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PHYSICAL ACTIVITY LEVELS AMONG SAUDI'S CHILDREN AND ADOLESCENTS WHO HAD COVID-19 INFECTION

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Abstract:

Objectives: The SARS-CoV-2 viral infection also known as Covid-19 has shown to have a negative impact on physical activity levels and other health related problems in infected children and adolescents. This cross-sectional study aims to provide a descriptive analysis of the levels of physical activity (determined by the MET measured in minutes per week), conducted by children and adolescents aged 7-17 years in Saudi Arabia who have developed a Covid-19 infection.

Methods: A total of 403 Participants, ages 7-17 years, answered the Global Physical Activity Questionnaire (GPAQ). The GPAQ assesses multiple components of physical activity such as intensity, frequency and duration yielding the metabolic equivalent (MET) measuring physical activity in minutes per week.

Results: One hundred and forty-five participants had a MET score of <600, 55 out of 145 participants had a MET score of 0, and 258 participants had a MET score of ≥600 following the WHO recommendations of physical activity performance. There was a significant difference in mean MET score by age group (7-12 years vs. 13-17 years), 3266 minutes vs. 2524 minutes respectively (p-value 0.015). Additionally male participants have shown to have 1.86-fold (95% CI1.23-2.81) higher odds of having conducted more than 600 MET minutes of physical activity in comparison to females.

Conclusions: A pattern was observed for the physical activity levels of children and adolescents during the pandemic who were infected with coronavirus and recovered which indicate higher activity for males and younger age groups.

Keywords: COVID-19; Coronavirus disease-2019; Children; Physical inactivity; physical performance, children and adolescents

Introduction

In December 2019, Covid-19 disease has emerged in Wuhan, China and managed to spread globally infecting more than 500 million cases worldwide up to-date and resulting in over 6 million deaths [1]. The disease is caused by the severe acute respiratory syndrome, SARS-CoV-2 virus, which belongs to the coronavirus family that cause diseases ranging from the common flu to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV)[2]. The SARS-CoV-2 outbreak has caused cases to suffer a myriad of symptoms, which include but aren't limited to fever, cough and respiratory discomfort leading to severe acute respiratory infections [2, 3]. Since its emergence Covid-19 has been declared a pandemic that has caused cascading deaths, severe pressure crippling public health systems worldwide in addition to uncertainty pertaining the future of global economies[4].

Countries worldwide faced with the burden of the spread of SARS-CoV-2 virus have imposed regulatory measures based on the WHO recommendations, aimed at preventing interpersonal contaminations and further disease transmission [5]. The WHO guidelines on a well-structured response included "active surveillance, continuous prevention and control of infection, effective plans for healthcare facilities, postponement of mass gathering events and raising public awareness and understanding of disease"[6]. Many countries have adopted these recommendations and responded by imposing stay at home restrictions to their citizens. Saudi Arabia similar to most countries has followed an emergency response that entailed preparing both public and private institutions in dealing with the pandemic. Their response included the suspension of all schools, activities (sports and social events) as well as both domestic and international travel after the announcement of the first Covid-19 case in the country[6]. This was followed by more severe restrictions on movement, which included a countrywide lockdown leaving residents strictly confined to their homes.

The home confinement of people worldwide has had a huge effect on their physical activity and strongly impacted lifestyle behaviors[7]. Being at home meant that children and adolescents could not go to school and engage in usual daily activities, while adults were no longer going to their workplaces. This has greatly cut the amount of physical activity performed by individuals worldwide. During the pandemic, researchers have raised concerns regarding the decline in functional physical activity and increased risk of other health-related problems [8, 9]. As schools have been shut for more than a year and individuals are quarantined at home, physical inactivity and sedentary behavior significantly increased [10].

The WHO defines physical activity as "any physical movement created by skeletal muscles that involves energy spending"[11], which includes but is not limited to activities such as active walking, participation in sports, dancing, cycling, or any other recreational activity [11, 12]. The WHO has recommended that children and adolescents ages 5-17 years perform at least 60 minutes per day of moderate-vigorous intensity exercises, which are primarily aerobic. Also, participating in vigorous-intensity exercises at least three days a week can be combined to strengthen muscles and bones. Additionally, the amount of time spent on recreational screen time needs to be limited [13, 14]. Physical activity is essential for improving bodily systems such as musculoskeletal and cardiorespiratory as well as brain health [5]. Studies have shown that consistent physical activity can have the ability to strengthen one's immune system and decrease the risk of viral infections [15].

