

# Adherence to Preventive Measures and Suspected Covid-19 Symptoms Development Among Nursing Students During Written Exams

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## Abstract

**Background:** Higher education has faced numerous challenges due to the COVID 19 outbreak, and written exams conduction with strict precautionary measures is one of them. **Study aims** were to evaluate adherence to preventive measures and factors affecting suspected COVID-19 symptoms development during exams. **Subjects and method:** a repeated cross sectional study was conducted at Mansoura University Nursing Faculty. The participants were nursing students at the fourth level and the calculated sample size was 215. Students were videotaped to assess their adherence during the exam hours using observation checklist and suspected COVID 19 symptoms were measured using the baseline questionnaire and were measured for 6 weeks every two weeks. **Results:** One or more suspected symptoms of COVID 19 had formed among 60.4% of students who were significantly higher at the first two weeks of exams. The mean hourly contact of the T zone was (13±11.3) and only (42.4%) of students wear the mask all exam time. **Conclusion:** Higher T zone touch, less adherence to mask wearing all exam time and less reported adherence directly predicting suspected COVID 19 symptoms occurrence. **Recommendations:** Raising students' awareness and finding new strategies to improve students' adherence to preventive measures during written exams is of great value during this epidemic.

**Key words:** preventive measures adherence, nursing students, COVID 19 suspected symptoms, written exams

## Introduction

On 11 March 2020, Coronavirus disease 2019 (COVID-19) outbreak was officially declared by the World Health Organization (WHO) as a pandemic (WHO, 2020a). As a precaution in the whole world, Egypt imposed lock down measures and schools and universities were all temporarily closed at this time (Crawford et al, 2020). Social distancing is the most efficient strategy to prevent COVID-19 and to comply with this measure education and exams were held online for all students using pass and fail evaluation except final year students' exams were postponed (Mohammad et al,2020;Tokuç & Varol,2020).

Respiratory droplets are a major rout for virus transmission. It can spread by coughing, sneezing, or touching infected surfaces and then touching the mucus membranes of T-zone (eyes, nose, and mouth) (Rahman et al, 2020). Following COVID 19 preventive measures including regular hand hygiene, avoid touch T

zone, practicing respiratory etiquette, wear mask in public places, maintain social distance, and stop going to crowded locations, is considered the best way to avoid and slow down its transmission (Maier & Brockmann,2020; West, Michie, Rubin,& Amlôt, 2020). Individuals with any of the following symptoms are suspected of COVID-19 according to the Center for Disease Control and Prevention (CDC): fever or chills, shortness of breath or difficulty, cough, new loss of taste or smell, muscle or body aches, fatigue, headache, congestion or runny nose, sore throat, nausea or vomiting, and diarrhea (CDC, 2020; Do et al,2020).

COVID-19 has spread to more than 216 countries as of June 27, 2020, causing approximately 9,843,073 confirmed cases. In Egypt, the number of confirmed cases was daily increasing; with 63,923 cases reported through cluster transmission and the overall prevalence was 625 per million people (Egypt Cabinet Information and Decision Center,2020).Starting from this date, most

COVID-19 restrictions were lifted, government decided to coexist with virus and hold written exams for final year students with an emphasis on following the precautionary measures, this was the first return of students to university after complete lockdown (**Egypt Independent, 2020**).

### Significance of the study

Monitoring online exams is difficult and cheating can go unbridled (Jervis & Brown, 2020). In contrast, written Exams are good deterrents against cheating but they are stressful environments linked to immunosuppression and a place for student meeting, which may increase their risk of COVID 19 infection during exams (**Kumar, Bishnoi, & Vinay, 2020; Trueba, Smith, Auchus & Ritz 2020**). Strict adherence to preventive measures is essential to control infection in higher education institutions and only reported adherence is tested in most recent studies (**Soltan, El-Zoghby, & Salama, 2020; Taghrir, Borazjani, & Shiraly, 2020; Wilson et al, 2020**). To the best of our knowledge, no research observed the adherence level to COVID-19 preventive measures among nursing students throughout the exams period. Furthermore, nursing students are potential practitioners who can manage arising infectious diseases (**Kim & Choi, 2016**) and the identification of behavior trends could direct the designing of better curricula regarding COVID-19 for final year nursing students' preparation to the internship year.

