SYSTEMATIC REVIEW

Barriers and Facilitators to Physical Activity and Exercise Among Individuals With Spinal Cord Injury: A Systematic Review

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ABSTRACT

Introduction: This study aimed to systematically conclude the barriers and facilitators of physical activity (PA) after spinal cord injury (SCI). **Methods:** A search was conducted involving literature from 2010 until 2021 using health-related online databases such as PubMed Central, MedLine, SCOPUS, and Web of Science. The initial screening found 788 articles, but only four studies were included in the review after assessing the duplicates, titles, and abstracts. Pain, lack of motivation, knowledge and skills to do PA are the main internal barriers to PA, while cost, lack of facilities and support are the external barriers to PA. Perceived benefits of PA and accessibility are the main facilitators of PA after SCI. **Results:** The findings of this review highlighted the challenges in promoting participation in PA among individuals with SCI. **Conclusion:** A multidisciplinary approach may be required to develop strategies and make decisions to enhance long term participation in PA among individuals with SCI.
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Keywords: Barriers, Facilitators, Physical activity, Spinal cord injury, Paralysis

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INTRODUCTION

Individuals with spinal cord injury (SCI) are prone to develop secondary complications such as cardiovascular diseases, diabetes mellitus (DM), pressure sores, low physical fitness [1], fatigue [2], and obesity [3] as a result of increased sedentary time following the injury. SCI may result in full or partial paralysis that may restrict participation in physical activity (PA). This is also attributable to the loss of sensation and control of the Autonomic Nervous System (ANS) such as blood pressure regulation, thermoregulation, bowel, and bladder routine [4] that may predispose individuals to difficulty in PA participation. PA can be defined as any bodily movement produced by skeletal muscles which results in energy expenditure above the resting level [5], including any types of activity such as household, indoor and outdoor chores, walking, cycling, shopping, sports, intentional exercises, and other activities of daily living or other recreational activities.

Previous studies have shown a low level of PA among individuals with SCI, particularly after being discharged from a rehabilitation [6] or therapy program [7]. Individuals with SCI were also in low compliance with exercise recommended guidelines [8,9]. A meta-synthesis [10] and systematic review (SR) [11] studies found several barriers and facilitators towards PA including general well-being, environment, physical capacity, body-self relationship, knowledge, and

perceived absences; however, these findings were based on several qualitative and mix-method studies which depend on self-feelings and expression rather than objectively measured as in the quantitative study. While one study found personal barriers such as disability and health conditions but only focused on competitive sports rather than on a broad definition of PA [12].

A previous systematic review also discovered barriers and facilitators among individuals with SCI to return to work (RTW) or employment status, which may be influenced by the employer support, compensation, job roles, education level, health-related issues, personal, environmental, psychological, and social aspects, however, the focus of this review was only on the job and occupational roles [13]. Therefore, a new systematic review based on quantitative studies on barriers and facilitators of PA is needed to provide more objectives findings for health practitioners or stakeholders to build effective strategies to enhance the level of PA after SCI.

MATERIALS AND METHODS

Literature search

A thorough search for eligible studies was initiated by entering the relevant keywords in health-related databases such as PubMed Central (PMC), MedLine, SCOPUS, Web of Science (WoS), and bibliography search. The relevant keywords were searched based on PICO (Population, Intervention, Comparison, Outcome) such as 'Spinal AND Cord AND Injury OR Paraplegia OR Tetraplegia', 'Barrier OR Facilitator', 'Physical' AND 'Activity' OR 'Exercise' OR 'Sports' OR 'Recreation' OR 'Leisure'. The search was restricted to only studies on human subjects, articles written in the English language, full article availability, academic journals, and those published from 2010 to 2021 (Table I)

Table I: Database and searching criteria

Criteria	Databases
	PubMed Central
Keywords	'Spinal AND Cord AND Injury OR Paraplegia OR Tetraplegia' AND 'Physical' AND 'Activity' OR 'Exercise' OR 'Sports' OR 'Recreation' OR 'Leisure'
Searching filters	Title; 2010-2021
Search modes	Boolean/Phrase
	MedLine
Keywords	'Spinal AND Cord AND Injury OR Paraplegia OR Tetraplegia', 'Barrier OR Facilitator', 'Physical' AND 'Activity' OR 'Exercise' OR 'Sports' OR 'Recreation' OR 'Leisure'
Limiters	Title, Full Text; Date of Publication: 2010-2021; Abstract Available; English Language; Human subjects
Expanders	Apply related words; Apply equivalent subjects
Search modes	Boolean/Phrase

CONTINUE

Table I: Database and searching criteria (CONT.)