The pandemic has severely affected individuals of all ages worldwide. Being physically inactive is a risk factor that can be particularly critical for populations, profoundly impacting their wellbeing, potentially contributing to obesity, routine changes, sleep disorders and other health problems [16-19]. Not only has Covid-19 affected adults, but it also had a major effect on children and adolescents. Prior to the pandemic, children's daily physical activities were attained through walking to and from school, physical education classes, spending time in playgrounds, and recess time at school. Covid-19 government imposed measures such as the mandatory confinement imposed, has left children and adolescents with a lack of physical activities, social interactions with peers, consequently affecting their mental health as well as quality of life [16-20]. Studies conducted pre and post the Covid-19 pandemic have confirmed that the decreased physical activity levels and increased sedentary behavior in children and adolescents is associated with a negative impact on their physical and mental health [5, 21, 22]. Moreover, the children's confinement has had an effect on their Vitamin D levels due to

their lack of sun exposure which according to a review by Beard et al, could elevate children's risk to respiratory tract infections thus making children more vulnerable to Covid-19 [23].
Also, the lack of physical activity and increase in screen exposure linked to it, may consequently lead to circadian regulation in individuals which may have an effect on Covid-19 infection severity [24]. Moreover, a contradictory relationship between PA and SB of children and adolescents before and during COVID-19 was observed. The more sitting time in SB, the less performing of PA during the pandemic, resulting in decreased quality of life of children and adolescents [25, 26]. Recent research indicated that an increase in SB during the quarantine could not be avoided for the individuals who were performed high levels of PA before the pandemic [14].

Although a myriad of studies have been conducted to study the impact of Covid-19 infection on physical activity levels of individuals, no study to our knowledge has investigated the impact of Covid-19 infection on physical activity determined by the metabolic equivalent of physical activity (MET) in children and adolescents within Saudi Arabia. Therefore, this cross-sectional study aims to provide a descriptive analysis of the levels of physical activity (determined by the MET measured in minutes per week), conducted by children and adolescents aged 7-17 years in Saudi Arabia who have developed a Covid-19 infection. The study will explore any trends of association between physical activity levels and potential risk factors such as sex, age, and geographic location.

Materials and Methods

1. Study Design

A cross-sectional study design was devised to evaluate physical activity levels of participants infected with SARS-CoV-2 virus during the peiord of March to June 2019. The study was approved by The Saudi Arabian Ministry of Health (MOH) Institutional Review Board (IRB) under project number; (20 – 150E). Access to the participants' data was retrieved from the Saudi MOH Central IRB and the Saudi Center for Disease Prevention and Control.

2. Participants

The study was performed on individuals aged between 7-17 years who were infected with COVID-19 and recovered between March and June 2019. A total of 403 participants met the inclusion criteria which constituted the following: a confirmed positive COVID-19 test within the last six months, no musculoskeletal pain, no chronic disorders or chronic respiratory distress, and must be residing in Saudi Arabia.

3. *Outcome Measures*

3.1. Sociodemographic Questionnaire.

The questionnaire conducted included questions identifying the age, sex, geographical location, and academic level of participants. In addition, the date of infection with COVID-19 and the date of recovery were recorded.

3.2. Global Physical Activity Questionnaire (GPAQ).

The GPAQ questionnaire, developed by the WHO, comprised several physical activity elements, such as intensity, duration, and frequency of physical activity, in addition to assessing multiple domains such as travel and to from places, engaging in sports activities and sitting or relaxing time. The questionnaire originally comprised of questions that assessed activity at work, however, since we only monitored children and adolescents, "activity at work" was excluded from the questionnaire. The questionnaire was not validated for this study population, however questions used have already been previously validated in other studies [27-30].

