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Review Article

The Promotion of Physical Activity and Health-Related Factors during Pandemic for Children and Adolescents: A Review Article

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Abstract

Background: Regularly performed physical activity promote proper development and prevent health risk factors in children and adolescents. Pandemic crisis has been limiting the scope of movement with social distancing for participation of physical activity for health promotion. This study aimed to review studies on promoting physical activity to prevent health risks for children and adolescents since the onset of COVID-19.

Methods: Three major online databases (PubMed, Medline, and Scopus) were searched for 'physical activity,' 'intervention' for children and adolescents. Seven articles were selected from 1,761 articles through the inclusion and exclusion processes.

Results: All studies were conducted through online. One study showed that streaming services and online apps majorly promoted MVPA (moderate-to-vigorous physical activity), MSE (muscle-strengthening exercise), or combined (MVPA, MSE) by 2.4, 3.1, and 4.3 folds, respectively. Another study showed that greater duration of physical activity (PA) prevented depressive symptoms during exposure to outbreak. Five intervention studies which used digital platforms to promote PA significantly encouraged PA along with the physiological, psychosocial, and academic achievement outcomes.

Conclusion: Internet-based digital platforms may assist to promote physical activity for improved psychosocial and academic achievement in children and adolescents during the untack period. Structured PA promotion platforms with various health outcomes for children and adolescents should be developed and scientifically evaluated.

Keywords: Children; Adolescents; Physical activity; Health promotion; COVID-19

Introduction

Special health care should be provided for appropriate growth and development of children and adolescents into their adulthood (1). Special care includes supporting to obtain sufficient mental health care, nutritional support, and physical activity among others (1-4). Parents, caregivers, and various experts have been trying to provide the best for children and adolescents from all over the world. However, the pandemic outbreak has altered and limited the means to cater the developmental needs of the children and adolescents (5-7).

To avoid the spread of the corona virus, assorted preventative measures have been implemented by

the authorities from all corners of the world. School closure, lockdown, and social distancing have been forcefully stipulated to unavoidably participate in the extend homeschooling, home confinement, and limited scope of movement (7, 8). On top of such restrictions, most of the outdoor as well as indoor activities have also been impeded to prevent close contact with others in response to COVID-19.

All the contagion preventative measures have led to compelling reduction in the amount health promoting activities of everyone including children and adolescents (7). Assorted health deterring problems have been reported through prolonged impeding behaviors and restrictions may lead to long-term health-related complications (2, 9, 10). Physical inactivity and weight gain are among the major long-term health deterring concerns (5). Many recent pandemic related reports showed drastic increase in inactivity and health management concerns (5, 7, 8, 11). Home confinement of the children and adolescents have also been known to gain weight and lead inactivity followed by various health concerns (8).

Undetermined duration of the pandemic situation is aggravating the health risks for children and adolescents (7, 9, 10, 12, 13). Current pandemic situation which first believed to be a transient problem is becoming a long-term obstacle with emergence of corona virus variants. Among other problems, physical inactivity and overweight have been known to be major risk factors in promoting severe COVID-19 infection and increasing mortality even in children and adolescents (5, 7). Therefore, promoting physical activity and reducing sedentary lifestyle during the time of pandemic crisis is vital in promoting healthy growth into the adulthood.

Although a considerable number of studies along with review articles have been conducted to observe and promote psychological and mental health of the adolescents, articles on promoting physical activity and sedentary lifestyle, especially review articles were scarce (10, 12, 14). Means to promote physical activity for general health concerns for children and adolescents are limited during the ongoing untact period. Scientific methods should be provided to promote physical activity for health risk prevention for children and adolescents. Therefore, this study aimed to analyze major online databases (PubMed, Science Direct, and Scopus) to search original studies on promoting health through physical activity in children and adolescents.

Methods

This study was conducted by searching three major online databases that included PubMed, Science Direct, and Scopus using the key terms "physical activity" and "exercise" with the following search terms: "intervention" and "COVID-19 from 2020-2021" Either the terms "adolescents," "children," or "youth" were alternatively used to widen the search.

Articles were selected based on the inclusion and exclusion criteria. Inclusion criteria included the followings: (a) scientific research articles searched based on the terms mentioned, (b) children and/or adolescents, (c) articles that analyzed health-related physical activity, (d) studies conducted after the onset of COVID-19 outbreak, (e) study design of either randomized control trial, experimental, cross-sectional, or longitudinal study, and (f) healthy subjects. There were exclusion criteria for further filtering of the studies were as followed: (a) case studies, review articles, meta-analysis articles, letters, proceedings, master or doctorate's thesis, and editorials, and (b) specially targeted subjects with clinical problem.

