Don't take down the monkey bars

Rapid systematic review of playground-related injuries

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Abstract

Objective To synthesize the available evidence on playground-related injuries and to determine the prevalence of these injuries in pediatric populations.

Data sources A rapid systematic review was conducted using PubMed, EMBASE, and the Cochrane Library, as well as the gray literature.

Study selection The search was limited to studies published between 2012 and 2016 and identified a total of 858 articles, of which 22 met our inclusion criteria: original quantitative studies published in peer-reviewed journals in the past 5 years, concerning unintentional injuries in playgrounds in children aged 0 to 18 years.

Synthesis Information was collected on study and injury characteristics, and the proportion of pediatric injuries related to playground activity was determined. Studies were performed in various countries and most were retrospective cohort studies. The prevalence of playground-related injury ranged from 2% to 34% (median 10%). Studies varied in the types of injuries investigated, including head injuries, genitourinary injuries, ocular and dental trauma, and various types of fractures. Most injuries were low severity.

Conclusion Although playgrounds are a common location where pediatric injuries occur, these injuries are relatively low in frequency and severity.

Editor's key points

- Playing outside has many benefits for children and is foundational to their physical, psychological, and social development. Playgrounds are a common venue for this type of play, but despite the known benefits, playground activity comes with the risk of incurring injury. The authors aimed to synthesize recent evidence to determine the prevalence of playground-related injuries.
- Although playgrounds are a common location for childhood injuries, the authors found that these injuries are relatively low in frequency and severity. Almost two-thirds of injuries are low-severity injuries, while about 30% are severe enough to prompt a medical consultation. In a minority of cases, injuries lead to emergency department visits, but rarely to hospitalization, and only a small proportion of children with playground-related injuries are likely to suffer any long-term sequelae.
- The risk of injury from playground activity must be weighed against the benefits that such activity provides for children. Playgrounds are a place where they can socialize, develop emotional intelligence, and reduce the risks of physical inactivity at a very low cost. It is also possible to reduce playground injuries simply with adult supervision.

Points de repère du rédacteur

- Jouer dehors est avantageux de plusieurs façons pour les enfants; cela joue un rôle fondamental dans leur développement physique, psychologique et social. Les enfants choisissent souvent les terrains de jeu pour s'amuser, mais malgré les avantages qu'ils en retirent, ce type d'activité présente certains risques de blessures. Les auteurs ont voulu faire un résumé des données scientifiques récentes à ce sujet afin d'établir la prévalence des blessures qui surviennent sur les terrains de jeu.
- Bien que des blessures surviennent sur les terrains de jeu, les auteurs ont observé qu'elles sont généralement peu fréquentes et rarement sévères. Environ les deux tiers d'entre elles sont de faible gravité, et seulement 30 % sont suffisamment sévères pour exiger une consultation médicale. Dans un petit nombre de cas, elles requièrent une visite à l'urgence, mais rarement une hospitalisation. De plus, il n'y a qu'une petite proportion des enfants blessés sur les terrains de jeu qui sont susceptibles de subir des séquelles à long terme.
- Le risque de blessures sur les terrains de jeu doit être évalué en tenant compte des avantages que cette activité procure. Le terrain de jeu est un endroit où les enfants peuvent socialiser, développer leur intelligence émotionnelle et réduire les risques liés à l'inactivité, et ce, à un coût minime. Il est d'ailleurs possible de réduire le nombre des blessures à ces endroits par la simple surveillance d'un adulte.

Ne supprimez pas les cages à grimper!

Une revue systématique rapide des blessures qui surviennent sur les terrains de jeu

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Résumé

Objectif Faire une synthèse des données actuellement disponibles sur les blessures qui surviennent sur des terrains de jeu et déterminer leur prévalence chez de jeunes enfants.

Sources des données On a effectué une revue systémique à l'aide des bases de données PubMed, Embase et Cochrane Library, mais à partir de la littérature grise.

