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Physiological and Perceptual Effects of Face Masks in Children: A Study on Exercise Intensity and Mask Types

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Abstract

Background: Face masks are crucial for preventing respiratory diseases; however, limited research has examined their specific effects on children's exercise performance, particularly in terms of physiological and perceptual responses at different exercise intensities.

Aim: This study examines the effects of N-95 and surgical masks on children's physiological and perceptual responses during exercise at varying intensities.

Martials and Methods: Twenty healthy children (age, 11.23 ± 0.59 years) performed in three 6-minute phases of a treadmill protocol at 25%, 50%, and 75% of maximal oxygen uptake, while wearing an N-95 mask, a surgical mask, or no mask. Physiological measurements (heart rate, blood lactate, oxygen saturation) and perceptual measurements (rate of perceived exertion, discomfort) were assessed.

Results: HR, PRE, and BLa increased with intensity ($p \geq 0.001$), with N-95 masks showing the highest HR and BLa compared to surgical masks and no masks at high intensity. SpO_2 decreased significantly with N-95 masks at moderate ($p=0.018$) and high intensities ($p=0.008$). Discomfort, especially in breath resistance and fatigue, was greater with N-95 masks.

Conclusion: Face masks, particularly N-95, significantly increase cardiovascular and metabolic demands during exercise, especially at higher intensities. Balancing respiratory protection with comfort is essential for safe exercise in children during public health crises.

Keywords: COVID-19, Face masks, Pediatric physiology, pandemic.

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1. Introduction

The COVID-19 pandemic, declared by the World Health Organization in 2020, necessitated widespread public health measures, including the mandatory use of face masks to reduce the transmission of respiratory droplets and aerosols [1, 2]. While regular exercise is widely recognized for its physical and mental health benefits, It also contributes to reducing inflammation and may help mitigate severe complications of COVID-19, such as acute respiratory distress syndrome [3]. However, concerns persist regarding the physiological and perceptual effects of exercising while wearing face masks, particularly in children.

Research investigating the effects of different face masks on physiological and perceptual parameters during exercise has yielded mixed results. Some studies report that wearing masks reduces oxygen consumption, increases carbon dioxide retention, and elevates breathing resistance, leading to discomfort and impaired performance [4-6]. Conversely, others suggest minimal or no significant impact on these parameters [7, 8]. Notably, N95 masks have been shown to impose greater restrictions on cardiopulmonary performance and result in higher ratings of perceived exertion (RPE) compared to surgical and cloth masks [5, 9]. These findings underscore the need to investigate how different mask types influence physiological and perceptual responses during exercise, particularly across varying intensities.

While there is growing evidence in adults, research on children—a population with distinct physiological responses to exercise—remains limited. Compared to adults, children have a lower stroke volume and cardiac output, partially compensated by faster heart rates, which may affect oxygen delivery during exercise, particularly at higher intensities [10, 11]. Additionally, children exhibit higher respiratory rates, reduced ventilatory efficiency [12], and greater perceived exertion, particularly during prolonged exercise [13]. These differences suggest that children may respond differently to the use of face masks during physical activity, warranting further investigation.

This study examines the physiological and perceptual effects of wearing surgical and N95 masks during low, moderate, and high-intensity exercise in children. We hypothesize that mask use will negatively impact physiological and perceptual responses compared to exercising without a mask, with the effects becoming more pronounced at higher intensities. By addressing this gap, the study aims to provide evidence-based insights to guide safe exercise practices for children during public health emergencies.