Search of the published literatures since 2020 yielded 32 articles from PubMed, 29 articles from Science Direct, and 1,700 articles from Scopus. A total of 1,762 articles were first reviewed and manually filtered out for the title to exclude overlapping of the articles. Further filtering was performed by reviewing the abstracts and main body of the articles if necessary. All possible articles were thoroughly reviewed.

The entire contents of remaining 26 articles were reviewed to confirm the inclusion criteria such as the study dates and study subjects. Although 19 articles were published after the initial outbreak

(years 2020 and 2021), actual tests were conducted prior to COVID-19. Seven articles met the inclusion criteria and were selected for this study (Fig. 1).

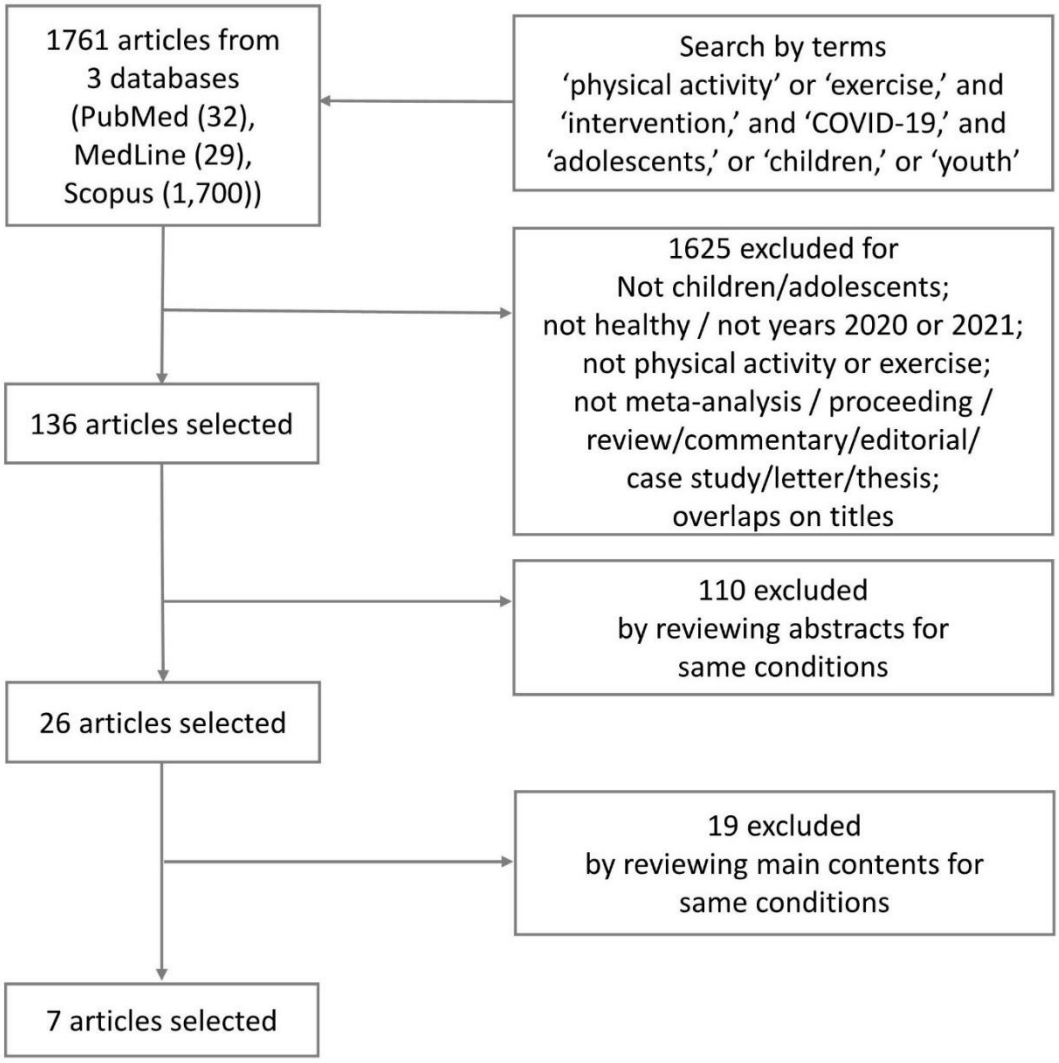

Fig. 1: Flowchart of the article select process

Results

A total of seven articles were selected out of initial 1,761 articles. Selected 7 articles were composed of 3 randomized control trial, 2 longitudinal survey, 1 cluster control trial, and 1 cross-sectional survey studies. The number of subjects ranged from 15 to 1,487 and the age ranged from 7 to 17 years (Table 1).