Choix des études On a retenu uniquement les études scientifiques publiées entre 2012 et 2016 : on a ainsi repéré un total de 858 articles, parmi lesquels 22 étaient conformes à nos critères d'inclusion, soit des études quantitatives originales publiées dans des revues révisées par des pairs au cours des 5 dernières années et portant sur des blessures non intentionnelles survenues sur des terrains de jeu chez des jeunes de 0 à 18 ans.

Synthèse On a recueilli des renseignements sur les caractéristiques des études et des blessures et la proportion des blessures chez les enfants qui étaient liées aux activités sur les terrains de jeu. Ces études provenaient de divers pays, et la plupart étaient des études de cohorte rétrospectives. La prévalence de ce type de blessure variait entre 2 % et 34 % (médiane 10 %). Les études variaient quant au type de blessures étudiées, dont des blessures à la tête, à la région génito-urinaire, aux yeux et aux dents ainsi que plusieurs types de fractures. La plupart étaient de faible gravité.

Conclusion Même si les terrains de jeu sont souvent l'occasion de blessures, celles-ci sont relativement peu fréquentes et de faible gravité.

Playing outside has numerous benefits and helps meet 3 key needs of children: physical activity,[1] emotional well-being,[2] and development of motor competencies.[3] Playground activity is foundational in the psychological and physical development of children and might predict future participation in other sports and recreational activities.[4-6] In fact, physicians are increasingly prescribing outdoor play to address the current epidemic of physical inactivity.[7] Risky play—a novel categorization of play that involves potential risk of physical injury—provides children with exhilarating positive emotions and exposes them to situations they might have once feared. As their coping skills improve, they are able to master situations and cease to fear them.[8] Risky play has been shown to be important for children's health, development, learning, social behaviour, self-esteem, independence, conflict resolution, risk detection, and risk competence[8-12]; playgrounds are a common venue for this type of play. Activities such as climbing, jumping, balancing, swinging, and running become essential aspects of a child's growth and development.

Although playground activity has known benefits, it comes with the risk of incurring a playground-related injury. In Canada, playground falls account for approximately 1500 hospitalizations each year.[13] An estimated 214 883 playground injuries occur in the United States each year, representing around 353 injuries per 100 000 children aged 14 years and younger.[14] Based on the reporting of playground-related injuries from government and media sources, it is possible that parents, playground supervisors, and other caregivers limit playground participation. Indeed, some municipalities are closing playgrounds or dismantling their equipment owing to fear of injuries and liability.[1,15] In order to inform the current knowledge regarding playground-related injuries, we conducted a rapid systematic review to synthesize the available evidence on playground-related injuries and to determine the prevalence of these injuries in pediatric populations.

Methods

A rapid systematic review of literature published within the past 5 years (2012 to 2016) was conducted to create an evidential summary of the most recent relevant research on playground-related injuries.

Data sources

We defined a playground as a piece of land used especially by children and usually equipped with facilities for recreation including slides, swings, monkey bars, seesaws, teeter-totters, jungle gyms, and climbing frames. A search strategy was built using a combination of search terms (MeSH, EMTREE) and key words including *child, playground,* and *injury* (search strategy is available from the corresponding author on request). This strategy was used to search 3 online databases (PubMed, EMBASE, Cochrane Library). We also used key words to search the gray literature for relevant publications using Google and Google Scholar. Searches were performed between June and September 2016.

Study selection

Original articles and abstracts published in peer-reviewed journals were eligible, as well as published reports from the gray literature. Our inclusion criteria were as follows:

- quantitative studies,
- articles published in the past 5 years (2012 to 2016),
- studies concerning childhood injuries,
- children aged 0 to 18 years,
- unintentional injuries, and
- injuries happening in playgrounds.

Case reports, articles written in languages other than English, and reports on bacterial outbreaks were excluded.

