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The role of facial contact in infection control: Renewed import in the age of coronavirus

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Background: Decreasing facial contact takes on new urgency as society tries to stem the tide of COVID-19 spread. A better understanding of the pervasiveness of facial contact in social settings is required in order to then take steps to mitigate the action.

Methods: YouTube videos of random individuals were included in a behavioral observation study to document rates of contact to the eyes, nose, and mouth area. Factors including age, sex, the presence of eyewear or facial hair, distraction and fatigue were analyzed as possible contributing factors that increase likelihood of facial contact.

Results: The median rate of facial contact was 22 contacts per hour. Men had a significantly higher rate of facial contact compared to women. Age, glasses, and presence of facial hair were not contributing factors. The mouth was the most frequently observed site of contact. Fatigue and distraction may increase rates of facial contact.

Conclusions: Changing personal behavior is a simple and cost-effective action that can be employed to reduce one's risk of acquiring an infectious disease. This study indicates that there are societal differences that put some individuals at higher risk of contracting infectious disease than others.

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Hand hygiene

BACKGROUND

The ability of society to reduce or eliminate infectious diseases has been a major medical accomplishment over the past century. In 1900, the top 3 causes of death in the United States, and 4 of the top 10, were infectious diseases (influenza and/or pneumonia, tuberculosis, gastrointestinal infections, and diphtheria). Today, demographics have shifted such that now the top causes of death in the United States are heart disease and cancer while only 1 of the top 10 is infection-related (pneumonia and/or influenza, ninth). Much of this change can be attributed to advancements in research, medical diagnostics, and treatment. While these efforts have been costly, the savings recuperated by the improvement in morbidity and mortality, as well as decreased number of work- and education-related sick days are immeasurable.

Although improvements in societal health have been largely driven by government and the private sector, not all measures employed over the past century to reduce communicable disease have come from public or private entities. Individuals have voluntarily altered personal behavior and adopted simple and relatively cost-effective strategies to reduce infection and transmission rates, including increased hand washing with soap and water, use of alcohol-based hand sanitizers, and participation in annual vaccination programs. More recently, self-initiated alterations in personal behavior such as social distancing, reduction in travel, and use of facial coverings have been employed in response to COVID-19.

Public health officials have stressed the importance of hand washing and not touching one's face as effective steps to reduce an individual's risk of infection with COVID-19. Good hand hygiene has long been recognized as an effective measure to counteract spread of infectious disease. The addition of behavior-altering techniques to decrease facial contact obviates a portal of entry for an organism, as many infections originate through contact of the mucous membranes of the mouth, nose, or eyes; however, a better understanding of the pervasiveness of facial contact in society is first required in order to then take steps to mitigate the action.

The information gleaned from recognizing what constitutes normal or habitual facial contact affords individuals the opportunity to employ behavior modification to change their actions and reduce the
risk of self-inoculation. Currently, such data is lacking, in large part because it is difficult to track and observe people in their daily life. Two previous studies have reported on rates of facial contact (ROC), or how often an individual touches their face with their hands. A study of 26 medical students who were monitored while attending 2 lectures showed that 23 times per hour the students made facial contact, 44% of which was with mucous membranes.5 In a second study, 10 students who volunteered to sit in an office-like setting demonstrated a rate of facial contact of 15.7 times in 1 hour.6 However, a major limitation of both studies is that the students knew prior to their participation that the studies involved behavioral observations, thereby allowing for the potential of behavior modification during their observation. Another limitation of these studies is their potential lack of broader applicability, as students who may be bored or distracted in a lecture or behavioral study may not be representative of the larger population. Further, these studies do not account for possible variation in rates among different individuals.

