DOI: 10.4025/jphyseduc.v33i1.3348

Review Article

COVID-19 AND THE INFLUENCE OF SOCIAL RESTRICTION ON PHYSICAL ACTIVITY AMONG CHILDREN AND ADOLESCENTS

COVID-19 E INFLUÊNCIA DA RESTRIÇÃO SOCIAL NA ATIVIDADE FÍSICA DE CRIANÇAS E ADOLESCENTES

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RESUMO

Os objetivos deste estudo foram verificar a influência dos procedimentos adotados para conter a pandemia da Covid-19 nos níveis de atividade física (AF) de crianças e adolescentes e verificar se há diferenças entre os sexos e faixas etárias. Foi realizada uma revisão rápida de literatura, com busca em periódicos disponíveis nas bases de dados PubMed, Scopus e Web of Science, utilizando as palavras-chaves: Crianças, Adolescentes, Exercício Físico, Atividade Física e Covid-19. Dos 449 estudos identificados, 17 foram selecionados pelo critério de conter dados referentes a antes e durante o período de restrição social no mesmo estudo. Com exceção de um artigo, a síntese dos resultados indicou diminuição dos níveis de AF e aumento do tempo em atividades de tela durante o período de restrição social, em maior proporção para adolescentes e para o sexo feminino. Os resultados são mais próximos entre países da mesma região do que entre diferentes continentes, devido às diferenças no ambiente sociocultural em que os jovens vivem, incentivados principalmente pelos seus responsáveis. Do ponto de vista da saúde pública, deve existir uma preocupação com a continuidade desse padrão de comportamento após o término da pandemia, o que aumentaria ainda mais o risco de problemas já existentes, como atrasos no desenvolvimento motor, sobrepeso, obesidade, doenças cardiovasculares e diabetes na vida adulta.

Palavras-chave: Infância, Adolescência, Atividade Física, Sedentarismo, Coronavírus.

ABSTRACT

The objectives of this study were to verify the influence of the procedures adopted to contain the Covid-19 pandemic on the levels of physical activity (PA) of children and adolescents, as well as to check if there are any differences between the sexes and age groups. A quick literature review was carried out by means of a search in journals available in the PubMed, Scopus and Web of Science databases, using the following keywords: Children, Adolescents, Physical Exercise, Physical Activity, and Covid-19. Of the 449 studies identified, 17 were selected by the criterion of containing data referring to before and during the social restriction period in the same study. With the exception of one article, the synthesis of results indicated a decrease in PA levels and an increase in time spent on screen activities during the social restriction period, in greater proportions for adolescents and for females. Results are similar among countries in the same region than comparing different continents, due to differences in the sociocultural environment in which young people live, mainly encouraged by their guardians. From a public health point of view, there should be a concern about the continuity of this pattern of behavior after the end of the pandemic, which would further increase the risk of already existing problems, such as delays in motor development, overweight, obesity, cardiovascular diseases and diabetes in adulthood.

Keywords: Childhood, Adolescence, Physical Activity, Sedentary Behavior, Coronavirus.

Introduction

In March 2020, the World Health Organization (WHO) declared the pandemic state for Covid-19, a disease caused by the SARS-CoV-2[1] virus. The virus can be easily transmitted through respiratory droplets, saliva or other contact routes and cause acute respiratory distress and other complications[2]. Although healthy children and adolescents are not part of the risk group[3], any individual can develop symptoms of the disease, from the mildest to the lethal ones; in rare cases, children can develop Multisystem Inflammatory Syndrome (MIS-C)[4], which affects the airways and lungs shortly after infection with the SARS-CoV-2 virus and can cause great difficulty in breathing, requiring intubation in some cases. In addition, there is concern about contagion, for instance, from their guardians and those considered as a risk group, that is,

people over 60 years old and/or with other pathologies and comorbidities, such as heart diseases, diabetes, hypertension, etc.[1]

