2944<math>\pm</math>0.595</b>						
<b>C. Compliance with Healthy safety measures</b>						
10. Are you avoiding crowded places (like malls and markets)?	0	0.00	841	77.9	239	22.1
11. Do you avoid gatherings of more than 5 people in one place?	0	0.00	620	57.4	460	42.6
12. Are you avoiding the eyes, nose, and mouth touching with your fingers or hands?	0	0.00	919	85.1	161	14.9
13. Are you avoiding hands shaking with others?	0	0.00	617	57.1	463	42.9
14. Are you avoiding people hugging or kissing?	0	0.00	692	64.1	388	35.9
15. Are you keeping a distance between yourself and others (at least 1 m)?	0	0.00	594	55.0	486	45.0
16. Are you staying at home and do not leave except for necessity?	0	0.00	546	50.6	534	49.4
17. Are you avoiding friends' meetings?	0	0.00	554	51.3	526	48.7
18. Are you avoiding relatives' meetings?	0	0.00	318	29.4	762	70.6
19. Will you stay at home when feeling flu-like symptoms	16	1.5	819	75.8	245	22.7
20. Will you avoid fast/uncooked food?	0	0.00	944	87.4	136	12.6
<b>Mean <math>\pm</math>SD 15.0593<math>\pm</math>3.079</b>						
<b>D. Compliance with clean environment and safety facilitiesprecautionary measures</b>						
21. Disinfect surfaces and objects in places where you are present?	676	62.6	192	17.8	212	19.6
22. Disinfecting phone	578	53.5	363	33.6	139	12.9
23. Disinfecting Laptop	463	42.9	408	37.8	209	19.4
24. Disinfecting TV remote	507	46.9	376	34.8	197	18.2
25. Disinfecting bag handles	550	50.9	443	41.0	87	8.1
26. Disinfecting and cleaning frequently touched surfaces such as door handles windows, light sockets, and shelves.	757	70.1	215	19.9	108	10.0
27. Keep the environment well-ventilated and ventilated periodically with renewed Air by opening windows and doors as much as possible.	0	0.00	1029	95.3	51	4.7
<b>Mean <math>\pm</math>SD 4.6593<math>\pm</math>1.873</b>						
<b>Total compliance</b>	<b>Mean <math>\pm</math>SD 31.8491<math>\pm</math>4.26230</b>					

**Table (7): Frequency distribution of the students, according to domains of compliance percent scores with their academic level**

Compliance items		First level		Second level		Third level		Fourth level		Total		X2 (P)
		N=(230)	%	N=(300)	%	N=(290)	%	N=(260)	%	N=(1080)	%	
A. Compliance with Hand hygiene and breathing etiquette measures	Poor	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	14.905 <sup>a</sup> 0.002*
	Fair	84	7.80%	102	9.40%	115	10.60%	128	11.90%	429	39.70%	
	Good	146	13.50%	198	18.30%	175	16.20%	132	12.20%	651	60.30%	
B. Compliance with wearing Mask.	Poor	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	20.790 <sup>a</sup> <.001**
	Fair	195	18.10%	240	22.20%	200	18.50%	206	19.10%	841	77.90%	
	Good	35	3.20%	60	5.60%	90	8.30%	54	5.00%	239	22.10%	
C. Compliance with Healthy safety measures	Poor	20	1.90%	10	0.90%	15	1.40%	10	0.90%	55	5.10%	8.938 <sup>a</sup> 0.030*
	Fair	210	19.40%	290	26.90%	275	25.50%	250	23.10%	1025	94.90%	
	Good	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	
D. Compliance with clean environment and safety facilities precautionary measures	Poor	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	14.905 <sup>a</sup> 0.002
	Fair	84	7.80%	102	9.40%	115	10.60%	128	11.90%	429	39.70%	
	Good	146	13.50%	198	18.30%	175	16.20%	132	12.20%	651	60.30%	
E. Compliance total scores	Poor	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	39.699 <sup>a</sup> <.001**
	Fair	213	19.70%	234	21.70%	205	19.00%	212	19.60%	864	80.00%	
	Good	17	1.60%	66	6.10%	85	7.90%	48	4.40%	216	20.00%	

\* P < 0.05 (significant) \* Poor: (<50%) \* Fair: (50<75%) \* Good: (≥75)

**Table (8): The relation between sociodemographic characteristics of nursing students and their total compliance scores**