2. Methods and Materials

2.1. Participation

Twenty healthy children aged 10-12 from an elementary school, were selected based on parental consent. The inclusion criteria comprised participation in the national physical education program, and the absence of chronic lung, cardiac, or neuromuscular diseases, motor disabilities, or being overweight. Individuals with body temperatures exceeding 37°C were excluded for COVID-19 safety reasons. None of them had sustained any recent orthopedic injuries in the past three months. A certified exercise physiologist assessed all eligible participants for potential high-risk cardiovascular diseases using a health history questionnaire. Written authorization was obtained from the school principal, and potential participants were interviewed following advertisements placed at the school. Consent forms and information sheets were distributed to children and their parents, and only those who returned the forms were considered eligible. Participants received a comprehensive explanation of the test and activity procedures, including potential risks or discomfort. They were assured of confidentiality and their right to withdraw from the study at any time. A power analysis was conducted using G*Power software (version 3.1). To calculate the required sample size, a power analysis was conducted using G*Power software (version 3.1). The analysis revealed that at least 17 participants were needed to achieve a power of 0.80, with an effect size of 0.25 and an alpha level of 0.05, based on previous studies examining similar interventions on physiological and perceptual markers in children

2.2. Preliminary Testing

During the first lab visit, participants' height was measured using a stadiometer (Seca, Leicester, United Kingdom), and body fat percentage, body mass index (BMI), and body weight were determined using a Tanita Corp. MC780MA body composition analyzer from Tokyo, Japan. Maturity offset equations from Mirwald et al. (2002) were utilized to evaluate maturity, with participants chosen in the pre-pubertal stage [14]. The maximal oxygen uptake (VO_{2max}) values were measured using incremental exercise Bruce protocol on a treadmill, following a method that has been used before [15]. Exhaled respiratory gases were collected and analyzed using indirect calorimetry [15]. Heart rate (HR) was continuously monitored. Participants were required to achieve a VO_2 plateau, a Rate of Perceived Exertion (RPE) of 9, and reach 95% of the age-predicted maximum heart rate [16].

2.3. Familiarization Trial

A familiarization trial was conducted during the second laboratory visit, one week after the VO_{2max} test. The trial aimed to familiarize participants with experimental procedures and confirm whether the prescribed exercise intensity met specified percentage VO_{2max} thresholds (25%, 50%, and 75% of VO_{2max}) for the experimental trial. Participants walked on the treadmill for six minutes at three preset speeds. Oxygen uptake data was recorded, and speeds were adjusted as necessary for subsequent trials [17].

2.4. Experimental Trials

Three experimental trials were conducted one week after familiarization, with participants being tested on a standardized treadmill (Pulsar 3p, h/p/cosmos sports and medical, Germany) while wearing an N-95 mask, a surgical mask (SM), or no mask (NM), with at least 72 hours separating the conditions. Each session occurred at the same time each day (±1 hour). The randomization process was carried out using a computerized tool that generated random numbers. Each trial followed the same incremental treadmill protocol, which consisted of three 6-minute stages at different VO_{2max} levels (25%, 50%, and 75%) [18].

HR was monitored throughout the experimental period using a Polar HR monitor. Data were recorded at baseline and at various exercise intensities (i.e., at the end of each 6-minute stage). For running speed, the average speed over the last 15 seconds of each stage was used. To estimate the exercise intensity, we calculated the target heart rate for each subject using the Karvonen formula [19]. No verbal encouragement or external stimuli were provided, and trial orders were randomly assigned using an online tool. We confirmed that the Oxygen Saturation (SpO_2) levels consistently remained within the normal physiological range of 95%–100% throughout the session, showing no signs of hypoxia. N-95 and SM masks (Chongqing BaiNa Medical Instrument Co., Chongqing, and Henan Zhongjian Medical Instrument Co., Henan, respectively) were used, with participants being blinded to test results before each trial. Trials were conducted under standard environmental conditions (temperature: 20-25°C, relative humidity: 40-60%), with mask comfort assessed using qualitative measures such as visual analog scales or Likert scales.

2.5. Physiological Measurements

2.5.1. HR

HR was recorded using a Polar HR monitor and T-31 coded chest strap (Polar USA, Lake Success, NY, USA). The chest strap synchronizes with the LODE treadmill and displays HR readings during exercise. Data was recorded at rest as well as during various levels of exercise intensity, at the end of each six-minute period. The average of the last 15 seconds of each stage was used for analysis.