Domain	Code
# of Days where vigorous work is done	P2
# of Hours where vigorous work is done	P3
# of Days where moderate work is done	P5
# of Hours where moderate work is done	P6
# of Days where participant walks or cycles for at least 10 minutes	P8
# of Hours where participant walks or cycles for at least 10 minutes	P9
# of Days where vigorous intensity sports are performed	P11
# of Hours where vigorous intensity sports are performed	P12
# of Days where moderate intensity sports are performed	P14
# of Hours where moderate intensity sports are performed	P15

During the pilot phase of the study, the questionnaire was modified based on the participants' comments on the questions; this was done with 10 random participants from the study population to ensure clarity of the questionnaire.

The Metabolic equivalent minutes of physical activity (MET) was computed as the sum of the total minutes of the participant's physical activity level per week for each activity setting. The sum equation-minutes/week was defined as [(P2 × P3 × 8) + (P5 × P6 × 4) + (P8 × P9 × 4) + (P11 × P12 × 8) + (P14 × P15 × 4)] [31].

The World Health Organization (WHO) recommends people undertake ≥600 MET minutes of physical activity per week [13]. Any participants in the study with less than 600 MET minutes were considered not within the WHO recommendations.

4. Procedures

Research assistants have reached out to participants and their parents through telephone conversations, where verbal consent was given. All participants received a full explanation of the study objectives, procedures, and outcomes prior to giving consent. Participants and their parents received a call to complete the Global Physical Activity Questionnaire (GPAQ) where each call lasted approximated 15-20 minutes. Research assistants were experienced and trained to respond to any queries parents or participants had regarding the questionnaire. Demographic characteristics (age, gender, academic level, and location) were documented. Participants answered the GPAQ themselves and in the younger age group with their parents' help.

5. Data Analyses

Data analyses were performed using the SPSS Statistical software (version 25.0; IBM Corp, Armonk, NY). A sample size of 403 participants was estimated from the percentage of the total population of children and adolescents infected with COVID-19, using a power of 0·8, moderate effect size (d=0·5), and a significance level of 0·05. Statistical significance was defined as a 2-sided P value of less than 0.05.

The MET score was computed through the equation explained above. All participants with MET scores ≥600 was deemed within the recommended WHO numbers. The mean and standard deviation of MET scores ≥600 was computed for different variables including sex, age, and geographic location. Quantitative variables were tested for equality of variances as well as normality through the Shapiro Wilk test. Since the data was not normally distributed, Man-Whitney U test was computed to explore differences in the mean MET values of participants meeting the WHO recommendations within different age groups, sex, and geographic locations.

Spearman's correlation was used to examine the correlation between the MET score and age as well as the MET score and sex. Moreover, a univariate logistic regression was computed to assess the relationship between changes in MET minutes of physical activity and potential risk factors such as sex, age, and geographic locations.

Results

Overall Characteristics.

The cross-sectional study constituted 403 children and adolescents, where male participants consituted the majority of the subjects (55.3%). The age of the subjects ranged from 7 to 17 years with a median age of 11 years, with the majority of the subjects being aged between 7-12 years of age (60.5%). The highest percentage of participants were from the Western Region (43.7%) followed by Eastern Region (26.3%) , while the lowest participants were from the Northern Region (5.2%). Out of the 403 participnts in the study, 64% had MET minutes of physical actvity ≥600, the remaining 36% that did not meet the WHO recommendations of sufficient physical activity were hospitalized due to Covid-19 infection. (Table1)

Table 1. Characteristics of the study Participants

Characteristics		Total N	Percentage (%)
Sex	Male	223	55.3
	Female	180	44.7
Age (years)	7-12	244	60.5
	13-17	159	39.5
Geographic Location	Central Region	70	17.4
	Eastern Region	106	26.3
	Western Region	176	43.7
	Northern Region	21	5.2
	Southern Region	30	7.4
Metabolic Equivalent (MET)	<600	145	36
	≥600	258	64

A total of 258 participants had a MET score ≥600, the remaining 145 were excluded from the analysis as they are considered below the WHO recommendations for metabolic equivalent minutes of physical activity. Therefore, any conducted analysis in the study moving forward will be referring to participants who conducted 600 MET minutes per week or more of physical activity unless stating otherwise. According to the results presented in Table 2, although male participants had a mean MET value of 3235 minutes while females had a mean of 2580 minutes, there was no apparent significant difference between the MET minutes conducted by both groups (Table 2).

