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## Abstract

**Purpose:** To examine the association between environmental attributes of facilities, female participation in sport and according to life stage. **Design:** Articles were identified through seven databases and included if female specific results were reported on the association between attributes of the physical environment and sports participation. **Findings:** The search yielded 3,118 articles, 24 met the criteria. Most studies were moderate quality and in terms of life stage focused on adolescent girls. Environmental attributes of facilities including perceived safety, convenient location and suitable amenities in sport and school facilities were associated with female participation in sport. **Practical implications / Research contribution:** Attributes of the physical environment may influence female participation in sport. Conclusions are tentative based on minimal studies in this area. More attention to identify environmental attributes of facilities associated with encouraging female participation in sport across their transitional life stage is required to enhance understanding and guide facility development.

*Keywords:* Sport participation; females, environmental attributes, facilities

## Introduction

Participation in sport can be undertaken as an individual or in a team playing a recreational or competitive activity with a common set of rules or expectations (Eime et al., 2017; Eime, Harvey, Sawyer, et al., 2013). The benefits of participation in sport for females include improved psychological well-being through building self-esteem, social integration, and can contribute to a reduction of stress, depression, anxiety and loneliness (Hanlon, Morris, & Nabbs, 2010; Taliaferro, Rienzo, Miller, Pigg, & Dodd, 2010). Psychological health benefits are important for females, as they experience depressive symptoms at almost double the rate of males (World Health Organisation, 2016).

An additional benefit of participation in sport for females suggests that young and adolescent girls who participate in sport outside school, are more likely to be physically active during the transition from adolescence to adulthood (Jose, Blizzard, Dwyer, McKercher, & Venn, 2011). Community well-being and social capital is also gained from female participation in sport (Eime et al., 2017). Despite these benefits, fewer females are physically active compared to males across all age groups (Hallal et al., 2012). As a result, the examination of attributes that encourage female participation in sport are an important research focus. Over the past ten years, research focus has broadened from predominately individual determinants to include an increased focus on the environmental determinants of sport and physical activity (Arango, Paez, Reis, Brownson, & Parra, 2013; Brown, Heesch, & Miller, 2009).

Facilities provide indoor and outdoor environments for people to be active and may thus facilitate engagement in physical activity. For example, environmental attributes of facilities include the space, aesthetics, convenience, and specific features such as the presence of footpaths, are associated with increased likelihood of physical activity (Humpel, Owen, & Leslie, 2002). Evidence suggests female participation in physical activity increases when

facilities are accessible to them (Eime et al., 2017; Wicker, Hallmann, & Breuer, 2013). Facilities for physical activity participation also provide a social hub in communities (Eime, Harvey, Craike, Symons, & Payne, 2013; Seifried & Clopton, 2013). Physical environments that support physical activity directly shape positive habitual behaviour patterns (Owen, Humpel, Leslie, Bauman, & Sallis, 2004) and are expected to have a long-term impact on individuals (Sallis, Floyd, Rodriguez, & Saelens, 2012).

Levels of engagement and the factors that influence physical activity vary for males and females and also across different life stages (Hanlon, et al., 2010; Milne, Divine, Hall, Gregg, & Hardy, 2014). Thus, environmental attributes that attract females to physical activity could also vary according to their transitional life stage. The transitional phase of growth and development across a life stage comprises childhood (aged 0-10 years), adolescence (aged 11-17 years) and adulthood (aged 18+) (WHO, n.d.). The transitional phase addresses the social transition which vary more with the socio-cultural environment more so than age that is only one characteristic that delineates a period of development and is more appropriate for assessing and comparing biological changes (WHO, 2016). For example, adolescent females tend to be attracted to multifunctional facilities (Limstrand, 2008) and adult females are attracted to participate in physical activity where there is adequate lighting, and access to facilities and transport (Caperchoine, Mummery, & Joyner, 2009; Cortis, 2009). Evidence synthesis of the environmental attributes associated with female participation in physical activity across their life stage therefore presents an important avenue of investigation.

Funding, policies and programs have been implemented globally over the past decade to increase female participation in sport. Examples include, the Gender Equality in Sport Strategic Actions 2014-2020 (European Commission), Actively Engaged: A Policy on Sport for Women and Girls (Sport Canada), and the 'This Girl Can' Campaign (Sport England).

These strategies could be enhanced by incorporating evidence relating to environmental attributes of facilities that attract females to a sport.

To date, systematic reviews have focused on the association between the environmental attributes and overall levels of physical activity (e.g., Arango et al., 2013; Heath et al., 2013; Owen et al., 2004). The findings of these reviews suggest that traffic safety, neighbourhood aesthetics, street scale strategies, and access to recreation facilities are associated with participation in physical activity. To the authors' knowledge, no systematic reviews have examined the environmental attributes of facilities associated with sport participation specifically among females, nor did they include an examination of such associations across their transitional life stage.

The aim of this systematic review is address this gap and examine evidence on the association between environmental attributes of facilities and female participation in sport across their transitional life stage. Davison and Lawson's (2006) descriptive systematic review, built on the work of past reviews (McMillan, 2005; Sallis, Prochaska & Taylor, 2000), and focused on environmental attributes of facilities (physical or built) and their association with physical activity behaviours. The current review will further expand on these descriptive reviews specific to girls and women across their transitional life stage and their sport participation. In this context, we modified the definition of environmental attributes of facilities (Davison & Lawson; McMillan; Sallis et al) to 'the objective and/or perceived attributes of the physical context in which females across their transitional life stage spend their time participating in sport external to their home, including attributes of urban design (e.g., residential density), design of venues for sport (e.g., parks, sport clubs and school yards), and safety conditions. Although safety is not directly an environmental attribute of facilities, it is included in this review due to the direct link it has with environmental attributes of facilities such as lighting, the condition of buildings, and the positioning of car

parks. Safety can also affect location whereby a specific location can gain a reputation for risk of safety'. The findings of this review will provide insights to advance research knowledge and practical understanding to guide grant providers, policy makers and practitioners on the environmental attributes of facilities associated with female participation in sport.

