General Original Article

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The effects of wearing a mask on an exercise regimen

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Abstract

Context: Masks have long been utilized to prevent the spread of airborne pathogens and diseases in the healthcare setting. Recently, due to the COVID-19 pandemic, mask use has been expanded to all public areas to help slow the spread of this virus. One such location where masks can be seen is gyms. While exercising, the needs of the body are altered due to the increased stress being placed upon it. Normal physiology is thus adjusted to meet these new demands and to maintain optimal functioning. Therefore, it is possible that adding a mask covering the mouth and nose while exercising could further exacerbate this physiologic alteration, causing potential concerns.

Objectives: The goal of this study is to identify the impact of mask use on normal perceived physiology (breathing, heart rate, temperature, exertion, stamina, and quality of workout) within the exercising population.

Methods: To obtain data focused on the research question, a self-reporting, online, anonymous Qualtrics survey was administered in local gyms and social media outlets. A total of 280 total participants were recruited between the ages of 18 and 65 who have ever exercised while wearing a mask. All results were analyzed utilizing descriptive statistics, bivariate correlations, Mann–Whitney U tests, and Kruskal–Wallis tests. A Cronbach's alpha was also calculated to check internal validity. The significance level utilized was $p \leq 0.05$.

Results: Completion of a Kruskal–Wallis test revealed statistical significance regarding the perception of masks in general and the participants' rating of the perceived physiological parameters (breathing: $p<0.001$; heart rate: $p<0.001$; temperature: $p<0.001$; exertion: $p<0.001$; stamina: $p<0.001$; and quality of workout: $p<0.001$), the duration of time the mask was utilized during the workout, and the participants' rating of the perceived physiological parameters (breathing: $p=0.001$; heart rate: $p=0.020$; temperature: $p<0.001$; exertion: $p<0.001$; stamina: $p=0.001$; quality of workout: $p<0.001$; and perception of mask: $p<0.001$), and the change in the number of days that the participants exercised per week during the pandemic as well as some of the participants' ratings of the perceived physiological parameters (breathing: $p=0.042$; exertion: $p=0.015$; stamina: $p=0.027$; and quality of workout: $p=0.016$).

Conclusions: Any alterations to normal physiology perception while exercising with a mask appear to be psychological and adaptive in nature. Masks alone did not contribute to the perception of their physiologic changes.

Keywords: COVID-19; exercise; mask; physiology.

The past two years have looked almost unrecognizable due to the COVID-19 pandemic which has impacted everyone worldwide. As a result, a new normal has been adopted, including lifestyle modifications to protect the masses. One such change that has been implemented is wearing face masks in public settings including the gym. Because workouts rely on cardiopulmonary function, among other things, studying the relationship that masks have on the exercising population can be crucial. The CDC suggests that wearing a mask properly requires completely covering both the mouth and nose [1]. This style of wearing a mask causes a potential issue during exercising because oxygen is essential and covering both entry points for air can possibly affect breathing and proper oxygen exchange.

Surgical masks have long been touted as an effective means to prevent the spread of airborne droplets. They have been utilized in various settings, especially by medical professionals, to prevent the spread of disease. Much research has been conducted in this capacity demarcating the effects of masks on the body's physiological functions. Prior research with 14 healthy men determined that wearing a surgical mask will reduce oxygen uptake (33.1 ± 5 mL min^{-1} kg^{-1} vs. 34.5 ± 6 mL min^{-1} kg^{-1}) while