For this reason, many countries have adopted social restriction measures[1], with the closing of schools and daycare centers, as well as parks, gyms and environments considered non-essential, thus changing the routine of children and adolescents around the world, particularly in relation to the possibilities of engaging in PA. Actually, even before the pandemic, low rates of PA among children and adolescents were already considered a serious public health issue[5,6], with girls, in general, having even lower PA levels compared to boys, especially with the increase in chronological age[7-10]. With the adoption of social isolation measures, there is a high probability of this situation worsening, thus resulting in a great effect on global public health. Recent studies indicate that there was a reduction in PA among adults and children during the social restriction period[11,12].

However, scientific evidence about the effect of social restriction on PA levels is still scarce, particularly because the duration, frequency and type of restriction were different in each country/region. Furthermore, a greater understanding of the influence of age and sex is needed. Therefore, due to the possible effect of social restriction on health, and taking into account the importance of PA in childhood and adolescence, there is a need for information aimed at the formulation of public policies applied to the resumption of face-to-face activities, both in the school context and in leisure. The objectives of this review research were: (i) to synthesize evidence from studies that have verified the influence of social restrictions resulting from the Covid-19 pandemic on the PA levels of children and adolescents; and (ii) to verify possible differences between the sexes and age groups. The hypothesis is that there has been a reduction in PA levels among children and adolescents of both sexes, which would lead to risks to public health becoming worse.

Methods

A quick literature review was conducted from the recommendations of the World Health Organization (WHO)[13], in which a quick review is described as a way to synthesize literature in a few weeks, without losing quality criteria, such as transparency, reproducibility and systematization. Thus, such studies are justified by the fact that systematic reviews require long periods of time (months/years) and costs related to the team of researchers, while quick responses are desirable in practical contexts of public policy formulation, especially during crises[13]. In this sense, the present text uses this resource to verify the effects of the pandemic on the engagement in PA of children and adolescents in the world, from the following scientific article databases: Pubmed, Scopus and Web of Science.