## **Method**

### ***Search Strategy***

Searches were performed on 11 June 2016. We included seven databases in our search strategy: Scopus; Sport Discus with full text via EBSCO; Cinahl with full text via EBSCO; Medline with full text via EBSCO, PsycArticles via EBSCO; PsycInfo via EBSCO; and Pubmed. The search terms were: Girl\* OR Wom\*n OR Female\* AND Sport\* AND “Sport\* facilit\*” OR “sport\* venue\*” OR “sport\* club\*” (as PubMed did not accept wom\*n, ‘woman OR women’ were used instead).

### ***Selection Criteria***

Inclusion criteria included quantitative or qualitative empirical studies, peer reviewed, English language articles reporting female specific results, with mixed gender studies included if female specific results were provided. Articles were included if they provided specific results relating to the association between the environmental attributes of facilities and female participation in sport regardless of their transitional life stage, with any results related to programming excluded.

Exclusion criteria included studies that were based in controlled settings, such as hospitals or retirement homes or studies published prior to 2007. Over the last decade there has been shift in research focus on factors that influence physical activity from predominately individual to environmental factors (Arango et al., 2013; Brown et al., 2009). Consequently,

in this review, we focus on research from the past ten years to identify environmental attributes of facilities associated with female participation in sport.

### ***Search Process***

Titles and abstracts were screened by one researcher (CJ). Full text articles and the reference lists of the subsequently included articles were then screened independently by all authors. Any disagreements related to inclusion were discussed and resolved by consensus.

Full details of this process is shown in Figure 1.

*[FIGURE 1 NEAR HERE]*

### ***Study Analysis***

Articles that met the inclusion criteria were analysed thematically, with the main themes derived from the environmental attributes of facilities definition used in this review. Articles were then categorised into sub-themes that evolved from the analysis process, using a mixed deductive and inductive approach. In Table 2, the results are classified as being in an expected direction (E), unexpected direction (U) or non-contributing (NC) (Arango et al., 2013) to sport participation. For example, an expected result is the perception that school physical activity facilities positively contribute to children's sport participation, whilst an unexpected result is that the presence of shower facilities is negatively associated with adolescent sport participation.

*[SUPPLEMENTARY TABLE NEAR HERE]*

### ***Quality Rating***

The quality rating tool developed by Kmet, Lee, and Cook (2004) has been used extensively in previous mixed methods systematic reviews and was used for this review.

Importantly, this quality assessment tool includes quality assessment tools for qualitative and quantitative research.

Kmet et al.'s (2004) quality rating system includes 10 assessment questions for qualitative studies, including use of a theoretical framework, a clear research question and context, systematic data collection and consideration of reflexivity. The system for quantitative studies includes 14 assessment questions, including appropriate research design and methodology, appropriate data collection and control for confounders. The possible score range for each included paper was 0.0-1.0.

Assessment questions were given a score of 'yes' (2 marks), 'partial' (1 mark) or 'no' (0 marks), with quantitative studies also including a 'not applicable' score. For the qualitative studies, the final score was calculated by the total sum = (number of 'yes' x2) + (number of 'partial' x1) divided by the total possible sum of 20. For the quantitative studies, the final score involved three stages: the total possible score was 28 – (number of N/A's x2) and the total score was (number of 'yes' x2) + (number of 'partial' x1). Therefore the summary score was calculated by the total score divided by the total possible score (Kmet et al., 2004).

Three researchers independently quality rated the included papers. One researcher rated all the quantitative studies (MC), while one rated all the qualitative studies (CH), dependent on their research expertise. The third researcher (CJ) participated in a pilot study of 10 papers for each type of method to ensure consistent rating of papers. A Kappa score for the two pilot studies was then calculated to express agreement. Any discrepancies were discussed and resolved before the two respective researchers conducted quality ratings for the remaining quantitative and qualitative studies. Each article was then classified as strong (>0.80), moderate (0.60-0.80) or weak (<0.60) (Henry et al., 2016). The quality ratings for each article are presented in Appendix 1.

## Results

The electronic search yielded 3,118 unique articles from the selected databases (see Figure 1). After title screening, 314 articles were reviewed and, after applying the inclusion criteria, 156 full papers were reviewed. One hundred and thirty-six papers were subsequently removed and 20 studies were identified as meeting the eligibility criteria and a further four were identified through the reference lists of the selected papers. In total, 24 papers were included to undergo full data abstraction.

### *Descriptive Review*

Supplementary Table 1 includes study characteristics and summary of results (1-24). Four studies were conducted in the UK, three in Canada and U.S.A, two in Australia, Belgium, Germany, Portugal, and one in Japan, Denmark China, New Zealand, Spain respectively, and one representing seven European countries. Five out of the 24 studies (20.8%) focused on children (aged 5-12 years), 10 studies (41.7%) focused on adolescents (aged 13-17 years), seven (29.2%) focused on adults (18 years and over) and in two studies (8.3%), the age of participants were not specified. Just over half of the studies were quantitative (n = 13, 54.2%) and 41.7% (n = 10, 41.7%) were qualitative. One study used mixed methods.

Quality scores of the studies ranged between 0.3 and 1.0 points (range 0.0-1.0); the average score was 0.75 (SD = 0.20). Twelve of the 24 studies (50%) were classified as moderate (0.60-0.80) in quality, eight (33.3%) were strong (>0.80), and four (16.7%) were weak (<0.60). Scores for the qualitative studies ranged from 0.3 to 0.9. A common theme among the qualitative studies was a lack of author reflexivity, with four studies partially recognising this potential researcher bias, and six not providing this recognition. Quality ratings for the quantitative studies ranged from 0.44 to 1.0. A common limitation of these

studies was not adequately defining the outcome and (if applicable) exposure measure(s) (n = 8) and not sufficiently describing the research question/objective (n = 8).