### Study aims

The aims of the study were

- (1) To evaluate both reported and observed levels of adherence to corona virus disease 19 preventive measures during written exams among nursing students.
- (2) To evaluate incidence of suspected covid-19 symptoms among nursing students during the written exams period and factors affecting their development.

### Research questions

- 1- What are the levels of adherence to coronavirus disease 19 preventive measures

among nursing students undergoing written exam?

- 2- Are there suspected symptoms to COVID-19 arising among nursing students undergoing written paper exam and what are factors affecting their development?

### Subjects and Method

#### Research Design:

A repeated cross sectional design was used.

#### Setting:

Participants were recruited from faculty of nursing Mansoura University.

#### Subjects:

A total of 489 students were undergoing written exam this year. The needed convenient sample size of 215 was calculated using [www.raosoft.com/sample\\_size.html](http://www.raosoft.com/sample_size.html). Based on the target population, a confidence level of 95% and 5% margin of error and anticipated frequency of 55.3%, in view of study done at china which reported that 55.3% of participants didn't wash their hands after mask touch (**Tan, Wang, Luo & Hu 2020**). The inclusion criteria were fourth level nursing students who agreed to participate, hadn't diagnosed with COVID-19 before, both genders, had access to internet and had whatsapp account.

#### Tools for data collection

Four tools were used in this study:

**Tool I: The demographic data and risk factors sheet** that included age, gender, residence, previous contact and presence of chronic disease.

**Tool II: The COVID-19 reported preventive behavior scale** assessed the students, reported adherence to preventive measures. It was developed by researcher and included previously validated and reliable 42 items used in previous studies (**Kim & Choi, 2016; Nicas & Best, 2008; Sultana, Mahumud, Sarker, & Hossain, 2016; Taghrir et al, 2020**). It consisted of 6 parts: hand hygiene practices (18 item), social distancing (8 items), respiratory hygiene (6 items), cleaning and disinfection (2 items), keeping immunity (4 items) and nurse role model (4 items). Each item was answered as

“always” (4) or “sometimes” (3) or “rarely” (2) or “never” (1). The total score was converted to a percentile and the level of adherence was classified as low if <50%, moderate if from 50 to < 75%, and high if  $\geq 75\%$ .

**Tool III: The Adherence to preventive measures observation checklist**, It was developed after thorough review of literature (Maier & Brockmann, 2020; West et al, 2020) and evaluated students for mask, face, T zone touch, hand hygiene frequency before t zone touch or after mask touch, and the time of wearing mask.

**Tool IV: The COVID-19 suspected symptoms frequency sheet**; assessed the appearance of suspected symptoms including ( fever, dry cough, shortness of breath, new loss of taste or smell, muscle pain, chills, sore throat, fatigue, congestion or runny nose, headache, nausea and diarrhea) . Any student reported presence of one or more of these symptoms at any follow up point were counted as suspected COVID-19 case (CDC, 2020; Do et al, 2020).

#### *Validation and pilot study*

All tools were face validated by a jury of five specialists in the field of medicine and nursing and there are no significant adjustments. Tool I, tool III and tool IV had an average content validity index (CVI) of 1.0 and tool II had an average CVI of 0.93. A pilot study was carried on 25 students, to test the clarity and reliability of the tools with acceptable Cronbach's  $\alpha$  for tool II (0.74) and tool IV (0.68).

#### *Data collection*

The data for this study were collected during exam period (six weeks) at four points from the 5<sup>th</sup> of July 2020 to the 16<sup>th</sup> of August 2020, point zero at the beginning of exams, point one after two weeks of exams, point two after four weeks of exams and point four two weeks post exams. At point zero, an online questionnaire using Google forms was developed and sent on 4th year whatsapp group before exams and it involved informed consent and tool I, II and IV. Students were informed that part of the study will be conducted during exams and this will require students to be observed. Students were not informed about

which behaviors will be observed or the exam that will be videotaped using high quality camera in exam halls; to minimize the potential for behavior change. The recorded video for three-hour exam was analyzed using tool 3 for preventive measures adherence. At point 1, 2 and 3 suspected COVID 19 symptoms development in the preceding two weeks were assessed using tool IV via Google forms.

