

Facilitators and barriers for participation in sports and physical activity for children with lower limb absence: A Systematic Review

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Abstract

Background: Sports and recreational activities offer physical and psychological benefits to children with limb absence. Understanding what facilitators and barriers exist for the participation in sports and physical activity is vital to aid stakeholders to continue enabling facilitators and develop means to tackle existing barriers, so that all children with lower limb absence can participate in sport and physical activity as they wish.

Objective: The aim of this systematic review was to identify facilitators and barriers that children with lower limb absence experience when wanting to participate in sports and physical activity.

Study Design: Systematic Review.

Methods: Five databases were used to identify literature relating to facilitators and barriers to sports and physical activity for children with lower limb absence. These were Medline, Scopus, Cochrane, SPORTDiscus and CINAHL. Google scholar was used as a

secondary source. The review followed the “Preferred Reporting Item for Systematic Reviews and Meta-Analysis” (PRISMA) guidelines.

Results: The review identified 10 articles for inclusion that met pre-defined inclusion criteria. The identified peer-review articles date from 1999 – 2021. The number of published articles steadily increases up to 2010 and then increase rapidly from 2016 - 2021.

Conclusion: The results show whilst there are facilitators for sports participation for children with limb absence, there are many barriers which continue to hinder many children from participating in sports and physical activity. Facilitators that exist include advancements in prosthetic design and technology, increased opportunities, and physical and social benefits. Barriers that were reported include prosthesis failure, stigma, and high costs.

Abstract word count: 250

Keywords

Systematic review, paediatric, sport, physical activity, facilitators, barriers, prosthetics

Background

Interest in recreational activity amongst amputees has increased significantly since the 1980s [1], as have the development of many sport organisations for the disabled [2], however facilitators and barriers affecting participation in sports and physical activity for children with lower limb absence have rarely been studied [3 4]. This has resulted in limited information currently existing in this area [3], yet many reviews continue to highlight the need for additional research [3-6].

Participation in sports and physical activity for amputees has been shown to improve their physical health, social inclusion, and overall well-being [2 7] Particularly in children with disabilities, sports and recreational activities offer physical and psychological benefits such as, promoting inclusion, optimising physical functioning, and improving self-esteem and quality of life [3 8 9].

It has been predicted that the number of young traumatic amputees is set to rise in the coming years [7]. As a result, it is therefore presumed that the number of young people with lower limb absence wanting to participate in sports utilising specialised sport prostheses will also increase in coming years [7]. The aim of this review is to identify and understand facilitators and barriers that currently exist for children with limb absence who want to participate in sports and physical activity. Identifying and understanding these facilitators and barriers will enable prosthetists, clinicians, sports organisations and other stakeholders to continue to enable current facilitators and

develop means to tackle existing barriers. Therefore, enabling more children with limb absence the opportunity to participate in sports and physical activity.

Methods

Eligibility Criteria

Peer reviewed literature, written in the English-language captured by a comprehensive database search were eligible for inclusion if they commented on facilitators and/or barriers for children (aged 5-17) with lower limb loss experienced when participating in sports and physical activity.

Search Strategy and Study Selection

A comprehensive search strategy was created by the author and completed on 8th June 2021 on five literature databases: Medline, Scopus, Cochrane, SPORTDiscus and CINAHL. Google scholar was also used as a secondary source to identify any missing literature. The PICO model [10] was used to clearly define the research question, synonyms of each area were then identified and used in the literature search with Boolean operators.

The results were downloaded and imported into the EndNote referencing software [11], where duplicates were automatically removed (n = 35). A single author worked to screen the titles and abstracts of the remaining 2751 articles against the inclusion criteria. This was then followed by full text assessment to evaluate suitability for inclusion. Reasons for exclusion were recorded for unsuitable articles. Reference lists of all included articles were then assessed for any appropriate additional literature which had not been found in the original search.