Review process

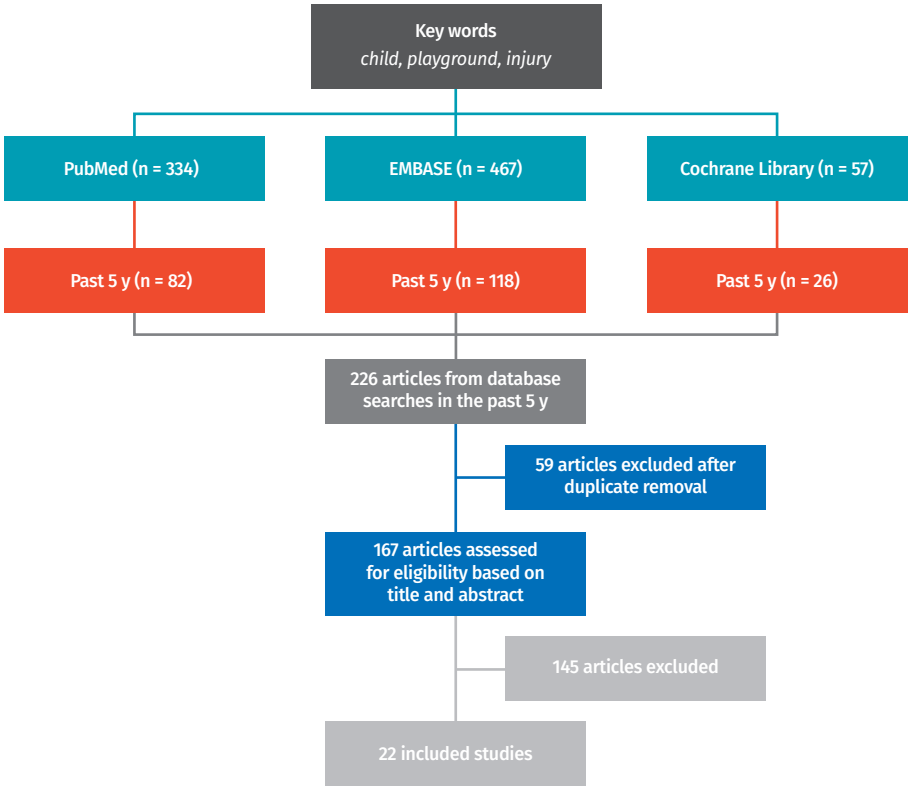
After performing the search, duplicates were removed, and the remaining articles were screened by title and abstract. Eligibility of articles for inclusion in the review was assessed by 1 team member (one of N.B., C.B., L.L.) and supplemented by an intercoder validation procedure whereby disagreements were resolved by discussion between 2 of those team members. Full-text articles were obtained if the title or abstract did not contain sufficient information for assessment against the inclusion criteria. The articles that met the inclusion criteria were split between 2 reviewers (C.B., N.B.), and data extraction was performed by each reviewer individually for their assigned articles, with the addition of intercoder validation. Information from studies selected for inclusion were entered in a data extraction sheet that included year, study design, cohort description, sample size, demographic characteristics, and number and type of playground injuries. We searched the references of included articles and relevant systematic reviews for additional articles. A narrative synthesis approach was used to present the results of the review.

Synthesis

In total, 858 articles were identified by the search strategy. We removed duplicates and excluded articles published before 2012, leaving 167 articles for screening by title and abstract. There were 22 articles that met our inclusion criteria and that were included in the review (**Figure 1**).

