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Face masks can reduce the frequency of face touching: an observational crossover study

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ABSTRACT

Objectives: The purpose of this study was to analyze face-touching patterns with and without a face mask.
Methods: The behavior of face touching with and without a mask during an interview was assessed in 40 individuals. The frequency of touching in different areas of the face covered by the mask was compared with areas not covered by the face mask.
Results: There was an increase in the number of individuals who touched the hair and the eye when they were not wearing the mask. There was an increase in the number of touches on the lips and hair when individuals were not wearing the face mask. When analyzing the area covered by the face mask, no difference was observed in the number of touches while using or not using masks. However, when the area not covered by a face mask was analyzed, a higher number of touches in individuals without masks was observed when compared with individuals wearing masks.
Conclusion: Using a face mask can reduce or change the face-touching patterns in normal individuals, especially in areas not covered by the mask. Using face masks can possibly reduce the chances of being infected by autoinoculation.

Introduction

The hands are considered vectors of healthcare-related infections (Gebreyesus *et al.*, 2013; Pittet *et al.*, 2006; Wertheim *et al.*, 2005). Autoinoculation of pathogens can occur through mucosal areas, such as the nose, eyes, and mouth (Gebreyesus *et al.*, 2013; Macias *et al.*, 2009; Masai and Akın, 2021; Pittet *et al.*, 2006; Wertheim *et al.*, 2005). Hands are also associated with the transmission of viral infections (Gu *et al.*, 2015; Gwaltney and Hendley, 1982; Winther *et al.*, 2007). This promotes the spread of highly infectious diseases such as influenza and SARS-CoV-2 infection or COVID-19, generating major socioeconomic impacts (Schoenbaum, 1987). The influenza, for example, has caused three pandemics in the last century (Kilbourne, 2006), and SARS-CoV-2 is the largest pandemic in recent history, exceeding millions infected and causing more than thousands of deaths.

Previous studies indicated that people touch their faces between 3.3 and 26 times an hour (Kwok *et al.*, 2015; Macias *et al.*, 2009; Nicas and Best, 2008), and even those who have received formal education in hygiene/disease transmission and who are aware of the risk of hand-mucous contact still maintain a high rate of touches between these surfaces (Gu *et al.*, 2015; Kilbourne, 2006; Kwok *et al.*, 2015; Schoenbaum, 1987).

There are few studies (Chen *et al.*, 2020; Lucas *et al.*, 2020; Tao *et al.*, 2020) evaluating how the use of face masks influences the face-touching behavior. Some of these studies suggest that people

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do not change the frequency of face touching (Tao *et al.*, 2020) or even reduce (Chen *et al.*, 2020; Lucas *et al.*, 2020) it by wearing a mask. However, these were conducted by comparing different groups, which may have unique face-touching behaviors because self-touches are influenced by various variables, such as sex and emotions (Grunwald *et al.*, 2014). Moreover, some other studies compared different groups before and during the COVID-19 pandemics, when people were more educated about the importance of face-touching avoidance.

Therefore, there is a need for a better understanding of the dynamic of face-touching habits during the use of a mask. The findings in this field of behavioral science are of great value due to their potential to collaborate in mitigating the transmission of viral infections, such as SARS-CoV-2, spread over contact, droplet, and airborne.

For this reason, we conducted a prospective observational behavioral case-crossover study to analyze face-touching patterns with and without a face mask in the same individual during an interview.

Methods

This prospective observational case-crossover study was approved by the institutional review board/ethics committee of the "Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (USP)" (Comissão de Ética para Análise de Projetos de Pesquisa- CAPPesq) under protocol number 31526620.8.0000.0068. The nature and possible consequences of the study were explained in detail before written informed consent was obtained from all participants. The datasets (video recordings) generated during the current study are not publicly available due to the possible identification of the volunteers but are available from the corresponding author on reasonable request in a nonpublic way.

Between May and June 2020, 40 healthy volunteers (aged 50.5 ± 9.65 years) were selected randomly as participants by nonprobabilistic sampling by quota (20 men and 20 women) chosen by the interviewer for convenience. The sample size was calculated based on a previous pilot study, considering a mean difference of three touches, comparing those with and without a mask, using a paired test with the standard deviation of the difference of four. We considered an alpha error of 0.05 and 80% of the power. A total sample size of 34 was obtained and rounded to 40, expecting losses during the study. They were invited by telephone to participate in the study. Participation was voluntary and we did not offer any compensation or incentives.