Associations between the environmental attributes of facilities, female sport participation, and the direction of these associations are detailed in Table 2. The associations are identified according to the life stage studied. First we present descriptive findings for each transitional life stage (WHO, n.d.) and then present the findings according to deductive coding focused on three a priori categories of environmental attributes of facilities (Davison & Lawson, 2006; McMillan, 2005; Sallis et al., 2000) including: safety; urban design; and design of sport facilities, highlighting differences and similarities of findings according to life stage. An inductive code also evolved from our review, school facility amenities.

*Children.* Five of the 24 studies (20.8%) focused on children. School facilities and amenities were predominantly reported among this group, with four studies (75%) focusing on the school environment; objective school facilities (n = 3), perceptions of school facilities (n = 1), objective school amenities (n = 1) and school fixed equipment (n = 1). Other attributes of the physical environment were seldom reported, with only one study examining attributes of urban design or safety.

*Adolescents.* Most of the studies that met our inclusion criteria focused on adolescents (n = 10, 41.2%). Studies of adolescents predominately reported on sport participation and attributes of urban design (n = 7), safety (n = 6) and physical activity venues and their amenities (n = 4). Fewer studies reported on school facilities and amenities (n = 3).

*Adults.* Seven studies focused on adults (18 years and over). Only one study focused on older adults, so these were included as 'Adults'. Six studies reported on sport participation

and physical activity venues and their amenities; fewer focused on safety (n = 3) or attributes of urban design (n = 2).

*All ages.* Two studies did not specify age groups, these two studies focused on attributes of urban design (n = 1) and physical activity venues and their amenities (n = 2) and safety (n = 1).

### ***Safety***

*Safety.* Perceived safety was the most frequently reported environmental factor in the studies included in this review (n = 13, two children, three adults, six adolescents, two ages not specified). There were mixed findings on the association between safety from crime and sport participation, with four studies finding an association in the expected direction and five finding no association. All four studies that found an association between safety from crime and sport participation were qualitative, whereas the five studies that showed no association were quantitative. Perception of traffic was reported in five studies (two of children and three of adolescents), three studies (all of adolescents) found no association; while two studies (both of children) found an association between perception of traffic and sport participation. Only a small number of studies examined safety from dogs (two studies), fear of injury (one study), lighting (two studies), and objective community disorder (one study), all were associated with sport participation.

### ***Urban Design***

Attributes of urban design were reported in 10 studies, the majority focused on adolescents (n = 6). Eight studies reported the perceived convenience of the location of facilities, with mixed results; five of the eight studies found conveniently located facilities were associated with sport participation and three found no association. Five of the studies that included perceived convenience of a facility focused on adolescents, and four of these found that convenience was associated with sport participation. Self-report was used to assess the

perceived convenience of facilities in all but one study. This study was of adults and included an audited number of facilities per 1,000 population. Findings revealed the availability of sports facilities were associated with self-reported participation.

Four studies reported on the association between sport participation and connectivity of street networks (two focused on adolescents, one on children and one age not specified). Three studies found connectivity of street networks was not associated with sport participation and one found an association. Three studies reported perceived land use mix access and diversity (two studies) or perceived residential density (one study).

### ***Design of Sport Facilities***

Eleven studies reported associations between sport participation and the amenities at built sport facilities. Ten studies (four of adolescents, four of adults, and two non-specified ages) examined the perception of facilities and nine of these found an association with sport participation. One study (of adolescents) found no association.

Many of the studies relating to perception of facilities identified appropriate facilities were needed for the population they served. For example, these facilities needed to be appropriate to the locality (urban compared with rural), and socio-demographics of the population (e.g., age, cultural background). One study examined overall satisfaction with facility provision and identified the need for multifunctional facilities that offer a range of opportunities. Two studies reported associations between sport participation and concerns about the maintenance of facilities. The one study in which perception of facilities was not associated with sport participation was a qualitative study of New Zealand adolescents. In this study, undesignated, undeveloped open spaces were commonly used by females to participate in sport and these locations were more popular than spaces designed for specific sporting activities.

Six studies examined the contribution of culturally appropriate environments (one of adolescents, three of adults and two were unspecified age). All of these studies showed that

provision of culturally appropriate environments was associated with sport participation. Two of these studies focused on Muslim females, one focused on Indian and other ethnic minority females, and three focused on females from various cultural backgrounds. The studies were predominantly qualitative in nature and dominant themes related to the importance of privacy in change rooms such as doors on showers or change rooms, blinds over windows, and the need for offering female only venues or separate areas for females to participate.

Four studies examined quality of amenities, all of which found these were associated with participation. Only one study reported provision of childcare and one study reported crowding.

### ***School Facility Amenities***

Seven studies reported factors relating to school facility amenities, four focused on children and three focused on adolescents. Four studies examined school facilities and three of these found an association with sport participation, two studies examined perceptions of physical activity school facilities and both found associations with sport participation. Two studies (both of children) examined perception of school fixed equipment, and showed associations with sport. One study used objective measures of school amenities and this study found school amenities were associated with participation in sport in the opposite direction to that which was expected. In this study of adolescents, the presence of school shower facilities was associated with lower sport participation in sport.

## **Discussion**

The purpose of this systematic review was to examine evidence about the association between environmental attributes of facilities and female participation in sport across life stages. Our findings show that despite the need to attract more females to participate in sport, and the large sums of money invested in sport facilities to increase sport participation (Limstrand, 2008), minimal research has been published on the environmental attributes of

facilities that are associated with female participation in sport. The lack of research precluded us from presenting robust findings relating to the transitional life stage of females, therefore although tentative, our descriptive findings suggest that environmental attributes of facilities are associated with female sport participation. Adolescence was the most frequently studied life stage, with 10 studies focusing on this stage, while fewer studies focused on children, adults, or older adults. Most of the studies focused on Western countries, which might be attributed to our inclusion of only English language papers. The small number of studies included in the review indicates that more research is required to investigate the environmental attributes of facilities associated with female sport participation across different the transitional life stages.