The characteristics of included studies are shown in **Table 1**.[14,16-36] Most were retrospective cohort studies, with sample sizes between 227 and 2 566 178 patients. Study durations were as short as 1 year and as long as 16 years. The prevalence of playground-related injuries ranged from 2% to 34% (median 10%).[31,35] Among

Figure 1. Search strategy



individual studies, male children accounted for between 45% and 70% of patients (median 62%).[16,36]

General epidemiology

Playground-related injuries tend to occur more often during early childhood. An Australian study found that playground falls were the leading cause of injuries leading to hospitalization among children aged 0 to 4 years, with 91.6 hospitalizations per 100000 individuals in this age group.[32] Using 2001 to 2008 data from the National Electronic Injury Surveillance System (NEISS) in the United States, Schwebel and Brezausek determined that playgrounds were the most common cause of injury in children aged 1 to 9 years while participating in sport or recreational activities.[33] A summary report of Canadian injury data showed that the highest number of fall-related hospitalizations in 2010 was due to falls in playgrounds.[13] Similarly, a Finnish study found that falls on the playground were the most common cause of injury in children aged 0 to 16 years, accounting for 34% of all injuries.[35] A study from Cameroon also observed that falls were the most common injury mechanism in children younger than 16 years of age, and that these injuries occurred most often on playgrounds.[21] In a study of injuries presenting at a primary care setting in Oman, playgrounds were the second most common location where injuries occurred, accounting for 10.2% of injuries.[16] Among other studies, playgrounds were the second most frequent cause of pediatric injuries in 3 studies,[23,24,28] the third most frequent cause of injury in 2 studies,[22,34] and the fourth most frequent cause of injury in 2 studies.[25,27]

Injury types

Studies examined various types of injuries that occurred on playgrounds. Five studies reported on various types of fractures,[25,27,30,34,35] 5 studies described head injuries occurring on playgrounds,[14,17,22,29,31] and 2 studies reported on genitourinary injuries.[18,36]

Fractures. Joeris et al reported that falls were the leading cause of long-bone fractures (27%), and leisure activities accounted for 25% of pediatric fractures; only 11% of fractures were caused by playground accidents.[25] Shah et al investigated wrist fractures in children using NEISS data from 1998 to 2013; they observed that 8% of wrist fractures were associated with monkey bars, playground gyms, or other playground climbing apparatus, and that wrist fractures were most common in

Table 1. Characteristics of included studies

AUTHOR, YEAR	COUNTRY	RESEARCH DESIGN	DEPENDENT VARIABLE
Al-Balushi et al,[16] 2012	Oman	Cross-sectional pilot study	Rate, type, and cause of injury
Andersson et al,[17] 2012	Sweden	Retrospective analysis	Mild traumatic brain injury
Bagga et al,[18] 2013	United States	Retrospective cohort study	Acute genitourinary injury
Branson et al,[19] 2012	Canada	Retrospective cohort study	Playground surface injury rates
Brussoni et al,[20] 2015	8 countries	Systematic review	Health in children
Cheng et al,[14] 2016	United States	Retrospective cohort study	ED visits for nonfatal, playground-related traumatic brain injury
Chichom-Mefire and Fokou,[21] 2013	Cameroon	Retrospective cohort study	Epidemiology of pediatric injury
Constantinidou and Argyrou,[22] 2012	Greece	Cross-sectional study	Traumatic brain injury
Dulal et al,[23] 2012	Nepal	Retrospective review	Epidemiology of ocular trauma
Janssens et al,[24] 2014	Netherlands	Retrospective cohort study	Moderate to severe pediatric trauma
Joeris et al,[25] 2014	Switzerland	Retrospective cohort study	Epidemiology of pediatric long-bone fractures
Keays and Skinner,[26] 2012	Canada	Case-control study	Playground-related injuries
Lam et al,[27] 2013	Singapore	Prospective consecutive study	Playground risk factors and severity of fractures
Lexomboon et al,[28] 2016	Sweden	Retrospective cohort study	Incidence of injuries to permanent incisors
Mihić et al,[29] 2012	Croatia	Retrospective study	Prevalence of head injuries
Nakaniida et al,[30] 2014	United States	Retrospective study	Pediatric orthopedic injuries requiring hospitalization, the main causes of these injuries, and their economic burden to health care cost
Samuel et al,[31] 2015	Israel	Cohort study	Severity of head injuries
Schmertmann et al,[32] 2012	Australia	Retrospective study	Injury submechanisms and epidemiologic profile of leading causes of injury in children 0-4 y
Schwebel and Brezausek,[33] 2014	United States	Descriptive retrospective epidemiologic study	Incidence of 39 sport and recreational injuries
Shah et al,[34] 2015	United States	Retrospective cohort study	Epidemiology of pediatric wrist fractures
Sinikumpu et al,[35] 2013	Finland	Retrospective study	Forearm shaft fractures
Tasian et al,[36] 2012	United States	Retrospective study	Epidemiology of genitourinary injuries