Inclusion criteria

All patients enrolled in our study fulfilled the following criteria: age over 18 years old, ability to technically make video calls by cell phone or computer, and agreed to be recorded.

Exclusion criteria

Patients with communication/network/connection issues, not consenting to be interviewed, lack of personal face mask, loose or inappropriate glasses or face mask, individuals who interrupted the interview during the first 30 minutes for any reason, and the presence of any systemic or facial disease that could interfere on face-touching patter (e.g., allergy, dry eye, autoimmune diseases, blepharitis, atopy) were excluded from the study.

Variables

Video interviews were conducted remotely online by three volunteers through Facebook video calls after proper consent. Participants were asked to perform their interviews at their own homes in a private room with no other individuals present. Patients were asked to turn off all electronic devices other than the ones used for the interview. Participants were asked about changes in their daily living habits since the beginning of the SARS-CoV-2 2019 pandemic. All recorded images were then reviewed by an independent examiner (A.V.C.F) using a specific editing program (Movavi®).

The interviewer and interviewee were at their own home, and all interviews were personal, with a duration of 30 minutes or more. Patients were asked to bring a mask to the interview; however, it was not mandatory to wear the mask at the starting point. If the individual started the interview with the mask, they were asked to take off the mask after 15 minutes of the interview. If the individual started the interview without the mask, they were asked to put on the mask after 15 minutes of the interview. The individuals were unaware that face touching was being analyzed until the end of the interview. To avoid environmental bias, such as temperature and humidity, the individual was not allowed to change places/environments during the interview.

The touches during these instructions were not included in the analysis.

Data sources/measurement

The location and the absolute number of hand touches on different parts of the face were analyzed after the interview by another independent examiner. The examiner reviewed frame by frame every time the participants touched anywhere in the studied area. The areas of the faces considered for this study were the nose, lips, cheeks, chin, forehead, hair, neck, ears, and eyes.

For this study, hand touch was considered when the participant had the surface of their own hand in contact with any of the areas mentioned previously. For long-haired individuals, only touches in the hair positioned above the neck were considered. If multiple touches were observed within 3 seconds or a prolonged period of hand-face contact was observed, only one touch was considered.

The different areas of the face were then divided into two groups and compared: areas covered by face mask (nose, lips, cheek, and chin) and areas not covered by face mask (forehead, hair, ears, and eyes). The neck was not considered for this specific sectorial analysis. Only 15 minutes with and without the mask were analyzed in all participants of this study. If the interview exceeded 15 minutes, the rest of the interview data were discarded from the analysis.

The Kolmogorov-Smirnov test was used to assess the data distribution, considering a P-value <0.05 to reject the hypothesis that the data are normally distributed. Categorical variables were expressed through their absolute and relative frequencies. The McNemar test was used to analyze whether there was a significant difference in the frequencies of interviewees who touched the parts studied with and without the use of the mask. Numerical variables were expressed as average and SD. Wilcoxon matched-pairs test was used to compare if there was a significant difference in the number of touches with and without the use of a mask and to compare if there was a significant difference in the distribution between two groups. For all tests, a P-value <0.05 was considered significant (R-project 3.4.2).

Results

After all videos were analyzed, seven individuals were excluded from the study (three badly positioned masks, one loose mask, and three badly positioned glasses). A total of 33 individuals (aged 43.7 ± 16.1 years, 17 were female) were included in this study after video analysis. Three individuals were health care providers.

A total of 17 individuals started the interview wearing a mask (51.5%). A total of 20 individuals wore cloth masks (60.6%), 12