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elevating airway resistance (0.58 ± 0.16 kPa l^{-1} vs. 0.32 ± 0.08 kPa l^{-1}) and heart rate (160.1 ± 11.2 bpm vs. 154.5 ± 11.4 bpm) [2]. Another study utilizing 14 healthy male participants identified a correlation between masks and a decrease in the maximum power between those who wore a surgical mask (269 ± 45 W), those who wore a FFP2/N95 mask (263 ± 42 W), and those who wore no mask (277 ± 46 W) [3]. These studies make it apparent that masks can potentially affect an exercise regimen due to the physiological implications. Recent research has shown this to be a possibility. One study recruiting 15 healthy males and nine healthy women revealed that in higher-intensity workouts, the pulse rate was higher in those who wore cloth or surgical masks vs. those who were unmasked ($p<0.01$ and $p=0.048$). They also found that the rating of perceived exertion increased in those who wore cloth masks ($p<0.01$) and surgical masks ($p<0.05$) compared to their unmasked counterparts with increased intensity [4]. Another study conducted with 71 participants focused on cardiopulmonary testing utilizing a ramped cycle ergometer protocol in which the individual completed this test with and without a mask. It was found that the mask-wearing group took slightly longer to complete the test than those who did not wear a mask (7.97 ± 1.5 vs. 8.20 ± 1.39 min, $p=0.052$) with an overall lower power output (142.9 ± 44.22 vs. 149.8 ± 46.04 W, $p<0.001$) [5]. The question remains whether an average gym goer perceives these physiological alterations. If these changes are perceivable, masks might directly impact exercising.

Whether you do aerobic or endurance exercises, there are physiologic alterations due to exercise alone. Once the exercise has begun, the body must adapt to the increasing demand being placed upon it in the environment. These adaptions include changes to body temperature, the cardiovascular system, and the pulmonary system. Exercise increases core temperature as heat is stored due to a difference in heat gain vs heat loss [6]. There is also a sizable increase in cardiac output as both heart rate and stroke volume are increased [7]. As a result of increased cardiac output, maximal oxygen consumption will also increase [7]. Because masks have shown similar physiologic changes to exercise, superimposing the two could prove detrimental.

Exercising is crucial to living a healthy lifestyle, now more than ever. Besides the well-documented and widely understood health benefits, exercise also can improve the immune system. This includes improvement to the viral infection immune response [8]. This makes exercising potentially crucial in the fight against COVID-19. However, with the mandated lockdowns that were put in place, exercising became increasingly difficult for the world at large, causing a decrease in physical activity. In a recent Spanish longitudinal study, the sample (n=161) was divided into those who are physically active and those who are not physically active both pre- and post–COVID-19 lockdown. Before the lockdown, 13.8% of the participants were inactive compared to 26.6% following the lockdown with a lower overall perception of well-being [9]. Another study found similar results regarding cancer patients in Utah. Out of 1,361 cancer patients, 32% reported decreased exercise during the pandemic, 11% exercised more, and 57% did not change their exercise regimen [10]. These findings are problematic because exercise is crucial for a healthy overall lifestyle.

This study aims to identify if the addition of a mask to the exercising population will alter normal exercise physiologic perception. Because masks and exercise both have similar physiologic alterations to the body, mask-wearing could cause individuals to be more aware of their body physiology such as changes to heart rate or breathing. If there is evidence that people do not work out as effectively while wearing a mask due to increased perceived physiology, it would be important to find other ways for these individuals to be active. In this study, we plan to explore this relationship between exercise and mask-wearing to identify ways in which physical health can be improved during the current pandemic. We predict that the addition of the mask to the exercising population will cause an increase in physiologic perception.

Methods

Institutional Review Board approval was obtained through Rowan School of Osteopathic Medicine. This study was deemed exempt (IRB number: PRO-2021-438).

Informed consent for this study was collected electronically. Prior to survey participation, each participant had to fill out the consent form electronically through Qualtrics, ensuring that they were over 18 years of age and consented to participating in the study. No compensation was provided for participation.

Participants

A power analysis was unable to be completed due to limited prior research into this topic. For this reason, a large sample size of at least 250 participants was the goal. The target population for the survey was individuals between the ages of 18 and 65 who have ever exercised while wearing a mask. No exclusion criteria were included for this study. The desired sample encompassed all demographics of the population including individuals with chronic health conditions that would further compromise cardiopulmonary function. This was intended so that further analysis could be done to identify possible

exacerbations regarding masks and health complications such as asthma or COPD. A total of 280 subjects were recruited for this study mainly residing in suburban/urban New Jersey with some participants from surrounding states. Out of the 280 subjects that were recruited, 251 completed the survey.