Also, when computing Spearman's rho correlation there was no significant correlation found between sex and MET minutes of physical activity (Table 3). On the other hand, participants aged 7-12 years had a significantly higher mean MET score of 3266 minutes compared to 2524 minutes for participants aged 13-17 years (Table 2). Also, a significant negative correlation was observed between age and MET minutes of physical activity, with a spearman rho's coefficient of -0.15 (Table 3). Moreover, no apparent significant difference was observed between the mean MET minutes in different geographic locations in Saudi Arabia (Table 2).

Table 2. Mean of Metabolic Equivalent minutes of Physical Activity on Average per Week for groups ≥600 (N=258)

Variable		N	Mean	Standard Deviation
Sex	Male	157	3235	2785
	Female	101	2580	1978
Man-Whitney U test	8804		***p-value***	0.135
Age (years)	7-12	158	3266	2679
	13-17	100	2524	2173
Man-Whitney U Test	9318		***p-value***	0.015
Location	Central Region	47	2794	2356
	Eastern Region	68	2885	2028
	Western Region	116	3274	2984
	Northern Region	15	2409	1333
	Southern Region	12	2075	2984
Kruskal Wallis Test	1.851		***p value***	0.763

Table 3. Spearman's Correlation showing the association between MET≥600, age, and sex.

Variable	Spearman's rho *ρ*	*p-value*
Sex	-0.09338081	0.135
Age (years)	-0.1515164	0.015

Results obtained from the Univariate logistic regression performed assessing odds ratios showed significant results for sex only. Results obtained have shown that males have a 1.86-fold (95% CI1.23-2.81) higher odds of having conducted more than 600 MET minutes of physical activity in comparison to females. Both age and geographic location yielded no significant association with MET scores. (Table 4).

Table 4. Univariate logistic regression analysis assessing changes in MET minutes of Physical activity by potential risk factors.

Variable		MET		OR	95% Confidence Interval	
		≥ 600	<600		Lower Limit	Upper Limit
Sex	Male	157	66	1.86	1.23	2.81
	Female	101	79	Ref.	Ref.	Ref.
	p-value			0.003		
Age (years)	7-12	158	86	Ref.	Ref.	Ref.
	13-17	100	59	0.92	0.61	1.4
	p-value			0.704		
Location	Central Region	47	23			
	Eastern Region	68	38	0.88	0.46	1.66
	Western Region	116	60	0.95	0.53	1.7
	Northern Region	15	6	1.22	0.42	3.57
	Southern Region	12	18	0.33	0.13	0.79
	p value			0.084		

Abbreviations: MET= Metabolic Equivalent; OR=Odds Ratio

Discussion

This cross-sectional study, to our knowledge, is the first study conducted in Saudi Arabia investigating physical activity levels through measuring the MET in minutes per week, in children and adolescents infected with the SARS-CoV-2 virus. The study aimed at exploring any trends of association between physical activity levels within Covid-19 cases and potential risk factors such as sex, age, and geographic location. Of the total 403 participants in the study, 64% met the WHO physical activity recommendations. The study identified a higher significant mean MET score for participants aged 7-12 years and a higher odds ratio for males for engaging in physical activity (≥600 minutes) in comparison to females within children and adolescents infected with Covid-19.

When comparing physically active participants (those scoring ≥600 MET minutes according to WHO recommendations) the study yielded differences in mean MET minutes of physical activity between different age groups, 7-12 vs. 13-17 years. Participants aged 7-12 years had a significantly higher mean MET score (3266 MET minutes) in comparison to those aged 13-17 years (2524 MET minutes), which is consistent with other studies. Also, a significant negative correlation was observed in our results between sex and the participants' MET scores (rho = -0.15) According to a scoping review conducted by Yomoda *et al.* looking into 21 published studies evaluating children's physical activity during the Covid-19 pandemic, most studies within the review reported that older children or adolescents experienced less physical activity during the pandemic [15]. Similar results were also reported by Guerrero *et al* in a study looking into trends of physical activity in US youth, where

adolescents aged 12-17 years were less committed to physical activity programs, while children under 11 years were seen to more likely engage in moderate-vigorous physical activity (MVPA) [32]. This increase in adolescents' inactivity could be attributed to the fact that children of younger age are more acquainted with playing in smaller confined areas in their preschools and homes, while adolescents are more likely to play in groups and engage in organized sports, which were cancelled during the pandemic. Additionally, adolescents are more likely to be engaged with social networking sites during quarantine in aims of reducing any feeling of loneliness and isolation, rather than performing any form of physical activity [33]. Also, the decrease in physical activity could be attributed to social isolation during the pandemic [34] or to the physical and psychological changes due to puberty associated with adolescence [33].