Because identification of any trends in society has the potential to reduce one's risk of self-inoculation through subsequent behavior modification, this study aimed to assess differences in rates of facial contact among various population subsets. To some degree, every person is influenced by an urge to make facial contact. For some people, the stimulus for habitual facial contact is stronger than for other people and can be influenced by socioeconomic or psychological factors. To gain insight into possible motives that might initiate facial contact, we investigated the effect of facial hair or eyewear as initiating factors that increase the probability of facial contact. Additionally, we assessed whether facial contact increased during times when individuals were tired or distracted. We report the effects of variants including age, sex, presence of eyewear, facial hair (beard and/or moustache), distraction or fatigue on rates of facial contact (ROC) or with eyes (ROCe), nose (ROCn), or mouth (ROCm) only. The data for this study was collected from YouTube videos of people from different demographic backgrounds, which contain a wealth of information regarding normal human social interactions and behavior and allow for observation of individuals in their normal course of daily life. Human social interaction is pervasive in society and its analysis provides information reflective of most of the world's population.

METHODS

Individual selection

YouTube videos from 100 people were observed, with an effort made to include people of different racial, ethnic, religious, and socioeconomic backgrounds.7−209 The videos were categorized into 10 groups: (1) younger men with facial hair (n = 10), (2) younger men with eyewear (n = 10), (3) younger men without facial hair or eyewear (n = 10), (4) older men with facial hair (n = 10), (5) older men with eyewear (n = 10), (6) older men without facial hair or eyewear (n = 10), (7) younger women with eyewear (n = 10), (8) younger women without eyewear (n = 10), (9) older women with eyewear (n = 10), and (10) older women without eyewear (n = 10). The individuals therefore were comprised of 60 men and 40 women, for a total of 100 individuals. The occupation, level of education, and age for each individual at the time the video was recorded and verified.209−41 Younger people were defined as persons under 50 years of age, and older people were defined as persons 50 years of age and older. Children were not considered for this study. To determine the person's age classification, the date of publication of the video as stated on the YouTube page was used, unless the publisher provided a different date of recording either in the title of the video, embedded in the introduction of the video, or provided in the accompanying supplemental information beneath the video. If an individual was younger than 50 at the time of publication, this was sufficient to verify categorization into the younger age group. If the individual was older than 50 at the time of publication, then other data was used, such as the date of recording as stated on the YouTube page, the date of the conference that the individual was attending, the stated age of the individual during the recording, or historical references made during the recording to verify that the individual was older than 50 years of age during the recording.

Data collection

All videos were observed by 2 authors (JA/RA or CA/RA) and both were required to concur that there was facial contact for an incident to be documented. Incidents that were equivocal or in which no consensus was obtained were not recorded. All videos were observed muted to avoid distraction. Because the eyes, nose, and mouth are portals of entry for an infection into the human body, contact only with these areas was recorded. Facial contact was defined as either direct contact with the mucous membranes or any contact within 1 inch of these anatomic structures as even proximity to orifices increases risk by facilitating organism entry. After facial contact, withdrawal of the hand or finger followed by a separate motion toward the face constituted a separate contact. A single motion could result in contact with more than 1 anatomic structure. For example, if an individual covered their mouth and nose when they coughed, this was recorded as a single contact of both the mouth and nose. In order to obtain additional data and minimize unknown inconspicuous factors (eg, illness or stress) resulting in artificially high scores within a single observation, individuals were observed on 2 different videos and 2 separate encounters with their data were then averaged into a single score. Because longer videos provided more meaningful data, all videos analyzed were a minimum of 30 minutes in length. Videos of approximately 60-minute duration were preferred for evaluation (see Measurement section below). The length of each video was recorded and the time an individual was off-camera was calculated and subtracted from the total length of the video to determine individual's facetime (FT). The time from zero at which each contact occurred was also recorded. Finally, all individuals were evaluated in a casual setting, defined as the subject being engaged in casual conversation with at least one other individual. This could occur in a variety of locations (indoor, outdoor, stage, sound studio, home, office, etc) but always with an individual sitting and in conversation with at least one other person. Examples of a casual setting included someone sitting on their couch at home talking with several other individuals, sitting on a stage and engaged in a question and answer session either alone or within a panel of other individuals, participating in a radio talk show, sitting in an office being interviewed by another individual, or participating in a podcast with several other individuals. If available, the same individuals were also evaluated in a formal setting, defined as subjects sitting alone on a stage or platform, speaking or lecturing to an audience. In contrast to the casual settings, where individuals may be more passively involved in a conversation, individuals in formal settings were the sole source of dissemination of information to a group of people and therefore actively engaged and focused in their thoughts and actions. Any additional observations, such as if subjects appeared bored or distracted (checking their watch, checking their phone, etc), were recorded.