Protocol

To better understand how the physiological implications of masks are perceived during an exercise, a cross-sectional descriptive survey study was utilized. Both objective data and perceptions of subjects were collected during a 1 month period. An anonymous online survey was administered via Qualtrics. Responses were collected starting on June 1st, 2021, for 4 weeks until June 29th, 2021. The survey was distributed to Facebook, Instagram, and local gyms to recruit subjects. The URL link to the survey was pinned to a social media profile managed by the authors and accessible to their followers. Biweekly social media story posts every Sunday and Wednesday during the data collection period were utilized to get traffic to the URL for participation. The followers of this account then had the option to participate in the study. In addition, flyers were handed out to local gyms that contained a scannable QR code linked to the survey. These flyers were taped to the front desk so that anyone who enters could participate if they chose. Because the survey was distributed in an online form accessible via the internet or by a scannable QR code, this can potentially lead to an age bias. No active efforts were taken to adjust for this potential bias.

The survey utilized was an original survey. Although the survey was not previously validated, it was checked for internal consistency and validity by a statistician. A Cronbach's alpha value, which consisted of seven items, was calculated to be α=0.744. It was found that the survey successfully captured the topic based on the completed literature review and the consistency with which participants answered the survey questions. The statistician did point out that one of the time intervals in the survey overlapped, which could cause potential confusion for the participants. However, this did not seem to impact the results.

Survey questions included demographic information, types of masks worn, exercise and mask-wearing habits, the participant's perception of the mask, and the perception of the well-documented physiological changes during exercise. The categories utilized for racial/ethnic classification can be seen in Table 2. These categories were provided by the authors as options from which the participants could choose. The reason that racial and ethnic information was collected was to see if masks impacted a specific race or ethnic group's physiologic perception during exercise more than another race or ethnic group. This could be very significant toward outcomes and future research. Most of the questions on the survey were fill-in-the-blank and multiple-choice questions. The physiologic perception questions were ranked on a scale of 1–5, with 1 meaning the mask had no effect on that metric, and 5 meaning the mask had a big effect on that metric. These perception questions include the effect of the mask on breathing, heart rate, body temperature, stamina, exertion, and the overall quality of the workout. Directions were specific enough that controlling for a response was not needed. Post hoc analysis of the results showed good item distribution, so there was no influence from a response set. A blank survey is included in Appendix A.

Statistical analysis

Grouping for statistical analysis was based on achieving comparable sample sizes for each group because there needs to be enough responses in each group to justify the use of the test. The overall feelings of masks were grouped into three categories; strongly dislike if rated <3, neutral if rated 3, and strongly like if rated >3. The types of masks worn were grouped into three categories: surgical, fabric (includes fabric and gaiter), and other (includes other and N95). In addition, how the mask was worn was regrouped into the following: I wear my mask the entire time (includes "I wear my mask covering both my nose and mouth for the duration of the workout" and "I wear the mask below my nose for the duration of the workout"), I sometimes take my mask off (includes "I sometimes wear the mask below my nose," "I sometimes take the mask off to catch my breath," and "I frequently wear the mask below my nose and take it off during my workout"), I usually have my mask off (includes "I take off my mask for most of my workout). No other survey grouping was altered because the sample size was already comparable (Table 1).

Once all data were collected, they were imported into SPSS from Qualtrics to examine. The data were analyzed utilizing frequencies, descriptive statistics, Mann–Whitney U tests, and Kruskal–Wallis tests. The level of significance for all tests was $p \leq 0.05$.