2.5.2. Blood Lactate Concentration (BLa)

BLa was measured during the final 15 seconds of each 6-minute stage and at baseline. Using the Lactate Scout by EKF Diagnostics (manufactured by SensLab GmbH, Leipzig, Germany), capillary blood samples (approximately 1 μL) were collected from the fingertips [20]. Exercise intensities in athletic, normal, and clinical populations are often evaluated by measuring blood lactate (BLa) levels

2.5.3. Oxygen Saturation (SpO_2)

The SpO_2 level was measured non-invasively using a portable finger pulse oximeter device, specifically the 3100 WristOx (Nonin Medicals, Plymouth, MN, United States), at baseline and during the last 15 seconds of each 6-minute stage. According to Jagim et al. (2018), this marker indicates the amount of oxygen bonded to hemoglobin in red blood cells in circulation [21].

2.6. Perceptual Measurements

2.6.1. RPE

The Children's OMNI-walk/run scale was used to validate the intensity of the exercise and measure RPE [22]. This scale utilizes an illustration of a walk or run on a hill to assist children in comprehending how to use it to articulate their level of exertion. At the lowest level of exertion (i.e., 0 = "not tired at all") and at the top of the hill, the person is sweating, hunched over, and has placed their head on the handlebars (i.e., 10 = "very, very tired").

2.6.2. Comfort/Discomfort Scale

Participants were asked to rate their level of comfort and discomfort on a visual analog scale ranging from 0 to 10. Here, 0 denoted "not at all," 5 denoted "mild," and 10 denoted "strong" discomfort. Ten domains constitute this scale: breathing resistance, tightness, feeling unfit, humidity, heat, odor, fatigue, itchiness, saltiness, and overall discomfort [23]. Five minutes after the mask-wearing trial, participants were asked to provide a qualitative description of their experience exercising while wearing a mask.

2.7. Dietary and Exercise Training Control

To control for the effects of diet, previous physical activity, and sleep, participants were required to fill out a food diary, record their physical activity using a pedometer, and note their sleep duration 24 hours before the first exercise test. Participants were provided with a copy of the diary and instructed to mimic their diet, physical activity, and sleep patterns as accurately as possible before each following test.

2.8. Statistical analysis

Data were analyzed using SPSS (Version 22.0, IBM Corp.). Means and standard deviations were used to present all continuous variables. The Shapiro-Wilk normality test assessed whether the mean values of all variables follow a normal distribution. Variations among participants wearing NM, SM, and N95 masks were assessed using repeated-measures ANOVA. Bonferroni post hoc test was applied to evaluate the differences between pairs of groups. A p-value of 0.05 was considered statistically significant. The effect size was calculated by applying Cohen's d to demonstrate the magnitude of the difference between two means. In general, effect sizes of 0.2, 0.5, and > 0.8 are considered small, moderate, and significant, respectively.

3. Result

All participants completed the required tests, providing valuable data for the research analysis. The average age of the participants was 11.23 ± 0.59 years. Demographic characteristics, including height, weight, body fat percentage, VO_{2max}, and HR_{max}, are outlined in Table 1. Importantly, baseline values for all parameters were consistent across trials.

The repeated measures ANOVA confirmed a significant main effect of exercise intensity on all variables. HR increased significantly with intensity (F=12335.833, p = 0.001, ηp2=0.997), PRE (F = 2448.791, p = 0.000, ηp2 = 0.983), BLa (F = 5809.435, p = 000, ηp2 = 0.993), and SPO_2 (F = 263.185, p = 0.000, ηp2 = 0.862). The interaction between exercise intensity and mask type was significant for HR (F = 11.154, p = 0.000, ηp2=0.347), and for SPO_2 (F = 4.538, p = 0.016, ηp2=0.178), indicating that the impact of mask type on HR and SPO_2 varied with intensity. However, interaction effects for PRE and BLa, and SPO_2 were not statistically significant.