[Insert Figure 1]

Quality Appraisal

A quality appraisal of all appropriate studies was performed by a single author using the MMAT, mixed methods appraisal tool [12], and CASP, the Critical Appraisal Skills Programme [13]. ‘The MMAT is a critical appraisal tool that is designed for the appraisal stage of systematic mixed studies reviews. It appraises the methodological quality of five categories to studies, qualitative research, randomized controlled trials, non-randomized studies, quantitative descriptive studies, and mixed methods studies.’ [12]. The quality appraisal of the appropriate studies generates a rating of methodological quality from 0 to 5. Studies were included in the review if they received

a minimum rating of 3, meaning they met at least 60% of the quality criteria. The CASP was used to critically appraise the systematic reviews included in this review.

Data Extraction

The data was extracted and compiled by a single author from all included articles: author, publication year, country, sample size, study design, aims, and facilitators and/or barriers to participation in sports and physical activity.

Synthesis

A thematic analysis was used to synthesis findings and outcomes from multiple studies together to gain greater value as a whole within this systematic review [14]. A single author undertook line by line coding to identity recurring themes. The codes were then grouped into a hierarchy structure, and new codes were created to encompass themes from the original codes, therefore creating descriptive themes. The descriptive themes were then analysed and conceptualised into analytical themes.

Results

Search Results

The literature search presented a total of 2786 articles via 5 literature databases and google scholar. Once duplicates had been removed there was a total of 2751 articles to analyse Figure 1. Of these, 10 publications met the pre-defined inclusion criteria and were included in this review. The 10 articles that met the inclusion criteria are summarised in Table 2. The methodical quality of articles was analysed using the Mixed Method Appraisal Tool [12], and the Critical Appraisal Skills Programme[13]. Table 3 details the appraisal for each article. All studies included in this review met a minimum of 60% in their respective quality appraisal and were considered to be of medium to high quality, therefore giving support to the findings of this review.

[Insert Table 1]

A thematic analysis was conducted and six main themes emerged in relation to facilitators and barriers experienced by children and adolescents with lower limb absence when wanting to participate in sports and physical activity. These themes are: Prostheses, Physiology, Enjoyment of sport, Environmental impact, Societal impact, and Research and Development. Table 4 gives an overview of the themes, subthemes, and facilitators and barriers that exist within them.

[Insert table 2]

[Insert table 3]

[Insert table 4]

Theme 1: Prostheses

Almost all children with lower limb deficiencies are fitted with prostheses to enhance their ability to participate in daily living activities [4 15], and due to the advancements in prosthetic technology and design, opportunities are continuing to grow for children and adolescents with lower limb deficiencies who want to participate in sports and physical activity [4 16]. However, the role of a prosthesis being a facilitator or a barrier to sports participation for children with lower limb absence remains debated [3]. As a facilitator the prostheses is needed or desired for many activities, with lower limb prostheses improving functional capacity and mobility such as improving posture, strength, stability, balance, and weight distribution [3 5 6]. However, prosthesis failure, ill fitted prostheses, frequent growth revisions, size and weight of components, cost, comfort, and mobility of prostheses act as barriers to participation in sports and physical activity through prostheses use [3 5 6 15-18].

Function

Function was found to be the first priority with the prosthesis in the majority of children, predominantly having the ability to walk, play sports, and go to school [17].

The weight of the prosthesis was also found to be an important factor, however with the use of materials such as carbon fibre, titanium, and graphite, strength and energy storing capabilities are possible whilst keeping the weight of prostheses to a minimum [16].

The function of a child with lower limb loss was significantly affected by their prosthetic components [6], therefore paediatric patients often begin ambulating using an energy storing type of prosthetic foot, due to their common use, relative cost, acceptance and durability [19]. Subsequently with improving ambulation and participation in recreational activities, patients often desire prostheses that allow more dynamic participation in activities involving running and jumping, for example a multiaxial dynamic foot [19]. After being fitted with a multiaxial dynamic prosthetic foot, patients reported subjective improvements in functional, high performance activities and increased athletic performance. However, it remains unclear whether different prosthetic feet allow children and adolescents to improve performance in functional activities [19].