#### *Ethical consideration*

Ethical Approval was obtained from the Faculty of Nursing – Mansoura University research ethics committee (research no. 0203). Official written permission to carry out the study was got from dean of faculty. Informed consent was obtained from all study participants and the study conforms to Declaration of Helsinki principles (Rickham, 1964).

#### *Statistical analysis*

Data were analyzed using SPSS version 20.0. The means and standard deviations were calculated for numerical variables and the frequencies and percentages were computed for categorical variables. None of the main outcomes followed a normal distribution. Cochran's and Friedman tests were used for repeated measures and Dunn's test for post hoc test comparisons. Mann-Whitney U-test, Chi-square test and fisher exact test were used to analyze relation between socio-demographic characteristics, risk factors and adherence with symptoms development. All factors that had significant association with symptoms development were tested by building binary logistic regression models with a forced entry method.

#### **Results**

At T0, the online questionnaire was completed by a total of 186 students, which is an 86.5 % response rate. However, the follow-up responses were slightly lower, with 166 at T1 and 144 at T2 and T3. Of the original 144 students completed the study (response rate 67%), this group was used for future analysis of symptom development during exam 6 weeks period.

**Demographics and risk factors**

In the present study the majority of participants students were female (77.8%) with mean age (22) and live in rural areas (72.2%). Regarding risk factors, 13.2% reported contact with suspected or confirmed case and 4.7% had chronic disease (Table1).

**Reported adherence level**

For adherence the total mean percentage adherence score was (88%) with most students had high adherence level regarding all domains (Table 2).

**Observed preventive measures adherence during exams**

For observed preventive measures adherence during exams students had high hand touch to mask and t zone with total touch per hour for mask was (38.3±17.6) and for T zone was (13±11.3). In addition, only (42.4%) of students wear mask all exam time and no students had performed hand hygiene after mask touch or before touching T zone (Table 3).

**Suspected COVID 19 symptoms development over exam period**

The results of the Friedman and dunn's test revealed a significant change over time in

symptom development with the highest rate (52.8%) occurred at the first two weeks of exams, and with a significant difference (p0.000) was found between point one, point zero and 4,also between point zero and point two (Table 4).

**Relation between suspected symptoms development and different influencing factors**

Results showed no significant relation between sociodemographic characteristics and suspected covid-19 symptoms development. A significant relation was found between suspected symptoms development and mask touch, face touch, t zone touch, mask adherence and reported adherence (P<0.001) (table5).

**Factors affecting student's likelihood to develop symptom over study period**

Results from the Binary logistic regression revealed that ; Compared to students who were the mask all the time,students who didn't wear the mask all exam time were about 7 times (OR: 6.682, 95% CI 2.171–20.568, p=0.001) more likely to develop symptoms. Also increase t zone touch and less reported adherence were associate with an increased likelihood to develop symptoms (OR: 1.073, 95% CI 1.007–1.142, p=0.029; 1.063; OR: 0.961, 95% CI 0.930–0.993 p=0.017) respectively (table6).

**Table 1.** Sociodemographic characteristics and risk factors among participated nursing students (N= 144).

Item	No 144 (%)
Gender	
Male	32 (22.2%)
Female	112 (77.8%)
Mean age	22 ± 0.06
Faculty level	
Fourth level	144 (100%)
Residence	
Rural	104 (72.2%)
Urban	40 (27.8%)
Living condition	
Single family home	116 (80.6%)
multiple family home	24 (16.7%)
Hostel or with friends	4 (2.7%)
Previous contact with suspected or confirmed COVID19 case	
Yes	19 (13.2%)
No	125 (86.8%)
Have chronic disease	
Yes	6 (4.7%)
No	138 (95.3%)