First study conducted was performed with 42 adolescents between the age of 13 to 16 years in the UK and Ireland (15). Moderate-to-vigorous physical activity (MVPA) was performed through 30-minute live physical activity sessions. Weekly behavior change support video calls were provided (1×30 min, 6×10 min) with text messages (3 per week) to promote participation. The intervention group (n=22) significantly showed improvements in physical fitness variables (P=0.022 to P=0.001) and psychosocial outcomes (P=0.037 and P=0.001) (Table 2).

Table 1: Characteristics of the selected studies

Reference	*Study Type According to Protocol*	*Study completion Date and Duration*	*Subjects*	*Study location*
(15)	Randomized controlled trial	April and May, 2020, Duration: 6 weeks	Age range: 13-16 years, mean age: 14.2±1.1 years, HERizon intervention (n=22), control (n=20)	UK and Ireland
(16)	Cluster control trial	Date: 16 March 2020, duration: 2 weeks	Planned number (n): 954, Mean age: 13.5(±0.5) years, grades: 7-12, Intervention (n=485), Control (n=469)	Zhaoqing city, China
(17)	Randomized control trial	Date: 2020, Duration: 3 months	Age range: 15-17, mean age: 16.29±0.57 years, Grades: 10-11, intervention (n=36), control (n=32)	Gonbad Kavous city, Iran
(18)	Randomized controlled study	Oct and Dec 2020, Duration: 8 weeks	Age range: 14-15 years, mean age: 14.53±0.50, intervention (n=15), control (n=15)	Italy
(19)	Longitudinal study	May 4-31, 2020.	Digital platform users (n=255), age: 16.2 (1.3) years, non-users (n=708), age: 16.3 (1.2) years	Australia
(21)	Cross-sectional survey study	April 19-26, 2020, Duration: 7 days	Age range: 10-17 years, mean age: 13.20±1.45 years, Adolescents living in quarantine: n=171 (1,316)	Zhengzhou city, China
(22)	Longitudinal study	Sept 24-Nov 3, 2020, Duration 7 weeks	Age range: 6 to 13 years, mean age: 9 years, n=53	Los Angeles, USA

PA: physical activity, PE: physical education

Second study, a cluster randomized controlled trial, was performed with 896 adolescents (16). Peer-to-peer live stream application was used during recessions of the daily online classes. Self-performed physical activity and sharing through online during recessions significantly reduced anxiety (P=0.02) and eye strain (P=0.02).

Third study was performed with 68 Iran high school students (17). Intervention group (n=36) participated the online physical education classes and performed 2 sessions per week for 3 months. Perceived autonomy support (F=292.44, P<0.001), intrinsic motivation (F=466.82, P<0.001), level of physical activity (F=113.48, P<0.001), self-reported physical activity (F=113.48, P<0.001), and intention to physical activity (F=82.50, P<0.001) all significantly improved.

Fourth study was conducted with 30 local high school students in Italy (18). Online at-home workout program was provided twice a week for 60 minutes of supervised training (EG) and theoretical knowledge (CG) education. Significant improvements were shown in physical fitness variables and body composition (all P<0.001).