Measurement

All 100 individuals had data collected from the casual setting. However, the FTS, or the amount of time individuals were recorded on camera, were of different lengths for each individual. For instance, comparing the ROC for an individual with 40 minutes FT with another individual with 80 minutes of FT would not be accurate. Therefore, conversions were obtained to compare individuals across data sets by
converting each individual's score into a 60-minute scale to determine their ROC, ROCe, ROCm, and ROCn as follows:

\[
\text{ROC (or e, n, m respectively) = \frac{\text{number of total facial contacts made (or eyes, nose, or mouth only)}}{\text{individual facetime (min)}} \times 60}
\]

An individual's final score was the average of their 2 evaluations. Then, if the individual also was observed in a formal setting, the above was repeated to determine their ROC in a formal setting.

Finally, the length of each video was divided in half. The number of times facial contact occurred in the second half of the setting was divided by the total number of facial contacts to determine the percent that occurred in the second half. The final percent that occurred in the second half was the average of the 2 casual settings if contact was observed in both videos. If there was no contact in 1 of the 2 videos, the percent was that noted in the single video.

Statistical analyses

Tests for normality were performed using the D'Agostino-Pearson test. Because the distribution of FT frequencies was not normal, non-parametric statistical tests were used. Statistical differences in FT frequencies for subject characteristics (age, sex, glasses, and facial hair) were analyzed using the Mann-Whitney test. Statistical differences in FT frequencies for paired events (fatigue and casual vs formal) were analyzed using the Wilcoxon signed-rank test using matched pairs. Statistical differences in site of FT (eyes, nose, mouth) were analyzed using the Friedman test followed by Dunn’s multiple comparisons test. A P value of <.05 was considered significant for all analyses. Data distributions were calculated as the median ± 25%-75% interquartile ranges. All analyses were completed using GraphPad Prism 8 (v 8.4.2).

RESULTS

ROC data are provided in Supplementary Tables 1-4. Subjects ranged in age from second decade of life to octogenarian, with 94% completing secondary school and 70% earning a postsecondary degree.

A total of 284 videos were reviewed with a total time of 15,561 minutes. The videos ranged from 30 to 140 minutes in length with an average of 55 minutes for all videos.

Table 1 shows the summarized ROC results. The median ROC in the casual setting for all 100 individuals was 22 per hour (interquartile range: 9-39); with an individual range from 0.5 to 228. Males had a significantly higher ROC compared to females (P = .0184). Age (under 50 vs over 50); glasses, and facial hair were not contributing factors to overall ROC. Glasses were not a contributing factor to eye ROC, and facial hair was not a contributing factor to nose ROC or mouth ROC. The mouth ROC was significantly higher than the nose ROC (P = .0004) and eyes ROC (P = .0063).

Demographic comparisons

The highest ROCs were concentrated among men under 50 years of age; this group contained 7 of the 10 highest total ROC. Of the 10 highest scores, 9 occurred in men, and 8 of the 10 highest scores occurred in people under 50 years of age.

Casual vs formal setting

Paired ROC rates are summarized in Table 1. Supplementary Tables 5 and 6 show differences in individual ROCs in casual and formal encounters. Of the 40 individuals, 28 (70%) demonstrated a decrease in their ROC in formal settings, 8 (20%) showed an increase, and 4 (10%) remained the same.