Perceived safety was the most frequently reported attribute in the papers included in our review, however findings were inconsistent as to whether there was an association between safety and sport participation. In qualitative studies, safety was associated with female sport participation. The particular aspects of safety identified as important to sport participation were the ease of traffic, safety from dogs, injury prevention, and suitable lighting. This finding is consistent with previous systematic reviews that examined the association between environmental attributes and physical activity for Latin-Americans (Arango et al., 2013), for walking among adults (Owen et al., 2004), and for people regardless of age, country or community (Heath et al., 2013).

Although we found an association between safety and sport participation in the qualitative studies reviewed, there was no association between safety and sport participation in the quantitative studies. The difference in findings might be explained by the definition of safety that represents a wide range of issues and the different ways that 'safety' was conceptualised. In the qualitative studies, safety was described by participants as the security of facilities and the presence of 'scary people'. In contrast, the quantitative studies measured safety as

neighbourhood safety and safety from crime, and this conceptualisation might be less personally meaningful to females. The lack of consistency on findings makes it difficult for conclusive statements and warrants further investigation to clarify the association between aspects of safety associated with female participation in sport. For example, a mixed-method approach where qualitative analysis could identify potentially significant factors associated with safety and sport participation for females, to then develop operational measures subject to quantitative analysis.

A consistent association was found between attributes of sport facility amenities and female participation in sport. For example, the quality of facilities such as football grounds or swimming pools, and the maintenance of facilities were important to females. These findings complement research on the importance of the aesthetics of an environment to increased likelihood of physical activity more generally (Humpel et al., 2002). Female perception of sport facilities warrants further investigation. More detail is required on what ‘quality’ means to women and girls, in regards to sport facilities and to what extent they are satisfied with the current provision of sport facilities.

Conveniently located sport facilities were associated with participation in sport, particularly among adolescents. Previous studies have identified an association between convenience and access to recreation facilities and physical activity (Heath et al., 2013; Humpel et al., 2002). Our review expands this knowledge specifically for female adolescents and the positive association between the convenience of sport facilities and their participation in sport.

### ***Differences across the Transitional Life Stage of Females***

We found subtle differences in the associations between the environmental attributes and sport participation according to life stages. This supports the suggestion that environmental

attributes attracting girls who are children and adolescents to participate in physical activity may vary to ones attracting women who are adults (Eime et al., 2017).

The studies included in this review that focused on girls reported associations between sport facilities in schools and sport participation. In particular, findings indicated facilities such as football ovals and fixed sporting equipment are associated with sport participation. There has been some suggestion that aesthetic qualities of a sport facility may be associated with sport participation for girls (Giles-Corti, Kelty, Zubrick, & Villanueva, 2009) and that girls were attracted to multifunctional sport facilities (Limstrand, 2008). However, we found a lack of evidence to support such claims and this warrants further investigation.

Adolescent females were the most commonly studied group in our review. One reason may be that sport participation declines in adolescence (Zimmermann-Sloutskis, Wanner, Zimmermann, & Martin, 2010), thus the identification of environmental attributes that encourage adolescent females to continue participating in sport is a priority. Our findings show conveniently located sport facilities are important for adolescent female participation. In particular, proximate and accessible facilities were commonly associated with participation in sport. The reason for this may be that adolescents seek and are often granted, greater independent mobility by their parents, resulting in the association between convenience of location and their sport participation (Carver et al., 2011; Giles-Corti et al., 2009). This signifies the importance for providers to actively promote public transport convenience and accessibility to sport facilities. Most of the studies included in this review used self-report measures of the availability of sport facilities and future studies are recommended that use objective measures to assess whether the number and location of facilities, or the perception of facilities, influence female adolescent participation in sport.

The provision of culturally appropriate facilities was associated with sport participation for both adolescent and adult females from multicultural backgrounds. Environmental attributes

included privacy in change rooms such as doors on showers or change rooms, blinds over windows, and offering female only venues or separate areas for females to participate.

Findings reinforce the importance of government agencies firmly embedding female cultural perspectives into sport policy and linking funding to the provision of culturally diverse sport facilities, thereby reducing the participation gap between different groups of females (Cortis, 2009). Female adolescents are very aware of their body image (e.g. weight and shape) (Sebire, Haase, Montgomery, McNeill, & Jago, 2014) and privacy in change rooms have been acknowledged in Ministerial inquiries on female participation (e.g., Victorian Inquiry into Women and Girls in Sport and Active Recreation).

### ***Limitations and Opportunities for Future Research***

Our review identifies that knowledge is slowly developing on the environmental attributes of facilities associated with female participation in sport throughout the transitional life stage. As a result, little consistency in the methods were used and at times opportunist designs were adopted (Davison & Lawson, 2006) to gain insights of how these variables link to encourage greater participation. Identification of limitations of the review can be transformed into associated opportunities and will allow for greater rigour in populations, methodology and definition, which is imperative to advancing this field at a quicker pace

Population limitations based on lack of knowledge across transitional life stages, general rather than gender specific populations, cultural specific, and representation of countries was evident. Limited research exists on the environmental attributes of facilities associated with older adult women. These findings are consistent with the lack of studies previously identified on environmental correlates and physical activity for older adults (Bauman et al., 2012). To advance knowledge in this area and assist funding organisations, future research could focus on studies of environmental attributes of facilities for older women, thereby assisting policy makers and facility managers to understand the needs of this cohort. Another

limitation was the number of studies (n=96) that reported general rather than gender specific findings on environmental attributes of facilities associated with participation in sport including accessibility aspects or the condition of facilities. The lack of gender specific findings made it difficult to provide conclusive findings in our review, this represents a gap in literature. There is the need for future research to clearly identify gender specific findings to expand knowledge on the needs of females in this field. The slow development of research in this field made it difficult to determine if culturally specific differences of environmental attributes existed between females from different cultural settings. Future research in this field could expand the body of research knowledge and practically assist grant providers, policy makers and practitioners to understand the different cultural needs of females throughout their life stage. The final population limitation was that the majority of studies reviewed were based in Western countries, as these countries tend to be more researched than developing countries (Hanlon, Khoo, Morris & Eime, 2017). Thus this review may not be sensitive to environmental attributes of sport facilities or females in their transitional life stages globally. To provide a more global representation of findings in a systematic review, future research is recommended in developing and non-Western countries.