At rest, HR values showed no significant differences between mask conditions (p > 0.05) as shown in Table 2. However, HR increased significantly with exercise intensity, and differences between mask conditions became more pronounced at higher intensities. At moderate intensity, HR was significantly higher with N-95 masks compared to no masks (p = 0.00), while the difference between N-95 masks and surgical masks (p = 0.236) and between surgical masks and no masks (p = 0.017) reached statistical significance. At high intensity, HR differences between mask conditions were more pronounced. N-95 masks resulted in significantly higher HR compared to both surgical masks (p = 0.029) and no masks (p = 0.000). Similarly, surgical masks elicited significantly higher HR than no masks (p = 0.003). These results suggest that N-95 masks impose the highest cardiovascular load, followed by surgical masks and no masks

PRE showed no significant differences between mask conditions at rest and low and moderate intensity (p > 0.05). At high intensity, N-95 masks elicited significantly higher PRE than no masks (p = 0.000), while surgical masks also resulted in significantly higher PRE than no masks (p = 0.003). However, differences between N-95 masks and surgical masks at this intensity were not statistically significant (p > 0.05).

BLa showed minimal differences between mask conditions at rest, low intensity, and moderate intensity (p > 0.05). At high intensity, N-95 masks resulted in significantly higher BLa compared to no masks (p = 0.028), while differences between N-95 masks and surgical masks (p = 0.224) and between surgical masks and no masks (p = 0.306) were not statistically significant.

SPO_2 was not significantly different across mask conditions at rest, low intensity (p > 0.05). However, at moderate intensity, SPO_2 was significantly lower with N-95 masks than with surgical masks (p = 0.029) and no masks (p = 0.018). At high intensity, SPO_2 with N-95 masks remained significantly lower compared to no masks (p = 0.008), while differences between N-95 and surgical masks (p = 0.355) and between surgical masks and no masks (p = 0.068) were not significant.

Table 3 illustrates the perceived discomfort levels reported by participants when wearing SM and N-95 masks during the exercise test. Across all measured domains, the N-95 mask was associated with higher discomfort levels compared to the surgical mask. The most notable differences were observed in "hot" (SM: 7.2 ± 1.14, N-95: 8.1 ± 1.58), "breath resistance" (SM: 6.8 ± 0.86, N-95: 7.9 ± 0.67), and "fatigue" (SM: 5.2 ± 1.14, N-95: 6.9 ± 1.54).

Figure 1 illustrates the physiological and perceptual changes in children across different exercise intensities under three conditions: wearing an N95 mask, wearing a surgical mask, and without a mask.

Table 1. Demographic characteristics of the participants

	(mean ± ST) n=20
Age (year)	11.23 ± 0.59
Height (cm)	134.6 ± 1.80
Weight (Kg)	33.46 ± 1.12
BMI (Kg/m^2)	18.47 ± 0.45
Body fat (%)	23.20 ± 0.86
VO_{2max} mL/kg/min	40.48 ± 1.66
HR_{max} (bmp)	208.46 ± 1.06

BMI, body mass index; bpm, beats per minute; HRmax, maximal heart rate; VO2max, maximal oxygen uptake