Demographic data		Compliance level						χ <sup>2</sup> P
		Poor		Fair		Good		
		N	%	N	%	N	%	
Gender	Male			288	26.70%	82	7.60%	χ <sup>2</sup> =1.644 <sup>a</sup> P=.200
	Female			576	53.30%	134	12.40%	
Total				864	80.00%	216	20.00%	
Age	18 –<20			360	33.30%	67	6.20%	χ <sup>2</sup> =17.342 <sup>a</sup> P=<.001**
	20 –<23			464	43.00%	147	13.60%	
	≥23			40	3.70%	2	0.20%	
Total				864	80.00%	216	20.00%	
Academic level	First			213	19.70%	17	1.60%	χ <sup>2</sup> =39.699 <sup>a</sup> P=<.001**
	Second			234	21.70%	66	6.10%	
	Third			205	19.00%	85	7.90%	
	Fourth			212	19.60%	48	4.40%	
Total				864	80.00%	216	20.00%	
Area of residence	Rural			627	58.10%	152	14.10%	χ <sup>2</sup> =.416 <sup>a</sup> P=.519
	Urban			237	21.90%	64	5.90%	
Total				864	80.00%	216	20.00%	
Marital Status	Single			780	72.20%	196	18.10%	χ <sup>2</sup> =.27 <sup>a</sup> P=.871
	Married			83	7.70%	20	1.90%	
	Widow			1	0.10%	0	0.00%	
Total				864	80.00%	216	20.00%	
Average family income	Enough			630	58.30%	131	12.10%	χ <sup>2</sup> =12.49 P=<.001**
	Not Enough			234	21.70%	85	7.90%	
Total				864	80.00%	216	20.00%	

**Table (9): Correlation between nursing students total knowledge score and total compliance score**

Compliance total score	Knowledge total score	
	P	0.025
R	-0.068*	

**Table (1):** Shows that the age of studied students ranged from (18 to 23) years old where ages (18 – <20) constituted the highest percentage for each age category of all academic levels. Females were more prevalent in the study sample than males; they constituted (65.7%) of studied students, rural residents constituted the higher percentage of the studied students (72.1%) and enough family income formed (70.5%) of the subjects.

**Table (2):** Shows that more than half of the studied students (64.8%) had no previous infection with COVID-19, while (35.2%) of them had once and recurrent previous of COVID-19 infections, where most of them received COVID-19 vaccination, with only (4.6%) of the studied students, stated that, they had recurrent infection post-vaccination. Also, it was found that more than three-quarters of the studied students (76.7%) have had relatives or friends been infected with COVID 19, and nearly half (45.3%) of them had relatives or friends who died from the COVID 19 infection.

**Table (3):** Represents means of nursing students' knowledge of COVID-19 precautionary safety measures, which are divided into four main domains including knowledge of the nature of the disease, transmission of disease, clinical manifestation, and measures to prevent the spread of disease, where the mean score knowledge score was (8.3167±1.6634), (5.6944±2.4625), (5.7139±1.9231) and (5.3565±2.1431) respectively, while the mean score of total knowledge was (25.0815±6.1605).

From **Table (4):** It can be seen that a statistically significant relationship was found among the four academic levels concerning their knowledge of the nature of the disease ( $p=.004^*$ ), while a highly statistically significant relationship was found among the four academic levels concerning their knowledge regarding mode of transmission, clinical manifestation and measures to prevent the spread of disease ( $p<.001$ ,  $<.001$ ,  $<.001$ ) respectively.

As well a highly statistically significant relationship was found among the four academic levels with their total knowledge score ( $P<.001$ ) where, a good knowledge score represented more than two-thirds of the studied students in the favor of the second level which represented the highest knowledge level among the four academic levels, followed by the fourth and third level.

From **Table (5):** It can be found that, the level of nursing student knowledge shows a statistically significant difference with gender ( $P=.030$ ). While it shows a highly statistically significant difference with students' age and academic level while no statistically significant relationship was found between undergraduate nursing student knowledge and their area of residence and family income.

**Table (6):** Shows the frequency distribution and means of nursing student's compliance with precautionary Safety Measures Post COVID-19 Pandemic, which is divided into four main domains including compliance with hygiene and breathing etiquette measures, compliance with wearing masks, compliance with healthy safety measures and compliance with environment and safety facilities.

The mean score of undergraduate nursing student compliance with hand hygiene and depressing etiquette measures was (9.8361±1.405). Regarding compliance with wearing the mask, the mean score represented (2.2944±0.595). Concerning the dimension related to compliance with healthy safety measures environment and safety facilities the mean score represented (15.0593±3.079) and (4.6593±1.873) respectively, while the mean total compliance score was (31.8491±4.26230).

**Table (7):** Identifies a statistically significant relationship among the four academic levels concerning their knowledge regarding the nature of the disease ( $P=.004^*$ ), while a highly statistically significant relationship was found among the four academic levels with their compliance to hand hygiene and breathing etiquette measures, and compliance to clean environment and safety facilities precautionary measures ( $P<.002$ ,  $<.002$ ) respectively.