Frequencies allowed the sample size and percentages to be achieved for all variables acquired from the survey. Descriptive statistics were utilized to find the mean, standard deviation, and ranges for the age and BMI variables. Bivariate correlations were utilized to analyze any statistically significant relationships that exists between age/gender/BMI/race and the six physiological perception metrics (breathing, heart rate, temperature, exertion, stamina, and quality of workout). The Pearson coefficient and p value from these tests were utilized. Due to the ordinal nature of the remaining analyzed data, nonparametric statistics were utilized. Mann–Whitney U tests were utilized to compare the type of workouts performed by the participants/the presence of chronic health conditions and the six physiological perception metrics (breathing, heart rate, temperature, exertion, stamina, and quality of workout). The mean rank, p value, and z value were utilized from this test. Finally, a Kruskal–Wallis test compared the number of days exercised per week/the change in the number of days exercised per week/length of exercise/change in length of exercise/type of mask/duration of mask use/perception of masks and the six physiological perception metrics (breathing, heart rate, temperature, exertion, stamina, and quality of workout). The mean rank, Kruskal–Wallis H test, and p value were utilized.

Results

Demographics

Of the 280 subjects recruited, there was an almost even distribution of males (n=131; 46.8%) and females (n=145; 51.8%) with nonbinary/third gender (n=4; 1.4%) being less represented. Most of the subjects were White (n=194; 69.3%) followed by Asian (n=61; 21.8%), other (n=15; 5.4), Black (n=6; 2.1%), Native Hawaiian/Pacific Islander (n=2; 0.7%) and prefer not to answer (n=2; 0.7%). In addition, not

Table 1: Summary of sample sizes.

Survey question	Group	Sample size	Percent
What type of workouts do you perform?	Cardio	209	76.8%
	HIIT	85	31.3%
	Resistance training	165	60.7%
	Other	57	21.0%
How many days a week do you exercise?	1	7	2.6%
	2	5	1.8%
	3	25	9.2%
	4	62	22.8%
	5	64	23.5%
	6	67	24.6%
	7	42	15.4%
Has the number of days you exercise changed due to the pandemic?	Yes, I exercise more days	63	23.2%
	Yes, I exercise fewer days	106	39.0%
	No, I exercise the same number of days	103	37.9%
How long is your average workout?	5–30 min	28	10.3%
	31–60 min	132	48.5%
	1–1.5 h	87	32.0%
	1.5–2 h	20	7.4%
	>2 h	5	1.8%
Has the length of your workout changed due to the pandemic?	Yes, my workouts are longer	37	13.6%
	Yes, my workouts are shorter	85	31.3%
	No, my workouts are the same length	150	55.1%
What type of mask do you wear while you exercise?	Surgical	108	41.7%
	Fabric	105	40.5%
	Other	46	17.8%
How do you wear the mask for the duration of your workout?	I wear my mask the entire time	116	44.8%
	I sometimes take my mask off	65	25.1%
	I usually have my mask off	78	30.1%
Do you have any pre-existing health conditions?	Yes	46	17.8%
	No	213	82.2%
What is your overall feeling about wearing face masks in public?	Strongly dislike <3	63	25.1%
	3	44	17.5%
	Strongly like >3	144	57.4%
What is the effect of the mask on your breathing during exercise?	No effect at all 1	21	8.4%
	2	33	13.1%
	3	70	27.9%
	4	67	26.7%
	Greatly affected 5	60	23.9%
What is the effect of the mask on your heart rate during exercise?	No effect at all 1	48	19.1%
	2	59	23.5%
	3	72	28.7%
	4	49	19.5%
	Greatly affected 5	23	9.2%
What is the effect of the mask on your body temperature during exercise?	No effect at all 1	51	20.3%
	2	63	25.1%
	3	62	24.7%
	4	50	19.9%
	Greatly affected 5	25	10.0%
What is the effect of the mask on your exertion level during exercise?	No effect at all 1	39	15.5%
	2	46	18.3%
	3	71	28.3%
	4	65	25.9%
	Greatly affected 5	30	12.0%
What is the effect of the mask on your stamina during exercise?	No effect at all 1	45	17.9%
	2	39	15.5%
	3	60	23.9%
	4	73	29.1%
	Greatly affected 5	34	13.5%
What is the effect of the mask on the quality of your workout?	No effect at all 1	36	14.3%
	2	59	23.5%
	3	67	26.7%
	4	49	19.5%
	Greatly affected 5	40	15.9%