Table 2. Mean physiological responses and RPE

Measures	Intensity	NM	SM	N-95	Difference (95% CI)	Cohen's d effect size	p-value
HR (bpm)	Baseline	88.6 ± 1.59	86.5 ± 2.09	87.6 ± 1.11	0.00 (-1.39 to 1.39)	0.000	1.0
	LIG	121.8 ± 0.06	122.8 ± 5.4	122.8 ± 4.6	0.73 (-2.09 to 3.55)	0.194	0.59
	MOD	146.7 ± 3.3	149.06 ± 2.54	152.06 ± 2.15	0.33 (-1.75 to 2.42)	0.85	0.000
	VIG	173.2 ± 2.9	179.1 ± 4.1	183.3 ± 3.8	5.93 (3.22 to 8.64)	1.63	0.000
RPE (0–10)	Baseline	1.46 ± 0.51	1.4 ± 0.48	1.49 ± 0.50	-0.067 (-0.44 to 0.31)	0.13	0.72
	LIG	3.81 ± 0.63	3.65 ± 0.54	3.92 ± 0.63	-0.26 (-0.74 to 0.20)	0.419	0.26
	MOD	5.43 ± 0.63	6.52 ± 0.47	7.13± 0.50	0.13 (-0.29 to 0.56)	0.231	0.072
	VIG	7.62 ± 0.61	8.81 ± 0.68	9.5 ± 0.5	0.73 (-2.09 to 3.55)	1.299	0.000
BLa (mmol/L)	Baseline	1.29 ± 0.31	1.31 ± 0.15	1.29 ± 0.20	0.00 (-0.15 to 0.15)	0.000	1.00
	LIG	1.47 ± 0.16	1.48 ± 0.18	1.47 ± 0.25	0.67 (-0.63 to 0.19)	0.39	0.30
	MOD	2.5 ± 0.21	2.69 ± 0.26	2.75 ± 0.26	0.40 (-0.14 to 0.22)	0.16	0.65
	VIG	5.22 ± 0.41	5.83 ± 0.20	5.98 ± 0.58	0.20 (-0.038 to 0.45)	0.63	0.021
SpO_2 (%)	Baseline	98.06 ± 0.70	98.2 ± 0.67	98.2 ± 0.53	0.13 (-0.38 to 0.64)	0.19	0.60
	LIG	98.0 ± 0.75	97.86 ± 0.74	97.96 ± 0.52	-0.13 (-0.69 to 0.42)	-0.18	0.63
	MOD	97.26 ± 0.79	96.6 ± 0.24	96.4 ± 0.56	-1.00 (-0.58 to 0.44)	-0.10	0.011
	VIG	96.53 ± 0.51	96.01 ± 0.60	95.23 ± 0.42	1.00 (-0.83 to 0.035)	-0.69	0.000

NM = no mask, SM = surgical mask; LIG: light intensity (25%VO_{2max}); MOD: moderate intensity (50%VO_{2max}); VIG: vigorous intensity (75%VO_{2max}). BLa, blood lactate concentration; RPE; SpO_2, oxygen saturation level.

Table 3. Perceived discomfort level when wearing the face masks during the test

Domain	0 (no discomfort at all) to 10 (maximal discomfort)	
	SM	N-95
Humid	3.8±1.14	4.5±1.12
Hot	7.2±1.14	8.1±1.58
Breath resistance	6.8±0.86	7.9±0.67
Itchy	4.26±1.03	5.28±1.62
Tightness	3.4±0.98	4.9±0.58
Salty	1.73±0.73	2.15±0.38
Unfit	1.86±0.74	1.25±0.85
Odor	2.4±0.73	3.9±0.65
Fatigue	5.2±1.14	6.9±1.54
Overall	4.45±0.32	5.97±0.48