Additionally, a statistically significant relationship was found among the four academic levels with the domain of compliance with health safety measures ( $P<.030$ ). While the highly statistically significant relationship was found among the four academic levels with their total compliance score ( $P<.001$ ) where fair compliance score represented most of the studied students in the favor of the second level which represented the highest compliance level among the four academic levels followed by third, fourth and first level.

From **table (8):** It can be found at, the level of nursing students' compliance shows a highly statistically significant difference with the student age, academic level, and family income ( $p<.001$ ), while no statistically significant relationship was found between undergraduate nursing student compliance and their gender, area of residence, or marital status.

This **table (9):** Shows a statistically significant correlation between nursing students' total knowledge score and total compliance score. ( $-.068^*$ ,  $p=.025$ ).

### Discussion:

The public's knowledge and compliance assessment toward infectious outbreaks are critical, especially given many misconceptions and false information circulating on social media about disease transmission

and methods of infection. This is critical for healthcare providers, service providers, medical and nursing students. In previous viral outbreaks such as SARS, MERS, and Ebola, such assessments have proven to be an important means of education and raising awareness of best practices (Geldsetzer., 2020).

Assessing the knowledge, and compliance of healthcare students regarding any infectious outbreak became a fundamental step to set an effective plan related to their preparedness (Al-Rawajfah et al., 2021). Accordingly, the current study aims to assess nursing students' knowledge and compliance with precautionary safety measures post covid-19 pandemic. Although the findings are specific to the COVID-19 post-pandemic era, they can also be applied to possible similar future infectious disease pandemics.

The current study results revealed that the overall knowledge of nursing students about the precautionary safety measures post covid-19 pandemic was good among the highest percentage of them. This may be a result of the spread of information about Covid 19 through different media, and also be due to the efforts made in disseminating COVID-19-related messages by governmental & non-governmental organizations, in addition to the application of workshops, and training programs related to the COVID pandemic and infection prevention as well nursing programs which enhance safety measures, such as proper handwashing techniques, sanitary protocols, and infection control guidelines.

Nursing programs as well prepare nursing students with necessary information related to the importance of epidemiology and the spread of germs, bacteria, and viruses, and can effectively educate their students on the best practices to maintain a safe environment. Nursing students also know how to properly use and dispose of medical equipment and supplies, and they are familiar with the necessary protocols for the proper use of personal protective equipment (PPE) which enhance their understanding of the importance of safety, to ensure that their practice is up to date and compliant with the latest regulations.

This finding comes in context with Calistus et al. (2022) who revealed that overall, student nurses have good knowledge of the preventive measures for COVID-19. Additionally, Nicholas et al. (2020), reported in their study that the participants were aware of infection prevention measures. Along the same line Ronald et al. (2020) and Odikpo et al. (2021) agreed with the findings of the current study and reported sufficient students' knowledge of preventive strategies for COVID-19.

Contrarily, to the finding of the current study, Al-

Rawajfah et al.(2021) revealed in their study that the overall knowledge of healthcare students about the current COVID-19 is not optimal, as only about one-quarter of the sample scored more than 75% of the maximum score. Furthermore, Chen et al., (2020) also find inadequate awareness of COVID-19 infection prevention practices among health workers.

The current study findings reveal a statistically significant relationship among the four academic levels with their knowledge regarding the nature of the disease, a highly statistically significant relationship concerning their knowledge regarding mode of transmission, clinical manifestation, and measures to prevent the spread of the disease. As well a highly statistically significant relationship with their total knowledge score where, a good knowledge score represented more than two-thirds of the studied students in the favor of the second, third, and fourth levels which represented the highest knowledge level among the four academic levels.

This may be attributed to that usually, with advanced higher-level with more training and clinical experience, clinical rotations in a hospital setting, enhance students' knowledge and practices which indicates that higher-level students typically have a more in-depth understanding of their chosen subjects, especially if they have been studying them for several years. They may also have access to more sophisticated resources and technology, allowing them to gain greater insight into the topics. Higher-level students also typically have more experience with their discipline, giving them a better understanding of how to apply their knowledge in real-world settings.

While for the first level, they are junior's students which means that they have less exposure to the pathophysiology and treatment options of COVID and similar conditions. These findings come in agreement with Khasawneh et al. (2020) & Hamza et al. (2021) who reported in their study that knowledge level is usually more advanced in higher-level medical students. As well Olum et al. (2020) also found that senior students in the clinical years had a higher level of knowledge than their counterparts in academic ones.