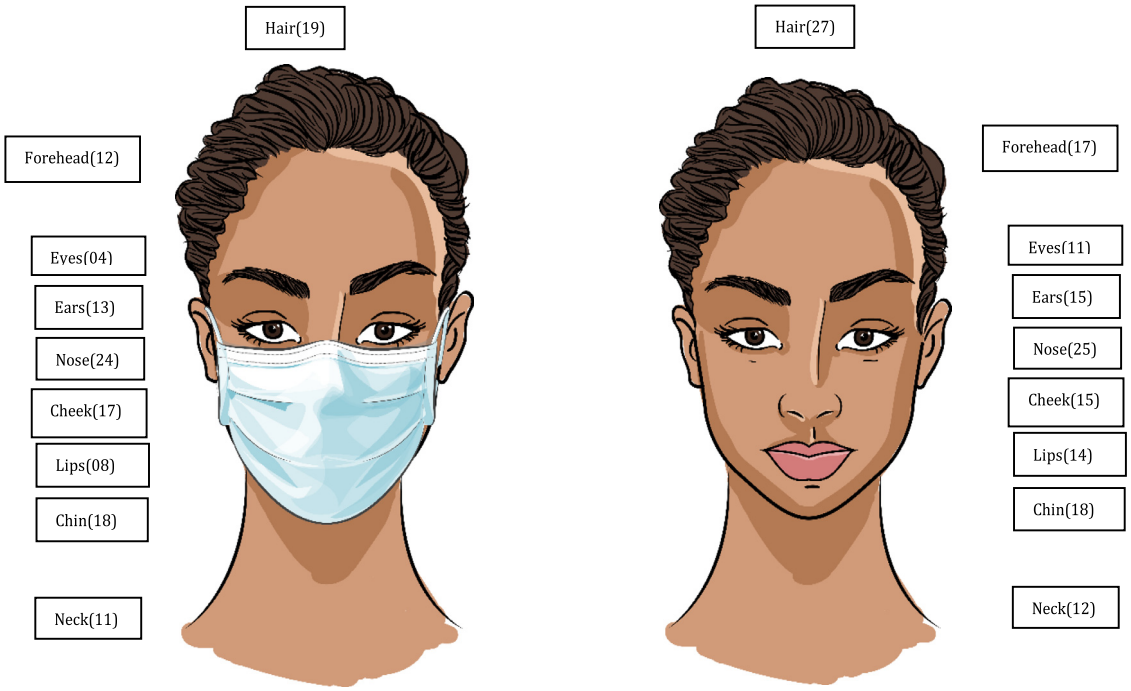

Figure 1. Illustration representing the absolute number of individuals who have touched each respective area of the face with and without a face mask. A statistically higher number of individuals without face mask touched their eyes ($P = 0.02$) and hair ($P = 0.04$) when compared with the number of individuals with face masks.

Table 1
Distribution of the absolute number of individuals who touched a specific part of the face while they were with or without a face mask (McNemar test).

Variables	with Mask		without Mask		
n	n	%	n	%	*P*-value
Cheeks	17	51.50%	15	45.50%	0.774
Chin	18	54.50%	18	54.50%	1.000
Lips	8	24.20%	14	42.40%	0.180
Nose	24	72.70%	25	75.80%	1.000
Neck	11	33.30%	12	36.40%	1.000
Hair	19	57.60%	27	81.80%	0.021 **
Forehead	12	36.40%	17	51.50%	0.267
Ears	13	39.40%	15	45.50%	0.804
Eyes	4	12.10%	11	33.30%	0.039 **
Total	126		154		

Table 2
Distribution of the average and SD of the number of touches in different areas of the face with and without face mask during an interview (Wilcoxon matched-pairs test).

	Variables	with Mask	without Mask	*P*-value	*P*-value
Area covered by mask	Cheeks	1.48 ± 2.36	1.06 ± 1.92	0.332	
	Chin	2.33 ± 2.93	1.55 ± 2.12	0.203	
	Lips	0.33 ± 0.65	1.06 ± 1.69	0.024**	
	Nose	2.30 ± 2.44	2.42 ± 3.30	0.999	
	Total	6.45 ± 5.68	6.09 ± 6.36		0.575
Area not covered by mask	Hair	2.73 ± 3.56	3.91 ± 3.52	0.041**	
	Forehead	0.82 ± 1.57	1.58 ± 3.05	0.123	
	Ears	1.06 ± 1.71	0.91 ± 1.44	0.609	
	Eyes	0.24 ± 0.79	0.58 ± 0.94	0.102	
	Total	4.85 ± 5.37	6.09 ± 6.36		0.037 **

** P <0.05 (Wilcoxon matched-pairs test)SD = Standard deviation

(36.4%) wore surgical masks, and only one (3%) used N95. Furthermore, 15 individuals (45.5%) used eyeglasses during the interview.