SM = surgical mask; N-95= N-95 mask

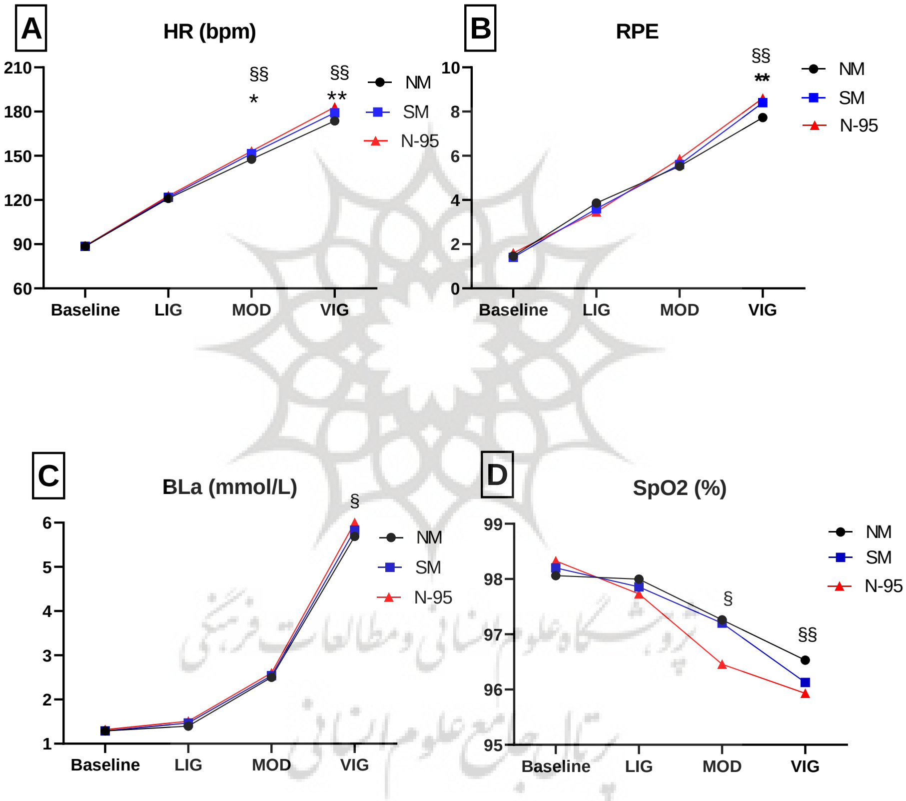

Figure 1. Mean changes in physiological parameters and Rate of Perceived Exertion (RPE) throughout the LIG: light intensity (25%VO_{2max}); MOD: moderate intensity (50%VO_{2max}); VIG: vigorous intensity (75%VO_{2max}) exeercise test (n=20) without a mask (NM), with a surgical mask (SM), and with N-95 mask. **A** Heart rate (HR) in beats*min−1 (bpm). **B** RPE. **C** Blood Lactate Concentration (BLa). **D** Oxygen Saturation (SpO_2). *p<0.05, NM vs SM. **p<0.01, NM vs SM. $^{§}p$<0.05. NM vs N-95. $^{§§}p$<0.01, NM vs N-95.

4. Discussion

This study explored the physiological and perceptual impacts of wearing surgical and N-95 masks across low-, moderate-, and high-intensity exercise in children aged 10–12 years. The findings indicate significant variations in HR, PRE, BLa, and SpO_2, particularly under high-intensity conditions when wearing masks. This study is among the first to systematically investigate these effects in children, contributing valuable insights into pediatric responses to exercise under masked conditions.

HR increased progressively with exercise intensity, with the highest values recorded under the N-95 mask condition, followed by the surgical mask and no mask. The differences became statistically significant during moderate and high-intensity exercise, where the N-95 mask imposed the greatest cardiovascular load ($p < 0.01$). The additional strain likely arises from the mask's high filtration efficiency, which increases the work of breathing and, consequently, cardiovascular demand. In children, this effect is particularly noteworthy due to their unique physiological characteristics, including lower stroke volume and cardiac output compared to adults [10]. To compensate, children exhibit elevated HR during exercise, which could be further exacerbated under conditions of increased respiratory resistance. While this heightened cardiovascular response was not detrimental to the participants in this study, it underscores the need for careful monitoring of during prolonged or high-intensity activities when children wear masks.

Our observation that N-95 masks impose a greater cardiovascular load during high-intensity exercise aligns with several studies in adults. For instance, Fikenzer et al. (2020) demonstrated that N-95 masks significantly increased HR and RPE during cardiopulmonary exercise testing compared to surgical masks and no masks (5). Contrary to our findings, some studies have reported minimal or no significant impact of mask-wearing on physiological parameters during exercise. For example, Doherty et al. (2021) found that surgical and cloth masks did not significantly affect HR, SpO_2, or RPE during moderate-intensity cycling in adults (7). Similarly, Poon et al. (2021) observed no significant differences in HR or SpO_2 when participants wore surgical masks during low- to moderate-intensity treadmill exercise (18).

SpO_2 levels were significantly lower under the N-95 mask condition during moderate and high-intensity exercise ($p = 0.029$ and $p = 0.008$, respectively). This suggests that the restrictive nature of the N-95 mask may hinder oxygen uptake, leading to transient reductions in oxygen saturation. Although SpO_2 values remained within normal physiological ranges (95%–100%), the observed reductions highlight potential challenges in oxygen delivery during intense physical activity. Previous studies in adults have reported similar findings, with restrictive masks causing slight decreases in oxygenation during exercise [24]. The current study contributes to this body of evidence, emphasizing the importance of further research to determine whether such reductions could have cumulative effects in children, particularly those with pre-existing respiratory conditions.