The study findings also show a statistically significant difference between the total knowledge score and student age & gender while no statistically significant relationship was found between undergraduate nursing student knowledge and their area of residence and family income. This may be attributed to that female students tend to perform better academically than male students, which could be due to disparities in educational opportunities, and differences in learning styles. Additionally, certain gender-based expectations and stereotypes may predispose female

students to higher levels of academic success than male students. Also, higher-level educated students would have a better opportunity to use different mass media to obtain relevant information about COVID-19.

In the same context, **Sultan et al. (2022)** in their study, found that the level of female knowledge is significantly higher than that of males. However, this finding was partially supported by **Kiros et al. (2023) & Zhong et al. (2020)**, who revealed in their study that the demographic variables age, and family income were significantly associated with good knowledge of the study participants toward COVID-19 and its preventive measures.

Additionally, **Saeed et al. (2021)** concluded in their study that Socio-demographic characteristics such as age, marital status, gender, and level of education were statistically related to a higher mean score of knowledge and practice towards the virus. However, contrary to the result of this study, **Yakar et al. (2020)** reported that the knowledge score of males was significantly higher than females.

Furthermore, other studies conducted by **Taghrir et al. (2022) & Modi et al. (2020)** found that there was no significant relationship between sex and knowledge, The result of this study also, revealed that 20.0% of the nursing students had good compliance levels with COVID-19 precautionary safety measures, while the highest percentage have fair compliance levels with a highly statistically significant relationship found among the four academic levels with their total compliance score.

This result may be related to the high knowledge level among the studied Nursing students and that nursing students typically have a high level of compliance with safety measures and protocols due to their educational background. Nursing students are required to learn and understand a variety of safety protocols as part of their core curriculum, which helps to instill a strong sense of responsibility when it comes to following safety guidelines.

Nursing students also receive an abundance of hands-on experience in a clinical setting, which helps to develop a deeper understanding of how to apply safety protocols practically. Overall, nursing students are well-equipped to consistently comply with safety guidelines and regulations, making them one of the most reliable groups when it comes to compliance.

This result goes in the same line with **Moradzadeh et al. (2020)** who concluded that improving practice toward COVID-19 preventive measures can be achieved only by improving students' knowledge and beliefs. Also, **Alzoubi et al. (2020)** indicated that a higher knowledge level resulted in an overall high level of attitude and good practice towards the disease preventive measures and their responses if contracted

infection among studied students.

Despite these supportive studies, in similar studies on compliance with standard precautionary measures among health workers, **Tariku et al. (2017)** reported a finding of very low or inadequate practice in their study. Along the same line, **Cooper et al. (2020)** reported poor compliance with standard precautions among the studied sample.

Regarding the relation between demographic characteristics of nursing students and their total compliance scores, the current study revealed that the level of undergraduate nursing students' compliance shows a highly statistically significant difference with age, academic level, and family income, while no statistically significant relationship was found between undergraduate nursing students' compliance and their gender, area of residence, or marital status.

However, **Calistus et al. (2022)** study concluded that knowledge, sex, level of education, and years of experience, are determinants of high compliance level to preventive measures for COVID-19. As well, **Soltan et al., (2020)** revealed a higher significant level of adherence to COVID-19 preventive measures among both females and senior students.

On the other hand, **Ahmed. (2022)** concluded that there was no significant difference relation with the adherence status of studied students and their sociodemographic variables (age, residence, and family income) and the academic variables (studying year and academic score) and rationalized the absence of significance in the study to be due to statistical reasons where a larger sample size was needed to yield significant results. However, it may be because of the students' narrow age range (18–26) and their educational similarity which overwhelmed the effect of residence and income differences and led to this insignificant difference.

Moreover, on studying the correlation between knowledge and compliance with precautionary safety measures, it was found that there was a significant correlation between them ( $P < 0.025$ ). Likewise, **Huynh et al., (2020)** mentioned that as the level of knowledge increases, favorable practices increase as well accordingly. Along the same line, **AL-Rawajfah et al. (2021)** in their study concluded that there is a significant positive relationship between students' knowledge and precautionary practices. These results should inform health professionals and academic educators about their responsibility of working on these factors to enhance the role of nursing students against the infectious pandemic.

### Conclusion and Recommendations:

Overall, the COVID-19 pandemic has presented unique challenges for nursing students to stay compliant with their educational requirements.

However, with proper planning and resources, nursing students can stay compliant while also taking advantage of the opportunities presented by the new digital environment. Therefore, health professionals and academic educators should:

- Be respondents to any pandemic and set plans related to nursing students' education.
- Updating nursing students with the most reliable information about the pandemic should be a priority for health professional educators.
- Develop new educational methods that enhance the knowledge, compliance, and experiences exchanged among nursing students.

#### Declaration of interest:

The contents of the paper and the opinions expressed within are those of the authors, and the authors decided to submit the manuscript for publication. All authors report no conflicts of interest relevant to this work.

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