Moreover, our results revealed gender disparity regarding physical activity levels of participants where male participants were shown to be more physically active than females. Our findings have shown that males have 1.86 higher odds (95% CI: 1.23-2.81) of conducting more than 600 MET minutes. Similar results were observed in previous studies, where females were less physically active than males during the pandemic [15]. According to Dallolio *et al,* females have shown to have participated in minimal moderate-vigorous activity and have reported very low MVPA minutes before and during the pandemic [35]. A significant difference was observed in MVPA minutes conducted between males and females in their study both before and during the Covid-19 pandemic, with males having reported higher minutes. Our findings were also supported by Moore et al's study investigating the impact of Covid-19 on the activity of Canadian children and youth [36]. It was observed that females were more engaged with social media use and were more likely to sleep additional hours in comparison to males. When exploring previous literature on the effect of Covid-19 on physical activity between different sexes, it was observed that males had higher physical activity levels than young females [37] and more compliant to physical activity guidelines [38] as aforementioned but are more likely to experience a decline in their activity levels relative to females during confinement [15]. This was not observed in our study as our study was cross-sectional, hence participants were not followed up before and during the pandemic to investigate comparisons in physical activity levels and to observe differences not only between different sexes but also different age groups.

When looking into mean differences between physical activity levels of participants in different locations within the Kingdom, no significant difference was observed. This could be attributed to the fact that all regions of the Kingdom had similar restrictions imposed by the government [6].

Limitations

Primarily, our study was a cross-sectional study which automatically limits the type of analysis that could be conducted with the data obtained and the conclusions reached are more limited with this nature of study design. Cross-sectional studies are more descriptive, hence we do not have data on participants before exposure to Covid-19. This lack of data restricts us from comparing and look at differences in behaviour before and after infection, thus the yielded analyses were purely descriptive. Also, no causal relationships could be established from the data provided. A follow-up study in the form of a longitudinal cohort study following up participants before and after Covid-19 infection to investigate the effect of the infection on their physical activity levels could be conducted in the future. This way a temporal causal relationship could be established which could provide us with more insight on the effects of Covid-19 infection and quarantine on physical activity levels. Another limitation in our study was that information bias could have been introduced during the data collection phase where parents were helping their children answer the questions. The parents could subconsciously sway the children's responses which could eventually alter our yielded odds ratios. Also, recall bias could have been introduced when asking children to remember their physical activity levels during their infection period.

Moreover, the questionnaire administered in the study was not validated for our study population but rather the questions were obtained from studies where their questionnaires were validated. This is not

sufficient to ensure the validity, internal consistency and reliability of the data obtained. This could be avoided in the future by testing for the validity and reliability of the questionnaire administered before commencing the study.

Recommednations

The impact of COVID-19 on physical health and its related fitness remains to be investigated, and further research is needed to investigate the effects of COVID-19 on physical health in children and adolescents. A follow-up study will help evaluate participant reactions to the future course of the COVID-19 pandemic. Moreover, a valid and reliable research is needed to assess the effect of PA levels during a summer activity, travel to and from places, recreational activity, and sitting time using GPAQ on the children's population. Since the previous studies examined the reliability and validity of adults, only one study existed in children.

Conclusions

In summary, this study portrayed patterns in physical activity levels in Covid-19 infected participants, where children aged 7-12 years showed significantly higher physical activity levels (higher mean MET scores) in comparison to adolescents aged 13-17 years. Moreover, male participants showed higher odds of having conducted more than 600 MET minutes of physical activity in comparison to women.

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Authors contributions:

Asma Alonazi comprehended of the presented idea. Asma Alonazi developed the theory and performed the computations. Asma Alonazi, Rahaf Alotaibi, and Saif Almutairi collected the data, Noha Daher performed and verified the analytical methods. Asma Alonazi and Danah Alyahya wrote the paper and reviewed the manuscript. All authors discussed the results and contributed to the final writing manuscript.

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