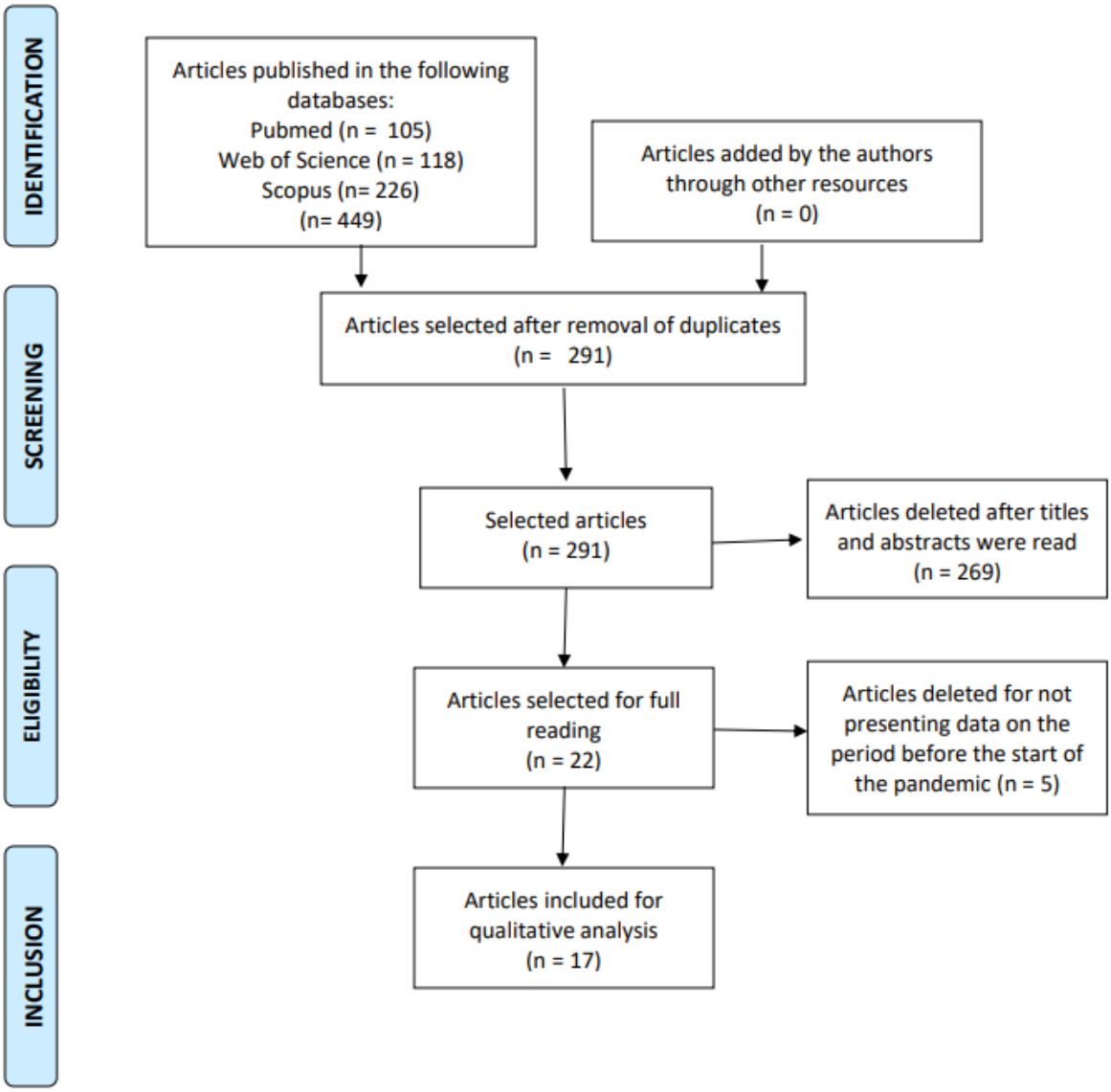

Figure 1. Quick review flowchart
Source: The authors

Eligibility criteria

Based on the research question, the search comprised original articles published in peer-reviewed scientific journals, in English, Portuguese and Spanish. More specifically, based on the "PICOS"[14] strategy, the following items were established, considering:

Population

Samples of children and adolescents aged between 3 and 19 years old (without disabilities and/or specific clinical conditions, except for samples specifically composed of overweight and/or obese children).

Exposure/outcome

Observational studies that have analyzed the effect of the procedures adopted to contain the pandemic, which include distancing, social isolation, lockdown, quarantine, and strict or relaxed confinement in engagement in PA, having as basis Covid-19 for exposure variable

and/or PA for outcome variable, provided that there were comparisons between current and pre-pandemic levels. No restrictions were imposed as to PA intensity (light/moderate/vigorous), domains (e.g., leisure, school or commuting), and instruments used to measure PA (e.g., questionnaires or motion sensors).

Study design

Cross-sectional and longitudinal studies that presented analyses on Covid-19 and PA were included, regardless of the protocol used (e.g., univariate or multivariate analyses). Case studies, reviews, meta-analyses, and event summaries were excluded.

Sources of information and search strategy

A search for journals available in the PubMed, Web of Science and Scopus databases was carried out, using the terms "Child", "Adolescent", "Physical Exercise", "Physical Activity" and "Covid-19". The terms "Children" and "Adolescents", as well as "Physical Exercise" and "Physical Activity", were joined in each database through the Boolean operator "OR" and their respective results; the term "Covid-19" was later connected through the Boolean operator "AND". One author (RPAJ) performed the initial search for articles, having December 31, 2020, as maximum date of publication, and introduced all retrieved articles in the Rayyan platform (https://rayyan.ai/reviews/231130)[15], where duplicates were identified and removed.