Criteria	Databases
	SCOPUS
Keywords	'Spinal AND Cord AND Injury OR Paraplegia OR Tetraplegia', 'Barrier OR Facilitator', 'Physical' AND 'Activity' OR 'Exercise' OR 'Sports' OR 'Recreation' OR 'Leisure'
Limiters	Title, Document type: Article ; Source type: Journal ; Published Date: 2010-2021
Search modes	Boolean/Phrase
	Web of Science (WoS)
Keywords	'Spinal AND Cord AND Injury OR Paraplegia OR Tetraplegia', 'Barrier OR Facilitator', 'Physical' AND 'Activity' OR 'Exercise' OR 'Sports' OR 'Recreation' OR 'Leisure'
Limiters	Title, Document type: Article ; Language: English ; Published Date: 2010-2021
Search modes	Boolean/Phrase

Study selection

The search for the eligible studies was performed based on the title (first phase), the abstract (second phase), and the full article (third phase). Two reviewers were responsible for selecting and summarizing the included studies. A consensus discussion was conducted to achieve a neutral agreement of the reviews. The articles included in this review were studies on subacute and chronic SCI, study populations from 18 and above, non-athlete, traumatic, and non-traumatic SCI, quantitative studies, studies from 2010 until 2021, and full population text only. Studies that were reported in the non-English language were excluded from the review.

Study appraisal of bias

The Appraisal tool for Cross-Sectional Studies (AXIS) was utilized as a critical appraisal tool to determine the quality and risk of bias of a cross-sectional study. Although the AXIS shows poor inter-rater reliability (intraclass correlation coefficient [ICC] = 0.49) and moderate reliability (ICC = 0.73) as well as required double-time to complete when compared to the Newcastle Ottawa Scale (NOS) [14], there is no clear support for the superiority of choice between the AXIS and NOS [14]. Despite that, AXIS can be used across disciplines as it was developed based on multimodal evidence-based expertise from many different disciplines [15]. The objective of the AXIS is to provide systematic interpretation and decision on a cross-sectional study. Two separate assessors with postgraduate qualifications and who had previously worked with individuals with SCI were chosen as the assessors for the selected studies. The first reviewer was a clinician with a postgraduate qualification who is currently working with individuals with SCI, whereas the second reviewer was an academician with a postgraduate qualification who previously worked with individuals with SCI. Both assessors came from local private organizations. Any disagreement was solved through consensus discussion among the reviewers.

Data extraction

The analysis of the contents of the selected studies was done based on a data extraction table that consists of (1) table of study and participants' characteristics, (2) study appraisal, and (3) barriers and facilitators to PA and exercise.

RESULTS

Study search

The search yielded 160 studies from PMC, 17 studies from MedLine, 601 studies from SCOPUS, five studies from WoS, and five from bibliography searching. A total of 788 studies were obtained for further review based on their title. A total of 20 duplicate studies were removed, which left 768 studies for the next review stage. After reviewing the title, 18 studies were reviewed based on their abstract. After that, seven eligible studies were reviewed based on their full articles. Finally, four studies were identified to be eligible for further review (Figure 1).