Some children reported that their prostheses and attachments facilitated their participation in sports, whilst other children explained how their prostheses was a hindrance to their ability to engage in sports and physical activity [3]. Perceived benefits included an increase in posture, strength and balance, as well as preventing overuse of their sound limb, whilst hindrances were noted as limited range of motion, a lack of comfort and fit, and the weight of the prostheses [3 18]. Children explained how

this limitation on their physical function acted as a barrier and directly impacted their social function in social activities with friends and family [18].

One of the most common reasons reported for temporary loss of limb use included prosthesis failure, with the most common components failures being feet, knees and cosmetic foams [17].

The use of specialised prostheses for sports or specialised attachments was reported by many children [3]. There are several prosthetic considerations for the child interested in using a prosthesis for sport and physical activity, one of the first is if the prosthesis will be used for both a specific sporting purpose and daily activities or exclusively for a particular activity, and another is the exact demands of the desired activity, including the environment in which the sport is to be played [16]. Typically, persons using a prosthesis for sports require extensive education regarding the maintenance, care and adjustments of the device. They need to be able to perform required prosthetic adjustments either before or during their recreational activity, they must also be able to identify signs of impending component failure [16].

Fit

Comfort was reported the first priority for 28% of children [17], as over 88% used their prosthesis for more than 9 hours per day [15 17]. Fitting children with a lower limb prosthesis is usually very successful and achieves high levels of rehabilitation [17],

however, maintaining an appropriate prosthetic fit is particularly important for children with limb deficiency, as they need frequent revisions with growth changes [16]. On average a child with congenital limb deficiencies has their first prosthesis fitted at 18 months old, [15], and then optimal fit in a growing child may require prosthetic adjustment or replacement as frequently as every 12-18 months [17]. As children are quick to outgrow their prostheses parents are required to anticipate changes and make appropriate appointments with prosthetists [3].

Ill fitted prostheses are a barrier for children with lower limb absence when wanting to participate in sports and physical activity [3 5 15 18]. Parents of children who use lower limb prostheses reported occasions where the child prosthetic leg would fall off when running, swinging, or kicking a ball [5].

Appearance

Cosmesis of the prosthesis was cited as a priority by only 8% of children, with 43% of children reportedly very happy, and 31% somewhat happy with the appearance of their prosthesis [17]. For prosthetic devices that are used for sports and recreation, cosmesis is less of a priority than function [16]. However, in more recent literature [18] it has been reported that prosthesis appearance was an important theme for children, and that the differences in the appearance of their lower limbs acts as a barriers and can discourage participation in social, recreational and leisure activities.

Prosthetic Design and Technology

Advancements in prosthetic design, componentry, and fabrication, which have largely been consumer driven, have led to increased opportunities for people with limb deficiencies to participate in sports and physical activity [16]. Many of these improvements have been driven by people with limb loss who have challenged the system and demanded prosthetic componentry capable of facilitating rather than limiting their athletic capabilities [16]. These technological and design advancements have made componentry failure much less of a problem [16].

However, these advancements have largely been for the adult market and the selection available for the paediatric population is still limited, this has resulted in many children's prostheses designs being small-sized adult devices that may not meet all the needs of children [6]. Prosthetic prescription is very different for a child than an adult, and therefore paediatric prostheses need to consider the specific needs of the child including functional and mechanical demands as well as activity types and levels [6]. While there have been attempts to design and test paediatric specific systems there is still room for more work. There are some specialised paediatric components, such as running prostheses, but there is no published study on biomechanical evaluations in the paediatric population [6].

Cost

It has been reported that the high costs of a secondary sport-specific prosthesis may be a potential barrier to sports participation for children with lower limb absence [3].