Subsequently, two authors (SAM, JVBXR), independently, reviewed, in the platform, the available articles by their titles and abstracts. Results were compared, and inconsistencies were discussed until consensus was reached. When no consensus was reached, a third author (GS) determined the eligibility of the study. After this phase ended, the same authors evaluated the full texts of the remaining articles. Data were independently extracted by two authors (SAM, JVBXR) in an electronic spreadsheet, which was organized into two levels of information: (1) descriptive (location, sample and age) and (2) methodological (design, characteristics of the procedures adopted to contain the pandemic, type and measure of PA, form of analysis, and main results). Data were extracted from the total sample only if data by sex were not available. Considering the heterogeneity among the designs and methods adopted, a descriptive synthesis of the available data was chosen.

Results

A total of 449 articles were identified in the selected databases (Pubmed = 105; Web of Science = 118; Scopus = 226), of which 158 were excluded in the duplicate removal phase. After the titles and abstracts of the remaining 291 articles were read, 22 articles were selected for full reading, and 17 were included for data synthesis, as shown in the flowchart displayed in Figure 1.

Among the 17 selected studies, 8 were cross-sectional, 8 were longitudinal, and only one was experimental. The sample size ranged from 41[16] to 1,711[17] participants. Most studies (n = 11) were conducted on the European continent[16-26]. All studies used questionnaires to measure PA, and only one study[26] used smartphone sensors, pedometer and motion-based activity recognition (MBAR). Regarding the characteristics of the procedures adopted to contain the pandemic, nine studies classified them as lockdown[16,17,19,20,22,23,26,28,29], two studies classified them as isolation or quarantine[18,30], five classified them as social distancing[24,25,27,31,32], and one study classified them as strict or relaxed confinement[21]. Despite different applications and concepts, the studies had similar results, regardless of the restriction model adopted (social isolation, lockdown, quarantine, confinement or social distancing). For this reason, we defined the use of "social restriction" as a single term to refer to the seclusion period during the

pandemic.

With the exception of the study from Germany[17], all studies reported a decrease in PA levels during the pandemic period compared to the pre-pandemic period. Among the studies that differentiated sex in the sample (n = 8), two found no difference between boys and girls[17,22], and six showed statistically significant differences in PA levels between the groups[18,19,20,28,30,31]. Among the articles that showed differences between the sexes (n = 6), three studies showed that there was a decrease for both sexes and that boys had higher PA levels than girls did[18,19,30]; two studies showed that, for the female sex, there was no significant difference in PA level before and during the pandemic[28,31], and one study showed that, among those who were active during the pandemic, girls were more active, and among those who were inactive, they were also more inactive than boys were[20].

Among the total number of studies that established some relationship with age (n = 7), only one study found no difference between ages[22], and five observed that the older the age, the lower the PA levels found when compared to younger ages in the same sample[17,19,28,29,30]. One study showed the opposite (the younger the age, the lower the PA levels)[21].

Table 1. Main descriptive results of the publications included

Author, Year / Country	Date / Type of restriction adopted	Age group	N (Male/ Female)	Results
Moore et al.[30], 2020 / Canada	April 2020 / Isolation or quarantine	5-17	1472 (775/689)	A total of 18.2% of children and 11.3% of adolescents were not meeting PA guidelines during the pandemic. More children (23.8%) were meeting physical activity recommendations compared to adolescents (13.2%). Fewer girls aged 5 to 11 years (19.0%) did sufficient physical activity compared to boys (27.9%) of the same age. Children and adolescents had lower levels of outdoor physical activity and sports (2.28 / 5.00 and 1.96 / 5.00 for children and youths, respectively).
Mitra et al.[29], 2020 / Canada	April 2020 / LD	5-17	1427 (775/689)	A total of 63% of parents reported decreased outdoor physical activity and sports, and 34% reported decreased indoor physical activity and sports among children and adolescents. Parents of adolescents reported a greater decrease compared to parents of children for outdoor physical activity, 40% and 27% respectively, and indoor physical activity, 68% and 59%, respectively.