Methodological limitations of the published papers reviewed that met the inclusion criteria for our review was evident. Studies used either descriptive or cross-sectional research designs. Thus, only associations between environmental attributes and sport participation could be determined. Future studies are recommended that include quasi-experimental or natural experimental designs to provide more robust findings on the effect of environmental attributes of facilities for females on sport participation. In addition, self-report measures of environmental attributes were predominantly used in these studies; which may be sensitive to reporting bias. Future studies that use objective measures are needed to determine the

association with objective (as well as self-report) environmental attributes (Arango et al., 2013; Davison & Lawson, 2006).

Definition limitations made it difficult to draw conclusions specifically about sport participation. Similar to other reviews that focus on sport participation (Arango et al., 2013; Jenkin, Eime, Westerbeek, O'Sullivan & van Uffelen, 2017), a limitation of this review is that many studies did not include a clear definition of sport, and sport was included within the broader context of physical activity. To assist in clarity of activity and allow for stronger global generalisation in sport, future research will need to be more specific in the types of physical activity studied.

Industry-perceived good practice rather than evidence-based good practice. . The lack of evidence on the environmental attributes that attract females to sport facilities and whether they vary according to life stage, has resulted in industry-perceived good practice. Including, attributes such as baby changing facilities, enhanced utilisation of natural light to interiors, close proximity to car parking and playing fields, and equal access to memorabilia space. These examples were noted from good practice in government guidelines on female friendly sport infrastructure (Victorian State Government, 2018). In addition, the lack of research-based evidence has resulted in government funding to focus on upgrades of sport facilities and change rooms for females (Victorian State Government, 2018), rather than broadly focused upgrades of sport facilities and urban design, as identified in our review, to encourage women and girls to participate in sport. Increased research in this area may also assist to identify what environmental attributes are prioritised by females when they progress through their transitional life stage in sport. These findings will assist funding bodies, policy makers, architects of sport facilities, and managers at sport clubs. In particular, these findings will advise on what environmental attributes need to be incorporated when targeting the life

stage of females to participate in sport, or on why a female may select one sport club over the other in a similar location.

### **Conclusion**

Notwithstanding the limited research in this area, particularly for older adult females, our review suggests that some aspects of the physical context are associated with female participation in sport. Specifically, perceived safety; convenient location; and suitable amenities in sport and school facilities appear to be associated with women and girls participating in sport. In addition, based on the transitional life stage of females, there are subtle differences in the association between the environmental attributes and sport participation. Adolescent female participation is particularly influenced by the convenience of sport facilities. Adolescent and adult females from multi-cultural backgrounds are influenced by culturally appropriate environments. Researchers need to give more attention to identifying physical environmental attributes associated with female participation in sport across their transitional life stage. Doing so will enhance understanding and guide sport industry sectors on the future development of facilities to encourage more female participation in sport regardless of their stage of life.

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Table 1

*Association between the environmental attributes of facilities and female participation in sport according to life stage*

Environmental attributes	Sport Participation		
	NC	E	U
	Included studies: 1A*+,3A, 5A*+,6A*, 8B*+,24B+, 13B, 9B*+, 17C+,20C*+, 23C^+ 21C*+, 19C, 2A*, 7B*+, 10B+, 11B*+,12B*+,14B+, 15B+, 22C+, 18C*+, 4E, 16E		
<b>School facility amenities</b>			
Objective school PA facilities (e.g., football ground)	5A*+	6A*, 2A*, 7B*+	
Perception of school PA facilities		3A, 13B	
Objective school amenities (e.g., change room)			9*+
Perception of school fixed equipment		3A, 2A*	
<b>Urban design</b>			
Perceived residential density (reported by participant)		1A*+	
Perceived land use mix access and diversity		1A*+, 24B+	
Connectivity of street networks (including linking of facilities)	1A*+, 11B*+, 12B*+		4E,
Perceived convenience of location of facility	1A*+, 23C^+, 12B*+	8B*+,13B, 21C*+, 10B+,11B*+,	

<b>Design of sport facilities</b>		
Perception of facilities (e.g., quality of facilities/satisfaction with facilities)	13B	24B+, 17C+, 19D, 14B+, 15B+, 22C+, 18C*+, 4E,16E
Perception of facilities in parks		
Provision of childcare facilities (only if there are no facilities, if lack of affordable childcare-do not include)	23C^+	
Provision culturally appropriate environments (e.g., section for women-only use)		17C+, 19C, 14B+, 22C+, 4E, 16E
Quality of amenities (e.g., Change room quality, privacy, cleanliness, quality car park)		24B+, 17C+,22C+, 16E
Crowded facilities/spaces		13B
<b>Perceived safety</b>		
From crime	1A*+,23C^+, 20C*+, 11B*+,12B*+	24B+, 13B, 15B+, 4E
From dogs		13B, 23C^+
Fear of injury		14B+
From traffic (including safety of road crossings)	13B, 11B*+,12B*+	1A*+, 8B*+,
Lighting		17C+, 4E
Objective community disorder in neighbourhood (e.g., researcher uses checklist to derive an assessment of this )		20C*+

\*: Quantitative; +: Self-reported; ^: Mixed method; A: Children; B: Adolescents; C: Adults; E: All ages