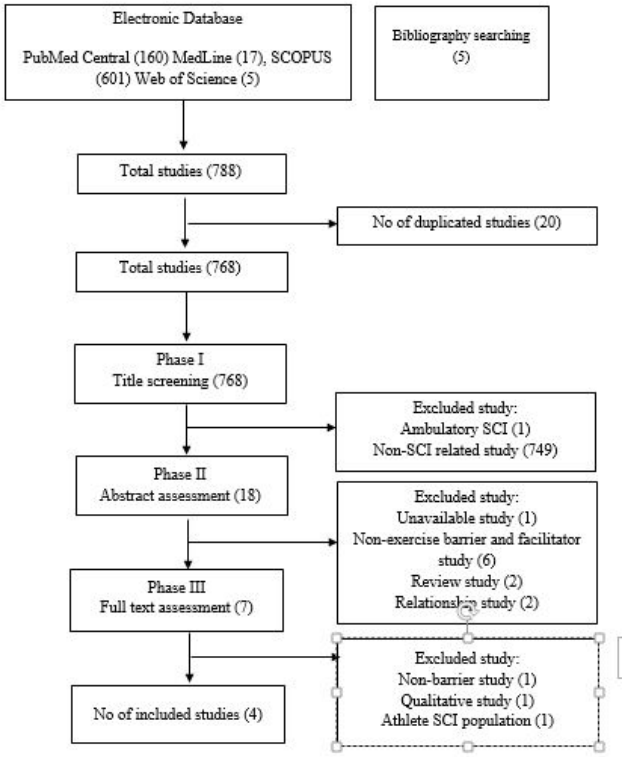

Figure 1: The search results

Characteristics of the studies

All of the included studies were conducted as cross-sectional studies [16–19]. The studies were conducted in Malaysia [16], the United States [17,18], and western Australia [19]. There were 70 participants in a study conducted in Malaysia [16]. Two studies were conducted in the United States, with 85 (16) and 180 [17] subjects participating in the study, respectively. One study was conducted in Western Australia, with 65 participants [19]. The outcome measures used were the Physical Activity Scale for Individual with Physical Disabilities (PASIPD) [16,19], Barriers to Exercise Scale (BTES) [16,19], Barriers to Physical Activity and Disability (B-PADS) [19], Modified Barrier to Physical Activity and Exercise (B-PED) [18] as well as Leisure Time Physical Activity (LTPA) Questionnaire [17].

Characteristics of the participants

In terms of the age of the participants, three studies have an average age of more than 35 years old [16–18], whereas one study did not report the age of the participants [19]. Three studies showed that most participants were more than five years since injury (YSI) [16–18]. Only one study has participants with injury of fewer than five years since injury [19]. All four studies were dominated by 60% males [16–19]. Two studies had the majority of participants with paraplegia (about 80%) [16,18]. However, one study has an almost equal number of participants with paraplegia and tetraplegia [17]. One study did not report the number of involvement of participants with paraplegia or tetraplegia [19]. There was a variability of races involved in the studies, such as White (87%) [18], Caucasian (77.6%) [17], Malays (47%) [16], Non-Malays (30%) [16], Latino (14.1%) and other minorities (less than 5%) such as African Americans [19], Asians or Pacific Islanders [17] Hispanic [18] and Native Americans [17]. Two studies involved participants who were not in a relationship (more than 54%) [17,18]. Only one study had most participants in a relationship (53%) [16]. The participants were mostly graduates (more than 63%) [16–19]. All four studies were participated by non-ambulatory individuals with SCI (more than 51%) [16–19]. Most of the participants were unemployed (more than 55%) [16–18]. Most participants were also from urban, suburban, and rural areas [16–18] (Table II).