Theme 2: Physiology

Children and adolescents with congenital limb deficiencies present limitations in activities [4], as they have altered structure and physiology of their limbs which impairs their balance, mobility, physical functioning and participation in physical activities [20]. For a child with limb deficiency, involvement in sport and recreational activities is an important mechanism for their development of motor coordination skills and adjustments to physical limitations [16]. Fundamental movement skills are commonly developed in childhood and are subsequently refined into context and sport specific skills. They include locomotor (running and hopping), manipulative or object control (catching and throwing), and stability (balancing and twisting) [5]. Children who experience physical activity barriers lag in the development of fundamental movement skills and are at risk of developing secondary health and behavioural problems. Current physiological barriers that face children when wanting to participate in sports and physical activity include mobility/functional limitations, pain, perspiration, and skin breakdown [3 5 6 15-18 20].

Mobility/Functional limitations

The majority of children are able to walk, most of them over 100m, and also cycle are over 4 years old [15], with the average distance walked per day being 5.24km which is five times that reported for adults with comparable deficiencies [17]. However, participation restrictions associated with mobility limitations, such as movement transitions, gait, and balance, were reported [5 6 18]. Children stated they were unable to do certain activities in a sport as they were difficult to complete because of their limb absence, which then limited their desire to participate [3]. Movement skills that required endurance, speed, strength, and coordination are reported as difficult, whereas simple movements such as walking are not difficult [5]. The limited physical function children with lower limb deficiencies experience directly impacts their social function in social activities with friends and families [18].

Pain

Pain was reported as a barrier to participation in sports and physical activity for children with lower limb deficiencies in three different articles [5 17 18]. It was reported as one of the most common reasons for temporary loss of limb use, and most frequently experienced during strenuous activities, with 16% reporting the pain as moderate or worse [17]. However, contrastingly Sayed Ahmed, et al. [3] reported that pain did not surface as a perceived barrier for children with limb absence when participating in

sports and physical activity during their study, but also explained that this could not be generalised to the whole paediatric population and could be further explored.

Perspiration

The majority of children reported not having problems with perspiration, however those that did report having problems, around 20%, reported that their perspiration problems were serious enough to limit prosthesis wearing time significantly. Perspiration problems for children with lower limb deficiencies appear to be bimodal, either the child had no problem or they had a serious problem [17].

Skin Breakdown

Skin problems are common amongst children with lower limb deficiencies and are often cited as a reason for return visits to orthopaedic workshops [15]. Skin breakdowns were a major concern for individuals [16] and result in one of the most common reasons for temporary loss of limb use [17].

Theme 3: Enjoyment of Sport

Children's enjoyment of sports acted as a facilitator for their participation. Many children reported feelings of pride, happiness, a sense of accomplishment, satisfaction, confidence, and fulfilment when participating in sports [3]. Children described sports as

being enjoyable, entertaining, fun, energy providing, and an opportunity to learn a new skills [3]. Some even spoke about the physical benefits they loved about participating in sports such as staying healthy and in shape, whilst others spoke about the social benefits of meeting new people, socialising, staying connected, and being part of a team as to why they love participating in sports [3]. Having the opportunity to participate in organised sports programmes locally and globally, such as the Paralympics, was another contributor to their love and passion for sports, alongside having professional athletes to look up to [3].

Boonstra, et al. [15] reported over 74% of children over the age of 5 participate in sporting activities, with the most common activity being swimming. A majority of children were reported to enjoy participation in activities involving playgrounds, swimming, outdoors, nature and parks. However, a lower percentage of children reported to enjoy activities such as dancing, team sports, martial arts and gymnastics [5]. Other sports children participated in are running, cycling, basketball, hockey, football, table tennis, figure skating, baseball, skiing, curling, karate, golf and snowboarding [3 17].

Theme 4: Environmental Impact

The environments in which a child with lower limb amputation who wants to participate in sports and physical activity experienced directly acted as a facilitator or a barrier to their participation.

Organised sports programmes

Opportunities for children with limb deficiency to participate in sports and recreational activities have increased dramatically over the past 20 years, partly due to the growth and development of sports organisations for the disabled which provide information, resources, and support [16]. Children expressed that having a coach that understands their abilities shaped their experience with sports participation, and having encouragement from coaches was a motivator for participating in sports as it made them feel like they were capable [3].

However, parents reported that organised sports programmes and facilities are expensive, and sometimes require driving long distances which is a hindrance and therefore acts as a barrier to participation [3].