**Table 2.** Reported preventive measures adherence among participated nursing students (N = 144)

Adherence scores	Mean (%)	Level		
		Low	Moderate	High
Hand hygiene	89.6	1 (0.7)	9 (6.3)	134 (93)
Social distancing	85.5	2 (1.4)	18 (12.5)	124 (86.1)
Respiratory hygiene	90	0 (0)	7 (4.9)	137 (95.1)
Cleaning and disinfection	89.5	0 (0)	16 (11.1)	128 (88.9)
Keeping immunity	82	2 (1.4)	31 (21.5)	111(77.1)
Nurse role model	87.9	0 (0)	14 (9.7)	130(90.3)
Total adherence score	88	1 (0.7)	10 (6.9)	133(92.4)

**Table 3.** Observed preventive measures adherence among participated nursing students during exams (N=144)

ITEMS	MEAN ±SD\ NO (%)
Mask touch	38.3±17.6
Eye touch	6.3±4.8
Mouth touch	3.2±4.1
Nose touch	3.6±4.1
Total T zone touch	13±11.3
Face touch	23±10.8
Mask wearing all exam time	
Yes	61 (42.4%)
No	83 (57.6%)
Hand hygiene after mask touch or before touching t zone	
No	144 (100%)

**Table 4.** Suspected COVID 19 Symptoms development among participated nursing students along 8 weeks period (N=140)

Symptom	To 2 wks. pre exams	T1 1 <sup>st</sup> 2 wks. of exams	T2 2 <sup>nd</sup> 2 wks. of exams	T3 2 wks. of after exams	Total T1-T3 #	P- value
Fever	3 (2.1%)	8 (5.6%)	5 (3.5%)	2 (1.4%)	13 (9%)	
Dry cough	3 (2.1%)	8 (5.6%)	6 (4.2%)	6 (4.2%)	15 (10.4%)	
Shortness of breath	3 (2.1%)	11(7.6%)	10(6.9%)	6 (4.2%)	21 (14.6%)	
New loss of taste or smell	1 (0.7%)	4 (2.8%)	2 (1.4%)	0 (0.0%)	4(2.8%)	
Muscle pain	7 (4.9%)	26 (18.1%)	12(8.3%)	10(6.9%)	30 (20.8%)	
Chills	2 (1.4%)	1 (0.7%)	1 (0.7%)	2 (1.4%)	4 (2.8%)	
Sore throat	5 (3.5%)	13 (9.0%)	9 (6.3%)	7 (4.9%)	22 (15.3%)	
Fatigue	9 (6.3%)	42 (29.2%)	34 (23.6%)	24 (16.7%)	55 (38.2%)	
Congestion or runny nose	6 (4.2%)	14 (9.7%)	8 (5.6%)	4 (2.8%)	19 (13.2%)	
Headache	9 (6.3%)	63 (43.8%)	38 (26.4%)	25 (17.4%)	72 (50.0%)	
Nausea	0 (0.0%)	7 (4.9%)	7 (4.9%)	3 (2.1%)	12(8.3%)	
Diarrhea	0 (0.0%)	16 (11.1%)	7 (4.9%)	3 (2.1%)	20(13.9%)	
Number of students who develop one or more Symptom						
Yes	17 (11.8%)	76 (52.8%)	57 (39.6%)	36 (25%)	87 (60.4%)	P<0.001*
No	127 (88.2%)	68 (47.2%)	87 (60.4%)	108 (75%)		
Median (IQR)	0(0-0) <sup>a</sup>	1(0-2) <sup>b</sup>	0(0-2) <sup>c</sup>	0(0-0.75) <sup>d</sup>		P<0.001**
		b>a <sup>^</sup>	c>a <sup>^</sup>			
		b>d <sup>^</sup>				