Table II: Studies and participants characteristics

Study characteristics					Characteristics of participants									
Author	**Study design**	**Setting**	**Sample size (n)**	**OM**	**Age**	**YSI**	**Gender**	**Level of SCI**	**Ethnic**	**Marital status**	**Education back-ground**	**Ambulation status**	**Employment status**	**Living area**
Mat Rosly et al. [16]	Cross-sectional	Klang Valley, Malaysia	70	PASIPD. BTES	Mean (SD) 39 (12.6)	> 1 year (mean 9.6)	Male: 49 (70%) Female: 21 (30%)	Paraplegia: 58 (83%) Tetraplegia: 12 (17%)	Malays: 33 (47%) Non-Malays: 21 (30%)	In-relationship (53%), Not in a relationship (47%)	Non-graduate (63%), Graduate (37%)	Ambulatory (49%), Non-ambulatory (51%)	Employed (39%), Unemployed (61%)	Urban: 43 (61%), Rural: 27 (39%)
Hwang et al. [17]	Cross-sectional	United States	85	LTPA Quest-ionnaire	Tetraplegia: 43 (50.6%) 18 - 35 (47%), > 35 (53%) 18 years old Ethnicity Mobility Devices	1-5 years: 37 (43.5%) 5-10 years: 15 (17.6%) > 10 years: 33 (38.55%)	Male: 56 (65.9%) Female: 29 (34.1%)	Paraplegia: 42 (49.4%) Tetraplegia: 43 (50.6%)	Caucasian: 66 (77.6%) Hispanic/ Latino: 12 (14.1%) Black: 1 (1.2%), Asian or Pacific Islander: 4 (4.7%), Native American: 42 (2.4%)	Single (37.6%), Married (34.1%), Divorced /separated (28.35%)	Non-graduate (16.5%), Graduate (83.5%)	Non-Ambulatory: 55 (64.7%) Ambulatory: (2.4%) Other: 28 (32.9%)	Employed (34.1%), Unemployed (65.9%)	Urban (32.9%), Suburban (45.9%), Rural (21.2%)
Cowan et al. [18]	Cross-sectional	United States	180	Modified B-PED	Mean (SD): 46 (11)	Mean (SD): 14 (11)	Male (63%), Female (30%)	Paraplegia (83%), Tetraplegia (17%)	White (87%), African American (5%), Hispanic (3%), Minority (6%)	Single (41%), Married (46%), Divorced/ separated (13%)	Non-graduate (37%) Graduate (63%)	Ambulatory (15%), Non-ambulatory (85%)	Employed (45%), Unemployed (55%)	N/R
Robertson et al. [19]	Cross-sectional	Western Australia	65	PASIPD, BTES, B-PADS	N/R	< than 5 years: 34 (53%) > than 5 years: 31(47%)	Male: 43 (70%), Female: 21 (30%)	N/R	N/R	N/R	N/R	Non-ambu-latory: (73%) Ambulatory (27%)	N/R	N/R

YSI: Years Since Injury, N/R: Not-Reported, OM: Outcome Measure, YSI: Years Since Injury, PASIPD: Physical Activity Scale for Individual with Physical Disabilities, BTES: Barriers To Exercise Scale, B-PED: Barriers to Physical Exercise and Disability, B-PADS: Barrier to Physical Activity and Disability Survey, N/R: Not Reported

Study Appraisal

It was found that most of the included studies have high quality and low risk of bias after being evaluated by two researchers utilizing the AXIS [15] (Table III). All the included studies were found to have clear objectives, appropriate study design, sufficient sample size, a sample taken from the appropriate population, appropriate assessments of the risk factors and outcome, clear statistical analysis and methods, discussion, limitation, and conclusion were justified by the results, and all results were presented according to the analysis [16–19]

Table III: Study appraisal

	FACTORS	AUTHORS			
		Mat Rosly et al. [16]	Hwang et al. [17]	Cowan et al. [18]	Robertson et al. [19]
	INTRODUCTION				
1	Were the aims/objectives of the study clear?	Y	Y	Y	Y
2	Was the study design appropriate for the study clear?	Y	Y	Y	Y
3	Was the sample size justified?	Y	Y	Y	Y
4	Was the target/references population clearly defined? (Is it clear who research was about?)	Y	Y	Y	Y
5	Was the sample frame taken from an appropriate population base so that it closely represented the target/references population under investigation?	Y	Y	Y	Y
6	Were measures undertaken to address and categories non-responders?	N	N	N	N
7	Were the risk factor and outcome variables measured appropriate to the study?	Y	Y	Y	Y
8	Is it clear what was used to determine statistical significance and/or precision estimates	Y	Y	Y	Y
9	Were the methods (Including statistical methods) sufficiently described to enable them to be repeated?	Y	Y	Y	Y
10	Were the authors' discussion and conclusions justified by the results?	Y	Y	Y	Y
	RESULTS				
11	Were the basic data adequately described?				
12	Does the response rate raise concerns about non-response bias?	N	N	N	N
13	If appropriate, was information about non-responders described?	N	N	N	N
14	Were the results internally consistent?	Y	Y	Y	Y
15	Were the results presented for all the analyses described in the methods?	Y	Y	Y	Y
	DISCUSSION				
16	Were the authors' discussions and conclusions justified by the results?	Y	Y	Y	Y
17	Were the limitations of the study discussed?	Y	Y	Y	Y
	OTHERS				
18	Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?	N	N	N	N
19	Was ethical approval or consent of participants attained?	Y	N	Y	Y

Legend: (Y) Indicate 'Yes', (N) Indicate 'No'

Barriers to Physical Activity

The internal barriers to PA were pain [17,20], lack of motivation, energy, interest, laziness [17,18], lack of time, problems with scheduling [17,18], and low knowledge and skills to perform exercise [17,18]. Whereas the external barriers were dominated mainly by the inability to support the cost of PA [16–19], lack of appropriate facilities, support, and accessibility [16,17,19], lack of adaptive equipment for inaccessible terrain [16,18,19], lack of personal care attended and trained instructor [17], lack of transport [20], and lack of a program for special needs [17] (Table IV).