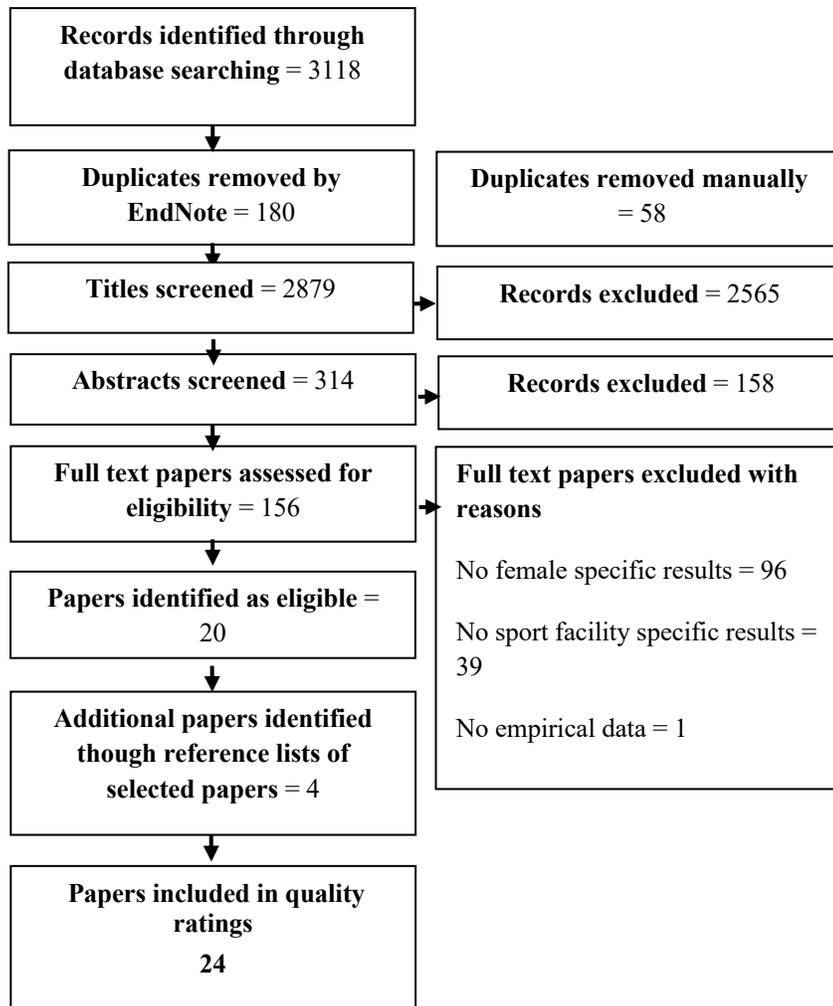


Figure 1

*Search process flow chart*

*Environmental attributes of facilities to encourage female participation in sport across the life stages*

Ref, Year & Country	Methodology, Design & theory	Measures of Main Outcomes relating to Review	Sample (n) Age range, Average age, SES status,	Research aim/question	Key finding(s)	Quality rating score
1. De Meester et al. 2014 Belgium	Quantitative. Cross-sectional	Children completed: The Flemish Physical Activity Questionnaire (FPAQ); and wore The Yamax Digiwalker SW-200 and the Actigraph accelerometer, model GT1M. Parents completed: Neighbourhood Environmental Walkability Scale for Youth (NEWS-Y) and items to assess the child's level of independent mobility	N = 736 children (aged 10-12 yrs) and their parents; 48.1% girls, Mean age (SD); girls 11.1 yrs (0.5); Mother education (girls): 51.8% college or university degree; Father education (girls):.44.9% college or university degree	To examine the associations of parental perceptions of neighbourhood environmental attributes with active transport and total PA in 10–12 year old Belgian boys and girls. Also examined the potential mediating effect of independent mobility on these associations.	* Girls reported higher total of school sport and leisure time sport when parents perceived high residential density, good land use mix access, well-maintained and high quality walking/cycling infrastructures and more traffic safety. *Independent mobility was found to be an important mediator of these associations in girls.	1.0
2. Ishii et al. 2014 Japan	Quantitative Cross-sectional Accelerometers/ Questionnaire	The School Physical Activity Environment Scale	N=64 boys/ 38 girls 6-12 yrs	To examine the association of perceived school environment with the level of physical activity during recess among Japanese elementary school children.	* Girls who perceived school facilities for sport to be good, spent longer time in moderate and vigorous sport during their morning recess. *Girls who perceived school equipment for sport to be good, engaged in light physical activity for a shorter duration. *To increase perception of facilities may be important for girls during morning recess.	0.75
3. Pawlowski et al. 2014 Denmark	Qualitative Focus group, Social-ecological theory		N=53 boys, 58 girls 10-11 yrs	To explore gender differences in children's perceptions of barriers to recess PA	* Lack of schoolyard play facilities, defined as buildings (e.g. gymnasiums), courts or equipment (fixed/unfixed) were the main barriers to recess PA (including sport). *Girls wanted to play soccer yet there was a lack of play facilities.	0.95
4. Roullet et al. 2014 Canada	Qualitative F-t-f electronic surveys Observation Semi-structured interviews, Grounded theory	System for Observing Play and Leisure Activity in Youth grid	N=372 *93: 6-7 yrs, *118: 12-17yrs, *141: 18+ *20 - Executives	To evaluate the impact the implementation of a free outdoor skating rink has on the local population's social identity and physical activity	* Outdoor rinks perceived by females to become symbolic male venues: Configuration of ice rinks look like hockey rinks (with boards, and lines limiting the field and goals). * To be more attractive to females, the need to pair sport and recreational facilities. *A strong connection between the security of a sport facility and the attendance of young girls.	0.65
5. Ward et al. 2015 Canada	Quantitative. Cross-sectional study	Based on the 2007-08 School Health Environment Survey (SHES)	N=776 348 boys/ 428 girls 10-11 yrs	To identify which school policies and built environmental characteristics were associated with participation in	* A school environment favourable to active commuting was associated with a higher likelihood of participating in organised and group based physical activity (including sport).	0.85