HIIT, high-intensity interval training.

of Hispanic, Latino, or Spanish origin (n=250; 89.3%) was the most common documented answer for ethnicity followed by another Hispanic, Latino, or Spanish origin (n=12; 4.3%), prefer not to answer (n=10; 3.6%), Mexican, Mexican American, Chicano (n=6; 2.1%), Puerto Rican (n=1; 0.4%), and Cuban (n=1; 0.4%). The age range of the subjects was 18–65 years old (M=25.59), while the BMI range was 17–39 kg/m^2 (M=24.24). Not many participants reported any of the preexisting health conditions (n=46; 17.8%). The most common mask type utilized while exercising was surgical (n=108; 41.7%) followed by fabric (n=105; 40.5%) and other (n=46; 17.8%) (Table 2).

Perception of masks on the physiological parameters

Bivariate correlation analysis

The bivariate correlation test of age, gender, BMI, and race between the six perceived physiological parameters yielded minor statistically significant correlational data (Table 3). Race had a statistically significant negative correlation with perceived body temperature (n=251; r=−0.157; p=0.013). Gender was found to have a statistically significant correlation with regard to the perceived quality of the workout (n=247; r=0.150; p=0.018). All other metrics were not of statistical significance.

Table 2: Summary of demographic information.

		Sample size	Percent
Gender	Male	131	46.8
	Female	145	51.8
	Nonbinary/third gender	4	1.4
Race	White	194	69.3
	Black or African American	6	2.1
	Asian	61	21.8
	Native Hawaiian or Pacific Islander	2	0.7
	Other	15	5.4
	Prefer not to answer	2	0.7
Ethnicity	Not of Hispanic, Latino, or Spanish origin	250	89.3
	Mexican, Mexican American, Chicano	6	2.1
	Puerto Rican	1	0.4
	Cuban	1	0.4
	Another Hispanic, Latino, or Spanish origin	12	4.3
	Prefer not to answer	10	3.6
Age	Range, 18–65 years		
	Mean, 25.59 years		
	Standard deviation, 8.311		
BMI	Range, 17–39 kg/m^2		
	Mean, 24.24 kg/m^2		
	Standard deviation, 4.089		

Table 3: Summary of bivariate correlation data. The variable/physiologic perception column is the variable (in bold) that was compared to each of the six physiologic perceptions due to mask-wearing with the corresponding findings in columns 2 and 3.

Variable/physiologic perception	Pearson correlation	p-Value
Age		
Breathing	0.109	0.084
Heart rate	0.062	0.329
Temperature	0.026	0.677
Exertion	0.116	0.067
Stamina	0.040	0.530
Quality	0.048	0.453
Gender		
Breathing	0.20	0.752
Heart rate	0.047	0.466
Temperature	−0.066	0.304
Exertion	0.017	0.791
Stamina	0.037	0.564
Quality	0.150	**0.018**
BMI		
Breathing	0.053	0.402
Heart rate	0.057	0.371
Temperature	−0.056	0.379
Exertion	0.020	0.756
Stamina	−0.008	0.897
Quality	−0.001	0.982
Race		
Breathing	−0.034	0.590
Heart rate	−0.004	0.949
Temperature	−0.157	**0.013**
Exertion	−0.023	0.721
Stamina	0.003	0.966
Quality	−0.031	0.621

BMI, body mass index. Bold values indicate statistically significant data points.

Mann–Whitney U test

The Mann–Whitney U test of the four types of workouts performed (cardio, high-intensity interval training [HIIT], resistance, other) while wearing a mask and preexisting health conditions between the six perceived physiological parameters yielded no significant data. All data can be found in Supplementary Table 1.