BLa levels increased significantly under the N-95 mask condition during high-intensity exercise, reflecting a greater reliance on anaerobic metabolism. This finding aligns with the observed reductions in SpO_2 and the elevated HR, suggesting that restrictive masks may limit oxygen availability, prompting earlier activation of anaerobic energy pathways [25]. The elevated BLa levels indicate greater metabolic stress, which could influence exercise tolerance over time. Consistent with these findings, prior studies have documented increased lactate accumulation during mask-wearing, further supporting the hypothesis that restrictive masks may impede oxygen delivery during strenuous activity [26].

PRE values were significantly higher under both the surgical and N-95 mask conditions during high-intensity exercise, with the N-95 mask eliciting the greatest perceived effort ($p < 0.01$). These findings are consistent with prior research suggesting that increased inspiratory and expiratory resistance associated with mask use can amplify perceived effort [5, 9].

The subjective discomfort reported by participants, underscores the significant influence of mask type on perceived exertion during exercise. Participants experienced greater discomfort with the N-95 mask compared to the surgical mask across multiple domains, particularly for breathing resistance (7.9 ± 0.67 vs. 6.8 ± 0.86), heat (8.1 ± 1.58 vs. 7.2 ± 1.14), and itchiness (5.28 ± 1.62 vs. 4.26 ± 1.03). These differences highlight the role of the N-95 mask's restrictive design and material in intensifying sensations of breathlessness and thermal discomfort, which are key contributors to heightened perceptions of exertion during physical activity. The overall discomfort score was notably higher for the N-95 mask (5.97 ± 0.48) than the surgical mask (4.45 ± 0.32), indicating that the N-95 mask imposes a greater perceptual burden. These findings align with prior research emphasizing the relationship between mask design and comfort during exercise [27, 28]. The increased discomfort associated with the N-95 mask may reduce exercise adherence, particularly in children, who are more sensitive to physical discomfort and less tolerant of prolonged exertion. These results highlight the importance of optimizing mask designs to balance protection with enhanced comfort, especially in pediatric populations engaging in regular physical activity.

The current findings suggest that children may experience more pronounced physiological and perceptual responses. The differences can be attributed to children’s distinct physiological profiles, including higher respiratory rates, reduced ventilatory efficiency, and greater perceived exertion during prolonged exercise [12, 13]. These unique characteristics necessitate tailored approaches to mask use in pediatric populations, particularly during high-intensity activities.

This study has certain limitations that should be acknowledged. The relatively small sample size may limit the generalizability of the findings to wider populations. Furthermore, the study was conducted exclusively on healthy children, leaving the effects of mask-wearing on children with pre-existing health conditions unexplored. Future research should address these gaps by investigating the long-term physiological and perceptual effects of repeated exercise sessions with masks in children. Additionally, studies should focus on developing and evaluating alternative mask designs that strike an optimal balance between respiratory protection and breathability. Lastly, further research is needed to assess the impact of mask use on broader physiological parameters, such as ventilation efficiency and oxygen uptake kinetics, across diverse pediatric populations. These efforts would provide a more comprehensive understanding of the implications of mask use during physical activity in children.

5. Conclusion

This study highlights the significant impact of face masks, particularly the N-95, on physiological and perceptual responses during exercise in children. Elevated HR, BLa, and PRE, coupled with reduced SpO_2, indicate greater cardiovascular and metabolic demands under mask conditions, especially at high intensities. While these effects did not impair overall exercise performance, they underscore the need for tailored strategies to minimize the challenges of mask use in children. Future studies should continue to explore the complex interactions between mask design, exercise intensity, and pediatric physiology to ensure safe and effective physical activity during public health emergencies.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

All authors contributed to the original idea, study design.

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All the volunteers and participants are greatly appreciated for their participation in the implementation of this research.

Ethical considerations

The author has completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc.

The ethical guidelines approved by the Ethics Committee of Islamic Azad University, Shahrekord branch (IR.IAU.SHK.REC.1401.025).

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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