Facilitators to Physical Activity

Accessibility to public facilities, transportation, community centers, and building were the most common elements that may facilitate individuals with SCI to engage with PA [17,20]. The other facilitating factors include health benefits, general well-being, secondary complication prevention, maintaining physical fitness and weight management [18], positive attitude and outlook on life [18], maintaining an independent level [18], and support from peers and friends [20] (Table IV).

Table IV: The barriers and facilitators to exercise among people with spinal cord injury

FACTORS	AUTHORS			
	Mat Rosly et al. [16]	Hwang et al. [17]	Cowan et al. [18]	Robertson et al. [19]
INTERNAL BARRIERS				
• Pain	/	/		
• Lack of motivation, energy and interest				
• laziness		/	/	
• Lack of time		/	/	
• Problem with scheduling				
• Low knowledge and skills to perform exercise		/	/	
EXTERNAL BARRIERS				
• Lack of appropriate facilities, support and accessibility	/	/		/
• Lack of adaptive equipment for inaccessible terrain				
• Unaffordable cost of exercise	/	/	/	/
•Lack of a personal care attendant		/		
•Lack of Trained instructor				
•Lack of Transport	/			
•Lack of program for special needs		/		
FACILITATORS				
• Health benefits				
• General well-being			/	
• Secondary complication prevention				
• To have specific outcomes of exercise such as to maintain physical fitness and weight gain prevention			/	
• Ability to explore strategies, modification and alternative options including assistive technologies and professional services				/
• Positive attitudes and outlook on life			/	
• To maintain independent level			/	
• Support and relationships from peers and friends	/			
• Accessibility to public facilities, transportation community centers and building	/	/		/

DISCUSSION

All the included studies were cross-sectional in design and utilized survey questionnaires to quantitatively obtain information on the barriers and facilitators of PA among individuals with SCI [16–19]. This study only concluded the study from quantitative design as it may provide a large sample size, objectively measured, and factful compared to qualitative design, which is mainly based on self-perceptions, opinions, and views [21]. However, the quantitative studies may be unable to discover the actual cause of low PA as the respondents in the included quantitative studies might have problems recalling and understanding the questions, sensitive topics, and fears of truthful response [21].

In qualitative studies, most individuals with SCI expressed their opinion and feeling, which they claimed the barriers include general well-being, environment, physical body, body-self relationship, knowledge, and perceived absences. However, compared with the results from the quantitative study, most individuals with SCI show pain, lack of motivation, knowledge, and skills to perform self-exercise, scheduling, and time management as the barriers to PA. Both studies show a variety of findings that informed the importance of both quantitative and qualitative studies to contribute to the body of knowledge.

The barriers to PA were categorized into internal and external factors. The internal barriers include pain, lack of motivation, knowledge, and skills to perform self-exercise, scheduling, and time management difficulty. The included studies show pain as one of the barriers to PA. However, the included studies did not further describe the type of pain, either neuropathic, musculoskeletal, or psychological pain. The type of pain is vital to support the selection of pain management after SCI to increase the individual's engagement in PA [16,17]. Hence, health practitioners or treatment providers should continually assess the type of pain in individuals with SCI to provide specific treatment such as conservative treatment, cognitive behavioral therapy (CBT), or self-management of pain to enhance individuals with SCI engagement with an active lifestyle. The other factors categorized under the internal barriers were motivation and laziness [17,18]. These modifiable factors can be altered by behavioral, education, or counseling programs [22]. However, the behavioral program may require specific expertise, such as a psychologist, to provide a behavior change program for PA. Other than that, the multidisciplinary health team or any other support group should always conduct an attractive PA program during rehabilitation or community to enhance the interest in PA. However, special programs yet attractive for PA, such as exergaming [23] and fitness integrated training (PARAFiT) [1,22] to enhance the PA level, may not always be available in the community setting. In addition, conducting an attractive program might be highly challenging as it may involve high costs and accessible facilities to conduct the events.
Although there are many attractive programs, individuals with SCI may lack the time or have difficulty spending time doing PA, which leads to low PA engagement [17,18]. Although most of the individuals with SCI were unemployed [16–18] and thought to have more free time, most of them may spend their time on activity of daily living (ADL) routine such as self-care, grooming, bowel and bladder routine, transferring and mobility [24]. They require more time and energy to perform such routines as they are disabled, and they should adjust and adapt themselves to unusual environment settings. The time allocation, arrangement, and schedule to perform PA was further limited [17,18] due to marital or family commitment, as most of them are not single [16–18]. More studies should be conducted to investigate the time spent in daily living routine, particularly in different geographical, cultures and settings.