Table 2: Intervention methods and physical activity and health-related outcomes

Reference	*Tools and Interventions*	*Physical activity variables and outcomes*	*Health-related outcomes*
(15)	HERizon Project; three 30-minute PA sessions per week performed. Weekly home-based online group exercises, behavior change support video calls (1×30 min, 6×10 min) and text messages (3 per week) made by activity mentors	Self-reported habitual PA (*P*=0.767), cardiorespiratory fitness (20 m shuttle run) (*P* = 0.001), muscular strength (standing long jump) (*P* = 0.022), intrinsic motivation (*P*=0.037), and body appreciation (*P*=0.003), muscular endurance (push up test) (*P*=0.022)	Psychosocial outcomes: intrinsic motivation (0.16 vs. 0.16; *P*=0.037) and body appreciation (0.44 vs. 0.11; *P*=0.003).
(16)	Tool/method: REAP (Recess and Exercise Advocacy Program) peer-to-peer live-streaming app, Intervention: self-reported physical activity during recess	Physical activity: stretching and home exercise during four 15-minute recesses per day	Manifest of anxiety difference –0.36, 95% CI –0.63 to –0.08; *P*=0.02), eye strain (intervention group: –0.08, 95% CI –0.10 to 0.06; control group: 0.07, 95% CI 0.05-0.09; difference –0.15, 95% CI –0.26 to –0.03; *P*=0.02), (*P*=0.23), screen time (*P*=0.84), reading time (*P*=0.47)
(17)	Tool/method: 2 session per week physical education class via WhatsApp mobile app with for 3 months	Intention to physical activity (F=113.48, *P*<0.001), self-reported physical activity (F=113.48, *P*<0.001), and intention to physical activity (F=82.50, *P*<0.001)	Perceived autonomy support (F=292.44, *P*<0.001), intrinsic motivation (F=466.82, *P*<0.001),
(18)	At-home online workout program twice a week for 60 min, structured physical education program as part of school lessons	Motor tests (Standing long jump test (*P*<0.001), Harvard step test (*P*<0.001), sit and reach test (*P*<0.001), and butt kicks test (*P*<0.001)),	Academic achievement test (Amos 8-15) for assessment of study skill (all *P*<0.001): motivation, organization, study flexibility, concentration, anxiety, and BMI.
(19)	Data from Our Life at Home study (OL@H), Adherence to physical activity guidelines by digital platforms	MVPA (OR 2.4, 95% CI 1.3-4.3), MSE (OR 3.1, 95% CI 2.1-4.4), and combined (OR 4.3, 95% CI 2.1-9.0) guideline adherence compared to non-users	Major services are streaming services (ex. YouTube, Instagram, Facebook): 102/255, 40.0%), facilitated online classes via an app or online (ex. MyFitnessPal): (77/255, 30.2%), subscriber fitness programs (ex. Zoom): 35/255, 13.7%.
(21)	Effects of at-home physical activity (eg., workout, outdoor walking, jogging, etc.) level of PA level 1(<0.5), PA level 2 (0.5-1 h), PA level 3 (1-2 hrs), PA level 4 (>2 h per day) on depressive symptoms.	PA without 2.18±0.79 h and PA with infection (2.14±0.78 h). Physical activity time (b=-.07, *P*<0.001) negatively associated with depressive symptoms.	Age (b=.05, *P*<0.001), community infection (b=0.27, *P*<0.001), and screen time (b=0.05, *P*<0.001) positively affected depressive symptoms. All 4 daily living routines (b from -.24 to .23) negatively affected symptom prevalence. Age (b=0.07, *P*<0.01), PA time (b=-0.15, *P*<0.01), and routines (b=-0.09, *P*<0.01) moderated the relation between infection and depressive symptoms
(22)	Online platform 'Padle' sent 7 videos (7 weeks) and 1 live 90-minute workshop to 120 adolescents. 53 youth participants reported on the virtual sport-based PYD program and 26 shared photos, images, or posts.	Positive perceptions of virtual sport-based PYD (positive youth development) activities	Life skill transfer, emotional responses, peer interactions, family engagement, and utilization of Environmental Resources.

PA: physical activity, PE: physical education

Fifth article observed adherence to physical activity guideline between April and May of 2020 (19). Among 963 adolescents, 255 (26.5%) reported of using online or digital platform to perform physical activity with the median frequency and duration of 4 times and 120 min per week, respectively. Streaming services were majorly used to promote MVPA (moderate-to-vigorous physical activity) and MSE (muscle-strengthening exercise) (20).

Sixth study conducted was conducted with 1,487 public school adolescents in Zhengzhou city, China (21). The adolescents were divided into those lived in the quarantine area (n=171) and non-quarantine area (n=1,316) after 2 months of quarantine period to observe effects of COVID-19 prevalence on the adolescents. Moreover, physical activity was categorized into four levels to observe the effects on the depressive symptoms. Age, physical activity, and disciplined routines significantly affected screen time (P<0.001), depressive symptoms (P<0.001), and improved all home routines (P<0.01).

Seventh study was performed with adolescents in Los Angeles, USA (22). Among the program participants, 53 youth reported their activities of the virtual sport-based PYD and 26 shared photos, images, or posts about their lived experiences. Positive perceptions of virtual sport-based PYD activities were reported from the participated adolescents. Moreover, positive life skill transfer, emotional responses, peer interactions, family engagement, and utilization of environmental resources were all reported for effectiveness of digital platform-based intervention on adolescents.