				organised, non-organised, individual and group-based activities	*None of the environmental characteristics was significantly associated with their participation in group based and individual physical activity/sport.	
6. Cohen et al. 2008 USA	Quantitative	Actigraph accelerometers	N=1566 Ave age =11.8 yrs	To examine 36 middle schools that participated in the Trial of Activity for Adolescent Girls (TAAG) and determined whether their physical features were associated with these two measures of physical activity among adolescent girls	* Schools that have a variety of sport facilities may stimulate more physical activity than schools with fewer amenities.	0.75
7. Czerwinski et al. 2015 Germany	Quantitative Cross-sectional	PA: Questionnaire single item Perceived environment: Questionnaire 3 items concerning the degree of perceived deprivation of the neighbourhood ; School-level correlates: School administrator's and Principal's questionnaires Social Ecological theory	N = 4829 (approx 51% girls) 11-15 yrs 11 yrs = 34.2% 13 yrs = 32.9% 15 yrs = 32.9%	To quantify the associations of several school-level and intrapersonal variables on MVPA among 11- to 15-years old German school children and to examine interactions between school-level and intrapersonal variables	*Girls attending schools with a football ground had significantly more days of sport than girls from schools without such a place.	0.8
8. Li et al. 2006 China	Quantitative Cross-sectional	Adolescent physical activity recall questionnaire; Environmental factors: Parents completed a questionnaire which assessed recreational facilities in the community (e.g., sports oval, stadium, swimming pool, and sports club), , transportation, level of residence, safety concern, Environmental factors at the school level: School environment questionnaires completed by school doctors	N=1787 889-girls, 898-boys 11-17 yrs	To explore the sociodemographic and environmental factors at community, school, and household levels associated with physical inactivity	*School organised sport meets were associated with increased sport activity for girls.	0.95
9. Kirby et al. 2012 UK	Quantitative Self-administered questionnaires		N=1978 secondary school girls & 123 head teachers Ave age (girls) 14.49 yrs	To explore school sports facility provision, physical education allocation and opportunities for physical activity and their association with the number of days adolescent girls participated in at least 60 min of moderate-vigorous physical activity (MVPA) per week	* Having school shower facilities resulted in decreased MVPA (which includes sport). * Physical education allocation and extracurricular clubs are likely to be of greater importance than having more school sport facilities.	0.9

10. Kirby et al. 2013 UK	Qualitative Photography, computer blogs, maps and focus group discussions Cross-sectional, Socio- ecological		N=62 boys/69 girls 11-13 yrs	To identify socio-environmental factors that influence choices young people make to their diet and physical activity to help inform development of interventions, aimed at promoting active living and healthy eating.	*The provision of sports clubs and extra-curricular sport activities is likely to have a stronger effect on the activity of girls.	0.9
11. Mota et al. 2009 Portugal	Quantitative Cross-sectional	PA: Respondents categorised in to active or non-active using a questionnaire with five questions with four choices; ed TV and use computer in the week Environmental Assessment: Questionnaire using the Environmental Module (Perceived Neighborhood Environments) of the International Physical Activity Prevalence Study	N = 162 girls; ave age (SD): 14.1 (1.5) yrs	To investigate perceptions of neighbourhood, amount of screen time and socioeconomic status (SES) in active and non-active 'overweight/obese girls'.	*Active girls who participated in sport were more likely to report living in a neighbourhood with several public sport facilities. *Sport facilities were associated with the likelihood of girls to be more active.	0.7
12. Mota et al. 2009 Portugal	Quantitative Cross-sectional	PA: Questionnaire included 21 leisure time activities, including participation in organized sports activities and/or non-organized sport activities. Environmental Assessment: questionnaire using the Environmental Module (Perceived Neighborhood Environments) of the International Physical Activity Prevalence Study	N = 425 girls; ave age 14.5 years	To examine perceived environmental associations with type of PA choices (organized and non-organized).	* No associations were between environmental perceptions and participation in organized sports activities. * Accessibilities to facilities, aesthetics, and social environment were associated significantly with girls' participation in non-organized sports activities.	0.7
13. Rehrer et al. 2011 New Zealand	Quantitative Descriptive study	Mapping exercises in which adolescents delineated favourite and least favourite places for sport and PA, where they went on a particular Sunday, how they got there and what	N = 173, females = 73 Age 12-13 yrs	To identify preferred places for sport and PA and establish factors that they adolescents influenced levels of PA	* Undesignated, undeveloped open spaces were cited as well used amongst males and females for PA and were more popular than spaces designed for specific sporting activities. *The most common reasons for liking these places were the ability to do sport or improve sporting ability there. *Safety was mentioned as a frequent reason	0.44

			they did, and chosen after-school activities and how they got there. Approximate distances travelled were estimated based upon scaling of maps.	for not liking or avoiding certain areas (i.e. the presence of “scary people”) *Living close to facilities, and having space were important.	
14. Roult et al. 2016 Canada	Qualitative Focus groups	N=72 38 girls 34 boys 12-17 yrs	To analyse the spatial planning quality of recreation and sports facilities in the regional county municipality and identify the perceptions of local actors working or involved with youth regarding these spatial planning elements	*Security re. spatial planning and accessibility is a constraint to involvement in sport and recreation. * Take advantage of opportunities specific to rural areas (high-quality outdoor areas, social proximity between local actors and users of leisure services, activities easier to renew owing to their small size, etc.) in an attempt to better adapt to girls.	0.8
15. Van Hecke et al. 2016 Belgium	Qualitative Walk-along interviews Cross-sectional, Grounded theory	N=30 64% boys 12-16 yrs	To determine which social and physical environmental factors affect adolescents’ visitation and physical activity in POS in low-income neighbourhoods.	* Physical attributes that affected feelings of safety were linked to fear from girls of getting hurt during a physical activity (including sport) e.g., poor maintenance of sport facilities.	0.85
16. Amara & Henry 2010 UK	Qualitative Fieldwork Semi-structured Interviews Cross-sectional, Critical discourse analysis	N=12 adult leaders 11 males 1 female	To examine how Muslims in two specific local contexts make sense of the relationship between their religious (Islamic) identities and sporting interests and how local policy makers perceived and responded to the sporting needs of these Muslim communities.	* Provision of sports facilities in suitable (e.g. gender-segregated) environments. * Separate gender provision made yet lack care in implementation, which may have been a reflection of a lack of appreciation of the requirements of, or empathy for, such an approach even though these were not new initiatives.	0.8
17. Cortis 2009 Australia	Qualitative Interview Focus groups Cross-sectional	Interviews N=15 NSO’s Focus groups N = 12 (94 females, late teen to in their 70’s)	To explore how two key groups view inclusion and diversity in sport and recreation: representatives of stakeholder organisations, and culturally diverse women themselves.	*Cultural appropriateness of sporting spaces, venues (including commercial gyms and pools) present barriers by failing to cater for diverse practices of female bodily expression/ culturally inappropriate spaces. *Deterred from attending a women’s only gym because the facility lacked a fully appropriate design and fit out - the change rooms didn’t offer an appropriate level of privacy. *Lack of privacy not only turn some women away from organised team sports, these also make it difficult or uncomfortable for them to participate in physical activities in public as well as commercial facilities. * Physical adaptations to improve privacy: putting doors on showers or changing rooms	0.35