School

Children with lower limb absence experienced limited participation at school in academic, sports and recreational activities [18]. Children experienced school based environmental barriers, feelings of isolation, but also emotional and instrumental

support from friends and teachers [18]. 90% of children aged 4 and over attended a normal primary or secondary school, with 93% of them being able to take part in PE, although 47% with some degree of difficulty [15]. Some children found alternate activities whilst at school that were physically less demanding to accommodate them [18].

Theme 5: Societal Impact

The social need for leisure has been identified as an important component of the quality of life of individuals, especially if their involvement in society is limited by a physical impairment [16]. Several studies note that participation in sport and recreation is a major concern for persons with limb deficiency and that these activities are important for their reintegration into the community [16]. Children with lower limb deficiencies are at risk of lower participation in social and leisure activities which could negatively influence their quality of life [4]. Whilst the full relationship between participation and quality of life are not currently fully understood, they are both considered main goals in paediatric rehabilitation [4]. Societal impacts that currently act as facilitators to sport and physical activity participation include psychological benefits achieved, social benefits, and family and peer encouragement [3-5 16]. Whilst the barriers that currently exist include stigma and bullying [3 18].

Psychological

Participation in sports and recreation has many psychological and emotional benefits for individuals with limb deficiency, which make integration into leisure, recreation and sports activities vital [16]. Psychological benefits for children with limb absence through participation in physical activity include self-efficacy, self-confidence, self-esteem, peer interaction, and social skills [3 5].

Social + Family and peer encouragement

Children with limb absence expressed that a facilitator for their participation in sports and physical activity is the social benefits it offers such as meeting new people, socialising, staying connected and being part of a team [3]. Children also reported that encouragement from their friends and families was a motivator for sport participation [3], with family being one of the most important factors that influenced participation [4].

Stigma

Children noted teasing and bullying during sport activities by their peers, and often felt isolated and left out [3 18]. These negative comments experienced from peers or members of the public limited sport participation for some children [3].

Theme 6: Research and Development

Recent reviews [4-6 18] highlight the need for additional research on children with limb loss, especially as prosthetic technology improves, potentially enabling increased levels of function in children and adolescents [6]. Lack of research including clinical research, lack of literature, and lack of investment all currently act as barriers for participation in sports and physical activity for children with lower limb absence.

Clinical Research

It is widely recognised but poorly documented that children with lower limb deficiencies have distinctly different clinical outcomes with respect to surgical and prosthetic managements than adults [17], however the functional abilities of children with lower limb deficiencies have rarely been studied [15]. While similarities between both adult and child populations in areas surrounding prosthesis use, social aspects, and person factors associated with sport participation, information relating to sport participation from adult populations may not generalise to younger populations [3].

Selection of paediatric prostheses and componentry is very limited compared to adults, and a lack of evidence on the effectiveness of different paediatric components prevents from sound clinical judgement leading to clinicians mostly making choices based on personal experience and intuition [6]. Manufacturers produce advanced high performance prosthetic technology mainly for the adult market; however, it is the young

and active children and adolescents who have the greatest need and ability to utilise them [6]. There have been attempts to design and test paediatric specific systems, advancements have been very slow due to the small population number, and there is still room for more work [6].

Literature

While it has been suggested that understanding the factors associated with participation in activities serves as a basis for decreasing barriers to participation and increasing physical activity levels in children with lower limb absence [3], limited information exists as no studies have reported specifically on this topic [3-5]. Barriers and facilitators affecting sport participation are well documented for adults, but have not been explored for children with lower limb absence [3], and therefore further research is required on how children participate and how they can be encouraged to do sports and recreational activities [4].

Investment

One barrier that currently exists preventing commercialisation of children's lower limb prostheses is the limited market size which presents a challenge to the cost of development and production [5]. Only 3.4 – 5.1% of prostheses produced are for patients aged 1 – 10, therefore manufacturers consider investment in paediatric

components as disproportionate for a limited return [6]. This has resulted in many children's prostheses designs being small-sized adult design that may not meet all the needs of the children [5].