#Not mutually exclusive

\* Cochran's test p &lt; 0.05

\*\* Friedman test p &lt; 0.01

<sup>^</sup> Dunn's post hoc test

**Table 5.** Relation between suspected symptoms development and different influencing factors. N=144

Factors		Symptom development		P value
		Yes N(%) / M(R)	No N(%) / M(R)	
Median Age		22(5)	22(2)	0.20 <sup>+</sup>
Gender	Male	16 (50%)	16(50%)	0.17 <sup>++</sup>
	Female	71(63%)	41(37%)	
Residence	Rural	66(63%)	38	0.22 <sup>++</sup>
	Urban	21(52%)	19	
Living condition	Single family home	47(40.5%)	69(59.5%)	0.87 <sup>+++</sup>
	multiple family home	9(37.5%)	15(62.5%)	
	Hostel or friends	1(25%)	3(75%)	
Previous contact with suspected or confirmed COVID19 case	Yes	4 (66.7%)	2(33.3%)	0.74 <sup>++</sup>
	No	83(66.4%)	55(33.6%)	
Have chronic disease	Yes	6 (100%)	0 (0%)	0.08 <sup>+++</sup>
	No	81(58.7%)	57(41.3%)	
Median mask touch		44(101)	30(99)	< 0.001 <sup>+</sup>
Median T zone touch		19(48)	3(43)	< 0.001 <sup>+</sup>
Median Face touch		26(62)	17(60)	< 0.001 <sup>+</sup>
Median reported adherence		147(97)	158(54)	< 0.001 <sup>+</sup>
Mask wear all exam time	Yes	17(28%)	43(72%)	< 0.001 <sup>++</sup>
	no	70(83%)	14(17%)	

<sup>+</sup> Mannwhitney <sup>++</sup> Chisquare M(R) median (range)

<sup>+++</sup> Fisher exact test P value significant < 0.05

**Table 6.** logistic regression of Factors affecting participated nursing students' likelihood to develop symptom over study period

Item	Develop one or more symptoms (N = 87)			
	Odds ratio	95% C.I		P value
		Lower	Upper	
Mask touch	0.980	0.952	1.010	0.185
T zone touch	1.073	1.007	1.142	0.029
Face touch	0.999	0.955	1.045	0.966
reported adherence	0.961	0.930	0.993	0.017
Mask wearing all exam time				
Yes	Ref			
No	6.682	2.171	20.568	0.001

P value significant < 0.05

## Discussion

Holding online exams pose many challenges like technical problems and deceitful behaviors which is a dilemma for students to finally graduate (**Chirumamilla, Sindre & Nguyen-Duc,2020**). In Egypt due to COVID 19 risk, written exams were held with precautionary measures for only final year university students. We hypothesized that student's adherence to preventive measures would predict suspected COVID 19 symptoms development.

## Reported adherence to preventive measures

In the present study regarding reported adherence to COVID 19 preventive measures the total mean percentage score was high and respiratory hygiene and hand hygiene adherence occupied the highest ranks. These results are in accordance with a study conducted at Italy among nursing students which reported good practice scores regarding COVID19 (**Provenzano et al,2020**). Also, a study conducted at Jordan reported that, more than four fifths of medical students adopted social isolation strategies and regular hand washing as their first line of defense against the virus (**Khasawneh et al, 2020**).

### *Observed adherence to preventive measures during exams*

In the present study students despite wearing mask they touch T zone on average of 13 touch per hour (T/h) with total face touches of 36 T/h. This was supported by a study of volunteers which reported T zone touch of 15.7 T/h (Nicas & Best, 2008). A systemic review reported higher results with total face touch of 50T/h (Rahman, Mumin & Fakhruddin, 2020). This result disagree with another study which reported 5.4 face T/h while wearing mask and 20 face T/h while not wearing mask (Lucas, Mustain & Goldsby, 2020). This may be due to that our study assessed students in closed places (exam halls), hot weather and no fans or conditioners fearing of COVID 19 spread, also exams as a stressful and cognitive load affect students' awareness to face touch (Mueller, Martin & Grunwald, 2019).

In the present study students touch front of their mask on average of 35 T/h and most students not performed hand hygiene after mask touch or before T zone touch. These results support WHO recommendations that face mask has the potential to increase risk of self-contamination due to the manipulation of a face mask and subsequently touching eyes, nose and mouth with contaminated hands (WHO, 2020b). Higher results were reported by a study at china among public that only more than half of those who touched or adjusted their mask failed to consistently wash their hands afterward (Tan et al., 2021). This highlighted the need to raise students' awareness during exams that touching face and mask is common and a possible vector in self-inoculation. This would reduce this habit and increase nursing students' adherence to hand hygiene, emphasize that every student must have his/her personnel alcohol gel.