Discussion

According to UNICEF (United Nations International Children's Emergency Fund), the persisting pandemic crisis has led to repeated closure of schools in more than 200 countries. Such ongoing school closures secluded and altered lives of everyone, especially adolescents (5, 7). Isolation by school closure and social distancing led to limited scope of movement and sedentary lifestyle in in children (5, 12, 13). Sufficient and adequate support is needed to promote growth and health during the developmental stage (1, 3).

To provide scientific means to promote physical activity and prevent corresponding health risks in adolescents, this study searched three major databases for recent research articles. A total of seven articles were selected out of 1,761 articles searched from PubMed, Science Direct, and Scopus through strict inclusion and exclusion criteria. All seven studies were conducted online and interventions of five studies were performed with internet-based digital platforms. Although different programs were used, all the intervention studies used real-time intervention methods of either peer-to-peer live streaming services, physical education classes, support video calls, text messages, and/or live workshops (15-18, 22). Moreover, survey study by Parker et al. reported that the major physical activity promoting method was based on streamlining services (19).

Participation of digital platform-based physical activity has swiftly increased since the outbreak (23). Rapid advances in internet-based technology has penetrated to everyday devices to monitor and advocate physical activity and general health in everyday lives (24). Various health-related factors can be targeted for rapid development for precise management (22, 25-28). Lives of children and adolescents today are very much involved and influenced by internet-based interactions. Extended homeschooling and social distancing aggravated the reliance on the internet-based interactions. Promotion of health promoting behaviors through digital platform seems unavoidable (27, 29). However, although promoting health behavior in children and adolescents via internet-based devices have previously been positively reported (25, 30), most are trial-based platforms or designed for limited group of individuals. Moreover, most of the studies do not include physical activity programs to meet the suggested physical activities guidelines (2). Most of the targeted children and adolescents for the digital platform studies were subjects with clinical complications including mental health (12, 27, 31). Physical activity is also known to improve academic outcomes that includes school perfor-

mance, memory, execution, and motivation (2, 32, 33). Most of the articles that are included in this study also positively reported on improved cognitive function and academic outcomes through physical activity participation (15-18, 21, 22).

The studies reviewed in this study reported of improvements in various health outcomes through increased physical activity. Improved health outcomes include reduced anxiety and negatively affected depressive symptoms (21). Psychosocial improvements, including autonomy support, intrinsic motivation, and body appreciation were among the outcomes (15-17). Study skill improvements include motivation, organization, study flexibility, and concentration were also reported. In addition, motivation to participate in physical activity, life skill transfer, emotional responses, peer interactions, family engagement, and utilization of environmental resources have also been reported (15, 19, 21, 22). Regularly performed physical activity has been known to improve almost all health aspects including physical, mental, social, and developmental factors with minimal side effects (2, 34-37). Body mass index improvement was also reported along with physical fitness variables (18). Even prior to the pandemic outbreak, physical inactivity was a global concern for the occurrence of various adult-onset complications including obesity (38, 39). Facilitated physical inactivity with obesity should also be controlled through increase physical activity.

Multiple factors should be considered in designing applicable studies. Different physical activity interventions such as aerobic and strengthening activities should be considered for different aspects of health for developing children (1, 2, 20, 36, 37). Usage of digital platforms also should be carefully considered. A sudden surge of digital tool usage has also influenced and led the healthcare's digital revolution for delivering mental and behavioral health services. However, platforms with credible contents may not be apparent (40). Moreover, digital space is like a double-edged sword: depending on the type contents provided, provided service may be helpful or harmful especially for children and adolescents (17, 26, 27, 40). Scientifically approached and designed platforms should be developed to promote proper amount of physical activity to support proper growth and prevent short- and long-term health risks for adolescents.

Factors such as age and gender may also influence the outcome of the digital platform-based intervention. For example, boys and older adolescents were reported to be inactive during pandemic compare to girls and younger children (11). It may be that boys and older adolescents are more likely to participate in organized team sports that require large space and participants (11, 41). In addition, residential environment including climate, income, race, dwelling space, density of resident area, infection cases, parental support, and family conflict among others have been reported to influence physical activity participation (11). Although abovementioned factors may be influential, mixed results have been reported with limited number of studies.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Conclusion

Promoting physical activity during pandemic was reported to be significantly influential in improving physical, mental, cognitive, and psychosocial health in children and adolescents. All the studies utilized internet-based digital platforms to conduct the studies. Effectiveness of streaming services were observed for physical activity intervention to significantly improve physical fitness and obtain physical activity related health outcomes. Applicable digital platforms should be developed with scientifically approached health-promoting considerations for children and adolescents.

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Conflict of interest

The authors declare that there is no conflict of interests.

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