					and blinds over windows and offering women only venues will go some way to promoting access and inclusion.	
<b>18.</b> Downward & Rasciute 2015 UK	Quantitative Cross-sectional	Sport: Questionnaire based on International Physical Activity Questionnaire Sport satisfaction: One item, rate overall satisfaction with sport provision in their local area o Number of facilities in Local Authorities: Active Places Survey (APLS).	N = 341,386 192,865 females 16 years and over Mean age (SD) = 48.9 (15.94) yrs	To examine the covariates of male and female decisions to participate in sport or not, and in particular, whether participation is of a sufficient frequency and intensity to achieve the desired contributions of sport to meeting health enhancing PA thresholds	*Satisfaction with sport facility provision significantly related to participation.	0.5
<b>19.</b> Kuppinger 2015 Germany	Qualitative Ethnographic fieldwork Cross-sectional		1 club	To analyse a Muslim women's sports club role and contribution in the construction of urban citizenship.	*A suitable pool, preferably somewhere in the centre of a building or with windows that could easily be covered. * The Club avoids proximity to mosques. * Pools in institutions for senior citizens or the like are the best choices as they are often "right under the gym, somewhere in the basement, and not visible from the outside."	0.3
<b>20.</b> Miles 2008 Data from 7 European cities	Quantitative Cross-sectional	Sport/Physical exercise: Single questionnaire item: "Which statement do you think best describes your amount of sports or physical exercise?"; Perceived safety: assessed by a single item Local neighborhood physical Disorder: based on inspectors' observations of three indicators of neighborhood disorder; Other indicators of the local neighborhood environment; proxy for residential density and whether the household was on a busy street; all were directly observed by the inspectors.	N = 2123 1380 females Overall sample median age = 48 years	To investigate whether neighborhood physical disorder is associated with respondents' readiness to encourage children to use local playgrounds as well as the respondents' own level of physical activity, and the extent to which perceived safety mediates the relationships.	* Living in a neighborhood with signs of low versus high physical disorder was associated with a significant increase in the risk of occasional versus no sport and exercise. The relative risks remained virtually the same whether perceived safety was in the model or not, suggesting the latter does not mediate the neighborhood physical disorder effect. * Neither living on a quiet street nor in areas of high residential density was associated with involvement in sport and exercise. * Perceived safety was not associated with sport and exercise.	0.9
<b>21.</b> Pascual et al.	Quantitative Questionnaire	Health Survey of the City of Madrid	N=6607 637 males / 758 females	To evaluate whether the availability of sports facilities helps explain the differences in physical inactivity	*Lower population density associated with physical inactivity (that is not participating in sport or other forms of physical activity).	0.8

2013 Spain			16-74 yrs	according to the economic context of the neighbourhood	*More green space associated with physical inactivity. *Fewer sporting facilities associated with physical inactivity.	
22. Sawrikar & Muir 2010 Australia	Qualitative Focus groups Cross-sectional	Six factor model of constraints	N=94 16-70 yrs	To understand why sport and recreational participation rates are lower for Indian women; to determine the perceived or experienced barriers that Indian women may face and how these compare to other ethnic minority women living in Australia; and, to outline how some of these barriers could be overcome to support the inclusion of Indian women and other ethnic minority women who face similar barriers	*Access constraints: the provision of appropriate facilities and transportation. *The availability of safe, comfortable and culturally appropriate sport facilities were identified as important influences on participation. * The most important issue was access to women-only exercise spaces, and private change room areas, especially for Muslim women. *Culturally inappropriate facilities generally pushed some groups of ethnic minority women into non-organised, informal physical activities e.g., walking. *Public transport to and from facilities, or having facilities close to home, was important to how the women could access sport opportunities.	0.8
23. Skowron, Stodolska, & Shinew 2008 U.S	Mixed Methods. Cross-sectional (Quantitative) and In-depth Interviews (Qualitative). Ecological Model	Constraints and attitudes: assessed via questionnaire Social support: modified Physical Activity Social Support Scale (PASS) ; PA: long form International PA questionnaire (IPAQ) Walking: short form IPAQ	N = 269 females (survey) 18-66 years; ave age = 30 years. 16 interviews 20-50 years	To examine leisure time physical activity (LTPA) among Latina women and to determine factors influencing their LTPA participation	*Qualitative findings identified women referred to sport, constraints included lack of childcare, lack of time, and not being able to afford to go to fitness/recreation facilities. Fear of unattended dogs and bad weather were also mentioned as important constraints.	0.75
24. Reis et al. 2008 US	Qualitative Cross-sectional In-depth interviews Direct observation, Grounded Theory		N=48 24 women 24 males 14-18 yrs/high school	To investigate environmental factors influencing the use of recreational facilities for physical activity by urban African-American adolescents.	*Yong women noted organised sport activities for their age group at public facilities were limited. *Women preferred sports based in parks near their homes or friends' homes because this offers a sense of security.	

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