Mask noncompliance is a frequently reported problem, in the present study only about two fifths of students wear mask all exam time. This was supported by a study which reported that young adults aged 18-24 years had lower agreement and adherence to wearing mask compared with those more than 25 years (Czeisler et al., 2020). Another study conducted in Singapore during the SARS outbreak, only 4% of the respondents had worn

a facemask in the preceding three days (Quah & Hin-Peng, 2004). This may be due to that wearing face masks results in the development of itch in many subjects (Szepietowski et al., 2020) and produces a significant increase in skin temperature and this finally may lead students to uncover nose or remove mask (Scarano, Inchingolo & Lorusso, 2020). This raise concern if special face shield can replace face mask in hot weather and to maintain constant temperature in exam halls.

### *Suspected COVID 19 symptoms development during exam period*

In our study written exams were the first return of students to universities after locking down. Throughout the study period about three fifths of students develop one or more suspected COVID 19 symptoms with a significantly higher frequency occurred during exam period than pre or post exams. The most common symptoms were fatigue, headache, muscle pain, sore throat, cough, shortness of breath, diarrhea, fever and only 2.8% lost taste or smell. This agreed with a study conducted in North Carolina University that reported rapid increases in COVID-19 cases occurred within 2 weeks of opening university to students (Wilson et al., 2020).

Another study conducted among college students post spring break reported that about three fifths of students had suspected COVID 19 symptoms; the most common symptoms were cough, sore throat, headache, shortness of breath, muscle aches, diarrhea and fever but with 17.2% lost taste and smell which is higher than our study, this may be due to that many students may not report specific symptoms fearing from exam cancellation or isolation. This study reported also that the likelihood of having a positive test result among those who were symptomatic were three and half times higher than asymptomatic (Lewis et al., 2020). This raises the concern that many students in our study might be COVID 19 positive during exams.

Regarding factors affecting suspected COVID 19 symptom development, students with less reported adherence were more likely to develop symptoms than highly adherent students. This agreed with a study conducted among HCWs who didn't care or contact

COVID 19 patients which reported that the better adherence to infection prevention control procedures the lower likelihood of suspected COVID 19 symptoms (Do et al, 2020). Another study conducted at Mozambique reported that persons with low reported adherence were more likely to develop suspected COVID 19 symptoms (Júnior et al., 2021).

The action of touching the mask or taking it off can reduce the protection offered and may even promote the viral infection spread (Stone, Kunaviktikul, Omura & Petrini 2020). In the present study students who remove mask during exam time were 7 times more likely to develop suspected COVID 19 symptoms. This agreed with a systemic review which reported that wearing masks in crowded places could reduce respiratory infections risk by twenty percent (Barasheed et al., 2020). Another study done in university residence halls reported a 35%-51% reduction in influenza-like illness in the mask and hand hygiene group compared with the no mask group (Aiello et al., 2020).

In the present study, the higher T zone touch, the higher likelihood to develop symptoms. This result agreed with a study conducted at china which reported that HCWs touching nose and mouth and check frequently during work were two and half times more likely to develop COVID 19 (Wang et al., 2020). Another study reported the fewer T-zone touch, the lower chance of respiratory tract infections (Gu et al., 2015).

#### *Study strengths and limitations*

This is the first study to observe students during exam period for adherence to preventive measures, suspected COVID 19 symptoms development and factors affecting its development. Due to scarcity of COVID 19 tests and limitation of fund, only suspected symptoms were evaluated. The evaluation was self-reported and many students may not report symptoms fearing of affecting their exam unless symptoms worsen.

#### **Conclusion**

Despite the highly reported adherence to COVID 19 preventive measures among nursing students the observed adherence level during

written exams showed high frequency of mask, T Zone and face touch and poor adherence to mask wearing duration and hand hygiene frequency. All over the study period there was a change in the frequency of suspected COVID 19 symptoms with the highest frequency occurred at the first two weeks of exams and most students develop symptoms. Students with higher T zone touch, less mask wearing duration time and less reported adherence were the factors that increase likelihood for symptom development.

#### **Recommendations**

Raising students' awareness for the importance of strict adherence to preventive measures during exams is a necessity to decrease COVID 19 risk. Finding new strategies to improve students' adherence to preventive measures is of great value during this new epidemic.

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