Kruskal–Wallis test

Completion of a Kruskal–Wallis test yielded insignificant findings for the following variables when compared to the six perceived physiologic parameters: number of days the participant exercised per week, the length of the workout, change in the length of the workout due to the pandemic, and the type of mask worn by the participant. All data can be found in Supplementary Table 2.

The change in the number of days that people exercised was analyzed against all of the perceived physiological parameters (breathing, heart rate, temperature, exertion, stamina, and overall quality of workout). There were three groups included in the analysis: those who exercised more days (n=52), those who exercised less days (n=102), and those who exercised the same number of days (n=97). There was found to be statistical significance between the change in the number of days people exercised and perceived breathing (H[2]=6.354; p=0.042), perceived exertion level (H[2]=8.360; p=0.015), perceived stamina (H[2]=7.236; p=0.027), and overall perceived quality of the workout (H[2]=8.228; p=0.016) at the p<0.05 level. The findings for perceived heart rate and body temperature were insignificant for this variable.

The duration of mask usage during an exercise was analyzed against all of the perceived physiological parameters (breathing, heart rate, temperature, exertion, stamina, and overall quality of workout). There were three groups included in the analysis: those who wore the mask for the entirety of the workout (n=116); those who sometimes wore the mask (n=64); and those who usually did not wear the mask (n=71). There was found to be statistical significance between the duration that the mask was worn

during the workout and perceived breathing (H[2]=13.192; p=0.001), perceived heart rate (H[2]=7.824; p=0.020), perceived body temperature (H[2]=15.249; p= <0.001), perceived exertion (H[2]=17.370; p= <0.001), perceived stamina (H(2)=13.745; p=0.001), overall perceived quality of the workout (H[2]=24.242; p= <0.001), and perception of face masks in public (H[2]=17.947; p= <0.001) at the p<0.05 level.

The overall opinions of masks were analyzed against all of the perceived physiological parameters (breathing, heart rate, temperature, exertion, stamina, and overall quality of workout). There were three groups included in the analysis: those who rated their opinion of masks <3 (n=63), those who rated their opinion of masks a 3 (n=44), and those who rated their opinion of masks >3 (n=144). There was found to be statistical significance between the perception of wearing face masks in public and perceived breathing (H[2]=43.006; p= <0.001), perceived heart rate (H[2]=35.110; p= <0.001), perceived body temperature (H[2]=29.288; p= <0.001), perceived exertion (H[2]=22.515; p= <0.001), perceived stamina (H[2]=33.126; p= <0.001), and overall perceived quality of the workout (H[2]=35.838; p= <0.001) at the p<0.05 level.

Discussion

After detailed analysis of all data, it was found that masks do not have a significant impact on the body's perceived physiological response to exercise. The impact of various types of masks on the six perceived physiological factors was found to be insignificant. Because the data collected was self-reported and not accurately measured through lab techniques, it is possible that there could be implications. However, this is not a novel finding. A recent literature review comparing the effects of masks on cardiopulmonary function shows similar conclusions. At rest to moderate exercise, wearing a surgical or cloth mask has no physiological implications. At higher intensities, there is a slight impact on physiology that is not of clinical importance. Although there are no true alterations to physiology, this literature review found that there still may be perceived alterations due to various factors such as warmth and humidity [11]. Due to this finding, the healthy population can continue to exercise while masked without adverse effects from the mask.

Analysis of the survey data shows that there might be other factors at play regarding the physiologic perception of mask-wearing on exercise. There was found to be statistically significant data pointing to potential psychological influence on whether physiological alterations are perceived. More specifically, the opinions held by study subjects on masks altered whether they perceived physiologic changes. This finding held true for all physiologic parameters measured. This is an important finding that shows that the perception of physiologic changes may expand beyond the already studied and proven effects of the mask alone on perception (changes in humidity, heat, etc.). Changing the public's perception of masks likely could influence how physiologic changes are perceived in exercise. Future research should be completed to further delineate the relationship between psychologic influence on perceived perception.