Author, Year / Country	Date / Type of restriction adopted	Age group	N (Male/ Female)	Results
Dunton et al.[28], 2020 / USA	April 2020 - May 2020 / LD	5-13	211 (100/111)	Parents of older children (9 to 13 years) were twice as likely as younger children (5 to 8 years) to have a change in perception that their children did less PA in the last 7 days compared to February 2020 (OR = 2.31, 95% CI [1.34, 3.98]). A total of 36% of parents perceived that their children's PA level decreased between the pre-Covid-19 period (February 2020) and the initial Covid-19 period (April - May 2020). Adolescents were twice as likely to perform less PA than children were.
Zenic et al.[24], 2020 / Croatia	October 2019 - April 2020 / SD	14-18	823 (/)	By the PAQ-A, PA levels decreased significantly ($p < 0.01$), from normal (2.97±0.61) to low (2.63±0.68), in the total sample.
Sekulic et al.[25], 2020 / Croatia	April 2020 / SD	15-18	388 (262/126)	By the PAQ-A, there was a significant decrease in PA levels for the total sample of study participants (from: 2.99±0.70 to: 2.67±0.60, $p<0.001$). When differences were calculated separately by sex, the decrease in PA levels was significant for boys (from: 3.10±0.78 to: 2.79±0.82, $p<0.001$), but not significant for girls (from: 2.71±0.66 to: 2.59 ±0.90). Significant differences between boys and girls in PA levels before ($p<0.01$) and after ($p<0.05$), with higher PA levels among boys.
Gilic et al.[18], 2020 / Bosnia and Herzegovina	April 2020 / Isolation or quarantine	15-18	688 (366/322)	By the PAQ-A, the PA levels of the total number of participants decreased significantly (from: 2.98±0.71 to: 2.31±0.68; $p<0.001$). There was a significant decrease in PA level among girls (2.69±0.49 to 1.95±0.56; $p <0.001$) and among boys (from 3.12±0.56 to 2.50±0.44; $p<0.01$). Boys had a higher PA level than girls did before ($p<0.001$) and during social isolation ($p<0.001$).

Author, Year / Country	Date / Type of restriction adopted	Age group	N (Male/ Female)	Results
Elnaggar et al.[31], 2020 / Saudi Arabia	October 2020 / SD	14-18	63 (34/29)	By the PAQ-A, PA levels significantly reduced among boys (before: 3.20±0.57; after: 2.76±0.49; p<0.001), while girls showed a tendency to reduced PA levels, but it was not significant (before: 2.87±0.45; after: 2.79±0.44; p=0.07).
Ng et al.[19], 2020 / Ireland	April 2020 / LD	12-18	1214 (340/874)	Girls were less prone to report the same usual PA levels during lockdown than boys were (odds ratio [OR] = 0.7, confidence interval [CI] = 0.5-0.9). A total of 49.7% of adolescents reported that they are doing less PA during the lockdown, 31.2% responded that they are doing the same amount, and 19.1% are doing more PA. Within the group of adolescents considered active in the pre-pandemic period, only 36.4% reported decreasing time spent on moderate or vigorous PA during the pandemic, against 71.8% of those considered inactive before the pandemic.
Munasinghe et al.[27], 2020 / Australia	November 2019 - April 2020 / SD	13-19	582 (102/465)	During physical distancing, there was a significant decrease in the number of adolescents who reported 60≥minutes of physical activity (odds ratio [OR]= 0.53, 95% confidence interval [CI] 0.34 and 0.83). Declines in physical activity were also evident from the average number of steps per day (3000 to 1500/day), and increased screen time (4 to 5 h/day).
Matos et al.[32], 2020 / Brazil	June 2020 / SD	7-18	69 (34/35)	Weekly energy expenditure reduced significantly among children (male: WE: 3.02, 95%CI: [1.93; 4.12], p <0.0001; female: WE: 3.26, 95%CI: [1.82; 4.69], p <0.0001), and among adolescents (male: WE: 4.25 , 95% CI: [3.06; 5.44], p<0.0001; female: WE: 4.01, 95% CI: [3.02; 5.00]; p<0.0001). About 84% of the sample was classified as inactive during social isolation.
Pietrobelli et al.[16], 2020 / Italy	March 2020 / LD	6-18	41 (22/19)	Time spent doing sports decreased significantly (p = 0.003) considering the results for both sexes, from 3.60±4.25 to 1.29±1.44 hours/week.