DISCUSSION

The use of mathematical modeling has been used to indicate how a disease will progress through a community to allow governments and public health experts to take additional steps to mitigate transmission by closing institutions such as schools and businesses, enact quarantine measures, and initiate contact tracing and tracking. However, an interesting dynamic occurs between human behavior and disease progression. Individuals have been known to change behavior when there is a perceived risk, notably smoking cessation to decrease risk of lung cancer. Although mathematical models may contain some degree of human behavioral variation, they may not fully account for the potential for individuals to adapt their behavior to mitigate risk of exposure after receiving warnings from social media, and web-based or local news sources. For example, data has demonstrated that individuals alter their behavior when there is a perceived risk of infection. Identifying if certain subsets of...
society are more at risk of facial contact and the subsequent likelihood of self-inoculation may provide actionable data to stimulate behavior modification.

The results of this study indicate that there is a wide variation in the rate of facial contact, ranging from less than 1 contact up to 228 contacts in 1 hour. One significant finding was that men demonstrated higher rates of contact than women (P = .0184). The presence of eyewear or facial hair were not contributing factors stimulating facial contact. A limitation of this study became evident when people would adjust the rim of their glasses. Facial contact was recorded only in instances of unequivocal contact; however, there were times this could not be ascertained owing to video angles. For instance, 1 individual had contact with the rim of the glasses 74 times in 59 minutes that were not included in the ROC because it was not possible to discern if there was also contact with the eye area at that time, which would have markedly increased the ROC to the eye area. Wearing eyeglasses may be an aggravating factor in some individuals.

Another finding was a significant decrease in facial contact when an individual transitioned from a casual, conversation-type setting into a formal, lecture-type setting (P < .0001). Not only did contact rates drop for most people, but in many cases it was a precipitous decline. One reason may be attributed to mechanics: in the sitting position, the hands are in closer proximity to the face and can encourage more habitual facial contact. But another intriguing possibility is that people, consciously or unconsciously, alter their personal behavior when they are in different social settings. When an individual is giving a lecture or speech, where they represent the sole person responsible for dissemination of information, they are more focused in their task, as compared to when they are more passively involved in a collaborative group with an exchange of ideas. An indirect finding to support this would be the observation that during viewing of subjects in a casual setting, there were numerous examples of people being distracted or disengaged during their conversation, such as yawning, stretching, checking their watches, picking dust off a desk, playing with their fingernails, or checking their phones. These actions did not occur in the formal setting. Additionally, facial contact occurred more frequently toward the end of an individual’s interaction (P = .0138), indicating fatigue may play a role in increasing the likelihood of facial contact. These findings suggest that higher ROCs occur when an individual is less focused in their actions. It also indicates that people knowingly or unknowingly are already employing behavior modification techniques during their course of daily human social interactions, with a reduction in rates of facial contact when one is more focused in their actions.

Another limitation of this study was that the 2 evaluators of the videos were not blinded to the other’s findings. It is possible that 1 author could have held firmer in their opinions and was more of an influence on the other. Videos were viewed simultaneously because of the innumerable times when contact was equivocal, necessitating pausing, enhancing and repeated viewing to determine if contact occurred. An additional limitation could potentially occur in the subjective determination of proximity of facial contact to the eye, nose, or mouth area (defined as within 1 inch). Finally, individuals may alter their behavior during the recording of YouTube videos. However, unlike a formal behavioral observational study, the individuals in this study were not informed ahead of time that their behavior would be evaluated for a study, thus limiting potential behavior modification. Alteration of behavior because of known recording in general cannot be discounted.

CONCLUSIONS

Changing personal behavior is a simple and cost-effective action that can be employed to reduce one’s risk of acquiring an infectious disease. This study indicates that facial contact is exacerbated by fatigue and distraction, which may place some individuals at higher risk. The potential to modify behavior to mitigate susceptibility is now clinically relevant.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.ajic.2020.10.017.

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