For the external barriers, unaffordable cost [16–19] to spend on PA was the most common reason why individuals with SCI do not participate in PA as they might need special equipment or a wheelchair to perform certain activities. In addition, unemployment and low socioeconomic income after SCI [25] may lead to the unaffordability of sports and paying the facilities fees. Although they are affordable, sports and recreational facilities such as gymnasiums and courts were not specially designed for the disabled or wheelchair users [16,17,19]. Individuals with SCI may require adapted weight machines, treadmills, or other equipment to accommodate their disability. Unfortunately, the existence of a disabled-friendly gymnasium is limited [17,19,20].

Other than that, the availability of personal trainer who is expert in conducting adaptive sports for people with a disability such as wheelchair basketball, archery, bocce, weightlifting, and marathon wheeling after SCI are limited [17,18]. In addition, adaptive sports require peers with an almost similar disability, which is sometimes difficult to find in the nearest community, particularly in rural areas [17,18]. Individuals with SCI may also require adaptive transport or accessibility to public transport to go to training or to play sports, but this may be impossible if the transportation is unavailable [20].

Perceived benefits of exercise were identified as one of the main factors in engaging the individuals with SCI with PA. Therefore, health practitioners should always integrate rehabilitation with behavior or education programs to disseminate the importance and benefits of PA. This strategy may increase participation in PA, particularly after discharge from rehabilitation settings [22]. However, integrating PA in a behavioral program may require dynamic multidisciplinary effort and contribution, involving more human resources, support, and expertise.

Despite that, to facilitate participation in PA programs, the accessibility to public facilities such as transportation, buildings, and community centers should be improved [26]. Likewise, individuals with SCI may perform PA in their neighborhood to enhance long-term adherence. Individuals with SCI may remain lonely and socially isolated, affecting their mental and psychological health [27]. Although the buildup process or modification of facilities may require high cost, it may be a beneficial 'investment' for the country or stakeholder as they can reduce the healthcare cost and burden and have better health, productivity, and QOL for the SCI community. Despite the findings such as barriers and facilitators from the included studies, however, it was found that most of the included studies did not investigate the type of PA that were performed by the participants when at home or outside from therapy or rehabilitation program. More quantitative studies should be conducted to highlight the type, frequency, and intensity of PA, exercise, or program that the individuals with SCI may involve. This information may help the health practitioners or stakeholders develop strategies and recommendations to encourage individuals with SCI to participate in PA.

LIMITATIONS

This review has some limitations. The searching method for this review did not include studies that were published in languages other than English. The search for grey literature was also not conducted. Although the search was comprehensive with much involvement from the health-related databases, only one author carried out the study searching. Therefore, some valuable information or studies may have been overlooked to be included in this study

CONCLUSION

In this review, factors such as pain, lack of motivation, knowledge, and skills to do PA, the problem with scheduling and time management were identified as the main internal barriers to PA after SCI, whereas factors such as cost and accessibility were found to be main external barriers towards PA after SCI. On the other hand, perceived benefits of PA and accessibility were found to be the main facilitator to engage in PA after SCI. The information on barriers and facilitators on PA after SCI may help the health practitioner or stakeholder find the best strategies for enhancing the PA level, particularly after discharge from a rehabilitation program. More studies should be conducted as the factors of barriers and facilitators of PA may evolve due to the rapid advancement of technologies, accessibility, and the deadly COVID-19 pandemic.

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