Author, Year / Country	Date / Type of restriction adopted	Age group	N (Male/ Female)	Results
López-Bueno et al.[21], 2020 / Spain	April 2020 / Strict confinement and Relaxed confinement	3-16	860 (437/423)	Overall physical activity showed a significant reduction between the period before and during confinement for all sex and age subgroups (Before confinement: 198.6 min/wk; during relaxed confinement: 97.8 min/wk; during strict confinement: 95.5 min/wk). The greatest reduction in weekly minutes occurred in the subgroup of participants aged between 6 and 12 years old (-120±159 minutes per week) compared to the group between 13 and 16 years old (-75±146 minutes per week).
Medrano et al.[22], 2020 / Spain	March 2020- April 2020 / LD	8-16	113 (58/55)	During confinement, considering the results for both sexes, total PA decreased (-91 ± 55 min/d, P<0.001), but there was no difference in PA change by sex, and there was no significant difference in primary schools (8-11 years) and secondary schools (12-16 years).
Orgilés et al.[23], 2020 / Italy and Spain	March 2020 / LD	3-18	1143 (600/543)	Before quarantine, 86.4% of children did 30 min or more of PA daily, while, during the pandemic, only 44.4% of children did 30 minutes or more of PA daily.
Francisco et al.[26], 2020 / Italy, Spain and Portugal	March 2020 - April 2020 / LD / VQ	2-18	1480 (781/699)	Before quarantine, most young people (33.1%) engaged in 30 to 60 min of PA daily, while during quarantine, most (53%) did <30 min of PA. Considering at least 30 minutes of daily PA, there was a decrease in the number of young people from before (87.2%) to during (47.0%) social isolation.

Author, Year / Country	Date / Type of restriction adopted	Age group	N (Male/ Female)	Results
Ruíz-Roso et al.[20], 2020 / Italy, Spain, Brazil, Chile and Colombia	April 2020 - May 2020 / LD	10-19	726 (289/433)	Of 722 individuals, 79.3% were not active during the pandemic, and of these, 61.4% were girls and 38.5% were boys, while 20.6% were active – 54.3% girls and 45.6% boys. Adolescents aged 16 to 19 had higher percentages across all PA classifications compared to the 10-15 age group: among 577 individuals who were not active during the pandemic, 53% were adolescents; among 149 people who were active during the pandemic, 56.3% were adolescents.
Schmidt et al.[17], 2020 / Germany	April 2020 / LD	4-17	1711 (859/852)	11% increase for children and adolescents meeting PA guidelines. Children accumulated more time spent on PA (4 to 5 years + 14.7%) compared to adolescents (14 to 17 years + 4.8%).

Note: SD = Social Distancing; VQ = Voluntary Quarantine; LD = Lockdown; PA = Physical Activity; PAQ-A = Physical Activity Questionnaire - Adolescents (scale from 0 to 5 representing minimum and maximum PA values, respectively)
Source: The authors

Discussion

The initial hypothesis was confirmed, as there was a decrease in PA levels among children and adolescents due to social restriction in 16 of the 17 analyzed studies (94%). Girls had a lower PA level than boys did, although some studies[25,31] have not found significant differences in PA for girls before and during the pandemic, probably because the latter already had low PA levels in the pre-pandemic period[33,34]. Most studies (n=4) comparing children and adolescents reported that the decrease or lower adoption of PA recommendations (PA ≥ 60 minutes daily) was greater in adolescents than in children.