There was a significant increase in the absolute number of individuals who touched the hair ($P = 0.021$) and the eye ($P = 0.039$) when they were not wearing the mask (Figure 1 and Table 1).

The total of face touches in individuals using face masks was 12.18 times and 14.0 times while not using them.

When analyzing only the area covered by the face mask (cheek, chin, lips, and nose), we observed no significant difference in the number of touches while using (6.45 ± 5.68 times) or not using (6.09 ± 6.36 times) masks ($P = 0.575$) (Table 2). However, when areas not covered by a face mask (hair, forehead, ears, and eyes) were analyzed, we observed a significantly higher number of touches in individuals without masks (6.09 ± 6.36 times) than in individuals wearing masks (4.85 ± 5.37 times) ($P = 0.037$). There was a significant increase in the absolute number of touches on the lips ($P = 0.024$) and hair ($P = 0.41$) when individuals were not wearing the face mask (Table 2).

Discussion

Among the various recommendations of World Health Organization and the Center of Disease Control for mitigating the transmission of viral infections spread by contact, droplet, or aerial transmission, such as SARS-CoV-2, there are hand hygiene, guidelines for avoiding face touch, and use of masks by symptomatic population and health professionals who treat suspected cases of the disease (prevention). Other studies have also mentioned the importance of face masks for disease prevention in various environments (Lo *et al.*, 2021; Masai and Akın, 2021; Schade *et al.*, 2021). We were all instructed not to touch the face, especially in the region of the masks, to avoid autoinoculation. The mask design is also being improved, aiming at greater comfort and providing a reduction in mask adjustments by the user's hand.

Face touch is a self-touch gesture, considered an unconscious self-regulatory movement, and has been associated with psychological and cognitive processes (Harrigan, 1985). It is related to the release of emotional excitement and a feeling of comfort, being fre-

quent in situations of anxiety and discomfort. Previous studies indicate that people touch their faces between 3.3 and 26 times per hour (Kwok *et al.*, 2015; Macias *et al.*, 2009; Nicas and Best, 2008); even those who have knowledge of hygiene/disease transmission and are aware of the risk of hand-mucous contact still maintain a high rate of touches between these surfaces (Gu *et al.*, 2015; Kwok *et al.*, 2015).

Although other studies comparing different groups have suggested that wearing masks could reduce the total face-touching behavior, this is, to the best of our knowledge, the first study in which the face mask wearer was used as his own control. Incipient or asymptomatic diseases and environmental bias (e.g., temperature, humidity, and time range) could be a major bias in spontaneous face touching due to sweating and discomfort; however, the authors have performed a well-designed sequential observational crossover study on the same individual to best minimize these facts.

Limitations of this study include choosing the sample by convenience in only one country (Brazil), thus partially limiting the generalization of the studied behavior to other parts of the world. Moreover, participants lived in distinct regions of this continental country. At the time of the interview, using masks was already mandatory in some regions and not in others. Thus, some interviewees might be more used to wearing masks than others.

This study only analyzed adults. The dynamics of face touching in children with masks may be unique so as adherence to mask use. The effect of education on face touching was not observed among the participants; however, the study only included people with a minimum formal education of 11 years (Brazilian High School). The population studied wore different types of masks; some were more uncomfortable than others and triggered a more frequent need for manual adjustment.

It is known that mirroring, behavior in which a person copies gestures of mimicry, body language, and facial expressions of other people during social interactions may have occurred during the interviews. To prevent this effect all interviewers were trained to avoid touching their own faces during the interview.

The use of face a mask can reduce or change the face-touching patterns in normal individuals, especially in areas not covered by the mask. The use of face masks can possibly reduce the chances of being infected by autoinoculation.

Conflict of interests

The authors have no competing interests to declare.

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Ethical approval statement

This study was approved by the institutional review board/ethics committee of the “Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo” (Comissão de Ética para Análise de Projetos de Pesquisa- CAPPesq) under protocol number 31526620.8.0000.0068.

Author contributions

Each Author’s contribution: A.V.C.F: literature search, figures, study design, data collection, data analysis, data interpretation, writing, critical revision, A.M.M: study design, figures, data collection, critical revision, A.A.S.: critical revision, P.C.C.: study design, critical revision, R.Y.H.: study design, data analysis, data interpretation, critical revision.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2022.07.072.

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