Discussion

This systematic review investigated the facilitators and barriers experienced by children with lower limb absence when participating in sports and physical activity. Six main themes emerged from the review: Prostheses, Physiology, Enjoyment of sport, Environmental impact, Societal impact, and Research and Development.

The results show that whilst there are facilitators for sports participation for children with limb absence such as advancements in prosthetic design and technology, increased opportunities, and physical and social benefits which aid in their participation, barriers for sports participation such as prosthesis failure, stigma, and costs are very prevalent and are continuing to hinder many children from participating in sports and physical activity as they would like to.

Prostheses or prosthetic technology was noted in 90% papers included in the review, however their role of a facilitator or a barrier to sports participation did not reach a consensus. Lower limb prostheses are needed for many activities for children as they improve functional capabilities and do enable children to participate in sports and

physical activity. However, there are many barriers that currently exist with prostheses and prosthetic technology that hinder children's participation in sports and physical activity and therefore need addressing. It is interesting to note that the issue regarding the fit of a prosthesis for a child has been reported since 1999 [17] to the present day [18] and is still not resolved.

The physiology of children with lower limb absence including their altered structure and impairments in balance and mobility, was discussed in 90% of papers included in the review, with physiology always being described as something which would act as a barrier to sports participation for children with lower limb absence. Participating in sports and physical activity for children with limb absence is important as it is a mechanism for physiological development [16], yet there are multiple physiological barriers such as pain and skin breakdown, that currently face them.

The enjoyment and feelings that children with lower limb absence receive from participating in sports and physical activity such as being happy and proud of themselves, acts as a facilitator to sports participation [3]. If a child falls in love with doing a sport and the good feelings and emotions that brings, then this will encourage them to continue to do that sport.

The environmental impact theme encompassed the environments in which a child with lower limb absence would experience when participating in sports and physical activity. The environment they experience has the ability to act as either a

facilitator or a barrier. Being in an environment which has been specifically designed to meet the needs of a child with lower limb absence such as organised sports clubs with experienced staff and coaches made participating in sports and physical activity accessible and achievable. However, when a child wants to participate in sports and physical activity in an environment which is not user friendly to children with lower limb absence, for example school or uneven playing surfaces, then participation can become very difficult if not impossible for them.

The impact that surrounding society has on children with lower limb absence when participating in sports also has the ability to act as a facilitator or a barrier to participation. The psychological and social benefits they receive from participating in sports, such as feeling part of team and making new friends will act as a facilitator and encourage sports participation. However, some children experience barriers and are put off from participating in sports due to stigma and bullying from peers.

There is currently a lack of research and literature pertaining to children with lower limb absence when participating in sports and physical activity. This lack of research and investment directly acts as a barrier to sports participation, as children are not receiving the newest designs, technologies or research which could change the way in which they could participate in sports, and therefore change their lives.

The findings from this review could be used as a starting point to disrupt the barriers that currently face children with lower limb absence when participating in sports and physical activity. Further research is now required to investigate these barriers in detail and implement ways of eradicating them.

Study Limitations

Even though the article selection performed was robust and followed the PRISMA guidelines, it is possible that some studies may have been missed in the grey literature. Also, with the rapid development in prostheses technology, it is possible that some findings from older research papers may not now be generalisable.

Conclusion

The aim of this systematic literature review has been met, as facilitators and barriers that children with lower limb absence experience when wanting to participate in sports and physical activity can now be understood and generalised into 6 overarching themes, Prostheses, Physiology, Enjoyment of sport, Environmental impact, Societal impact, and Research and Development. In order to enable every child with lower limb absence to participate in sports and physical activity to their full ability it is important to understand and consider the current facilitators and barriers that exist.

This knowledge provides insights into what drives children with lower limb absence to participate in sports and physical activity, and also the challenges that face them. This research now provides a starting platform to continue to enable the facilitators, and to start addressing and tackling the barriers experienced by children with lower limb absence when wanting to participate in sports and physical activity.

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