To control the increase in cases of Covid-19, restrictive measures such as the closing of schools, as well as PA and sports programs, brought about drastic changes in family routine and raised the likelihood of sedentary behavior and of parents' having trouble balancing responsibilities with education, health, PA time and work. Evidence prior to the pandemic[33,35,36,37] has already reported lower PA levels among girls and a reduction in PA for both sexes in early adolescence[37], a phenomenon that remained during the social isolation period. Additionally, the results of the present study showed that, both in childhood and adolescence, boys who were more active in the pre-pandemic period were more likely to maintain the same PA levels during social isolation[18,19,30]. These findings reinforce the perspective that children/adolescents who were more active before the pandemic tend to remain more active during the pandemic, when compared to the less active in the pre-pandemic period. That is, engagement in PA before the pandemic was a protective factor for the maintenance (or smaller reduction) of PA during the pandemic.

The results show that changes in PA levels due to the pandemic were similar across countries in the same region. The consequences of social isolation have shown adverse effects on the movement and playful behaviors of Canadian children and adolescents[29] in activities

such as walking/cycling, outdoor and indoor physical exercise, and outdoor play. Many young people were not meeting PA recommendations during the pandemic, which could be related not only to the closing of schools and PA places, but also to a lack of adequate space at home or even a lack of family encouragement. In research involving different continents, Brazil and Chile had a higher rate of inactive adolescents during the isolation, compared to Italy and Spain[20]. In Brazil, a single study showed that there was also a significant reduction in weekly physical activity among children and adolescents of both sexes[32], with most of the sample being inactive during the social restriction.

In countries on the European continent, similar results have been found during the period in which social restriction measures were implemented. In a systematic review, Hesketh et al.[38] pointed out some barriers to children's PA in studies conducted in Europe, the United States, Canada and other countries, with highlight to climate, safety and interaction between parents and daycare teachers in PA-related care; within this context, social restriction can be considered a potentiating factor for these barriers. Most studies have not described or considered physical activity in housework or gardening, which may be the reason for the increase in PA that has occurred in Germany, where these tasks were considered in the applied questionnaire[17].

From a public health point of view, there is a risk that the increase in sedentary lifestyle and screen time will remain post-pandemic, which would increase the prevalence of existing problems, such as delays in motor[37] and social-cognitive[39] development, in addition to greater risks of overweight, obesity, cardiovascular diseases, diabetes and physical inactivity in adulthood[40]. Thus, the data of the present review justify the need for integrated public policies on education and health, aimed at families, schools and the use of leisure areas, such as parks and squares. Among the limitations of the present research, it is worth mentioning the relatively small number of studies and the use of recall questionnaires to measure PA. Moreover, information about sedentary behavior, such as screen time, was not found in all articles, which can be extremely important, since, during social restriction, Remote Learning was adopted, increasing the need to be immobile in front of screens. With the continuity of research (post-pandemic), a greater understanding of the effect of social restriction on the PA and motor development of children and adolescents is necessary, taking into account the sociocultural context and the application of public policies and/or intervention programs.

Conclusion

Low PA rates among children and adolescents were already evident before the pandemic, particularly among girls. Social restriction measures have contributed to decreasing PA during the pandemic, with a greater effect on adolescents and girls. Encouragement towards and evaluation of PA in the family environment, at school and in leisure time should be considered in further research. It is paramount that other health professionals promote PA as a tool for the biopsychosocial development of young people, also with a view to minimizing the negative effects resulting from the Covid-19 pandemic and consequent social restriction.

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Received on Sep 15, 2021.
Reviewed on Jun 01, 2022.
Accepted on Jun 25, 2022.

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