In addition, how the mask was worn for the duration of the workout was found to be statistically significant. As previously explained, there is a psychological aspect influencing the overall physiological perception. Those who wear the masks properly for the duration of the workout feel more strongly about masks in general, and those who do not wear the mask for the duration of the workout strongly dislike masks. This psychological opinion is driving how the participants rated the perceived physiological metrics.

Finally, there was found to be statistical significance between the change in the number of days that one exercises following the mask mandate and the perception of breathing, exertion, stamina, and the overall quality of the workout. Wearing a mask more days per week during exercise can potentially allow the body to adapt both to the new microenvironment created by the mask and to any minimal change in physiology that occurs. Therefore, over time, perception of these physiological factors can change.

There was no statistically significant data pointing toward a single type of mask potentiating these perceived physiologic consequences more than any other. In addition, among the preexisting health conditions, age, gender, BMI, race, and type of workout had no significant impact on the intended research question.

Osteopathic significance

A holistic approach to medicine is the hallmark of osteopathic medicine. To truly treat a patient, all aspects of their lives need to be explored. Exercise is just one aspect of this overarching theme that helps patients live healthy and disease-free lives. Due to the findings presented in this paper, physicians should feel confident that they can continue to recommend exercise to their healthy patients irrespective of the need to wear a mask to improve patient outcomes.

Limitations

A true response rate cannot be calculated based on the design of this study because it is impossible to know for sure exactly the reach of the survey. However, based on the number of individuals who started the survey (280) and the number of individuals who completed the survey (251), the completion rate can be calculated at 89.6%. This percentage was satisfactory because it allowed us to reach our target participation goal.

One limitation to the study, as previously mentioned, was reliance on the internet/QR codes for data collection. This limits our sample to those individuals who have access to the internet and or a smartphone to scan the code. The population would also have to know how to scan a QR code, which could be confusing for the upper end of the desired age range. However, it was assumed for this study that most people have access to these items and properly know how to utilize them. For this reason, it is possible that data can be skewed toward the younger cohort's physiology. Similarly, there is a risk for volunteer bias because our sample population consists of only individuals who were willing to participate and complete the survey. This also has the potential to affect the results and could alter generalizability. Any impact from volunteer bias seems minimal. Another limitation to this study includes the sample being predominately White with little Black/African American representation. In addition, all data collected were self-reported. In the future, research should be conducted with a more diverse population to make the findings more generalizable. There could also be a more objective way to collect all of the data to refrain from relying solely on self-reported data.

Conclusions

The main factor implicated in perceived mask-associated physiological decrements were psychological in nature. The way the participants felt about masks was strongly associated with how they rated their perceived physiologic changes. Results from the study showed that those in favor of masks had lower perceived physiologic deficits. Those not in favor of masks had higher perceived deficits. Masks alone did not contribute to the perception of their physiologic changes. Rather, the perception ratings were deeply rooted in opinion. It is important to note that these perceptions do not equate to actual physiologic change. For example, someone who perceived their heart rate to be higher while wearing a mask does not mean that their heart rate was truly elevated. More research should be conducted in this area to solidify this association. In addition, there was also evidence of slight adaptation in the population who exercised more since the implementation of the mask mandate. As the number of times of exercise per week was increased, the perception ratings went down for some of the categories.

As a result of the findings from this study and previous research, physicians should be confident and comfortable recommending regular exercise to their patients considering the pandemic. Exercise is a crucial aspect of preventative medicine and will help to improve patient outcomes regarding both physical and mental illness.

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Competing interests: None reported.
Ethical approval: The International Review Board at Rowan School of Osteopathic Medicine deemed this study exempt (IRB number: PRO-2021-438).
Informed consent: Informed consent was provided electronically to all participants prior to participation in this study.

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