ED—emergency department.

children aged 3 to 10 years.[34] When examining a 16-year trend, the authors reported that the incidence of playground-related wrist fractures has remained relatively unchanged overall. Another study of 2006 data from the Kids' Inpatient Database in the United States observed that a fall from playground equipment was the leading cause of humerus fractures (21.9%) and radius fractures (11.3%).[30] In a European study conducted from 1997 to 2009, playground falls caused 6.2% of both-bone forearm fractures and were the most common cause of injury for both boys (36%) and girls (30%).[35] Furthermore, in their investigation on the severity of playground-related fractures in Singapore, Lam et al reported that any amount of supervision at the time of injury resulted in a lower likelihood of serious fractures (ie, requiring reduction or operative fixation), although supervision by a parent or sibling resulted in a lower likelihood of serious fractures than supervision by grandparents or maids.[27] While Lam and colleagues also observed that increased patient weight was directly related to the severity of fractures, they found no correlation between fracture severity and the height or type of playground equipment.

Brain injuries. In their investigation of mild traumatic brain injuries (TBI), Andersson et al found that falls from a height were the most common cause, and playgrounds accounted for 8% of the locations where such accidents occurred.[17] Another study examined the prevalence of TBI in school-aged children and found that blows to the head were the most common risk factor for persistent alteration of mental status, with 9% of children experiencing blows to the head receiving

them in playgrounds.[22] According to Mihić et al, 5.7% of head injuries occurred at the playground, and these injuries were most frequently inflicted by hitting.[29] Falls from a playground device accounted for 2% of all falls among mild head injury patients in Israel aged 0 to 2 years.[31] Finally, Cheng et al examined 2001 to 2013 data from the NEISS and found that, in the United States, there was an annual average of 21 101 children 14 years of age and younger who were treated in emergency departments for playground-related TBI.[14] Overall, 95.6% of these patients were treated and released without hospitalization, suggesting that the severity of injury was relatively minor in most cases.[14]

Other traumatic injuries. Dental, ocular, and genitourinary traumas have also been investigated in playground injury studies. Playground equipment such as swings, slides, rocking horses, and climbing structures, as well as jumping on trampolines, accounted for 13.4% of dental trauma cases in children 8 to 10 years of age.[28] Playgrounds were also the second most common location where ocular traumas occurred in pediatric patients, with 25.3% of these injuries sustained on the playground.[23] Bagga et al and Tasian et al used NEISS data from 2002 to 2010 to examine genitourinary injuries due to falls from playground equipment. Bagga et al reported that these injuries occurred in 16% of children aged 4 to 7 years and in 12% of children aged 8 and older,[18] while Tasian et al found that 6% of genitourinary injuries in children younger than 18 years of age who presented to emergency departments were caused by playground equipment.[36]

Effect of playground setting. Using emergency-based surveillance data for Canadian children aged 3 to 11 years, Keays and Skinner compared the severity of playground-related injuries occurring at home versus in public settings.[26] Although fewer playground injuries occurred at home (16% vs 84%), children who fell from playground equipment at home were more likely to have severe injuries (odds ratio [OR] of 1.30, 95% CI 1.23 to 1.37) and fractures (OR=1.47, 95% CI 1.39 to 1.55). Children 3 to 5 years of age who fell from a slide at home had the greatest odds of severe injury (OR=1.72, 95% CI 1.41 to 2.09) and fractures (OR=2.17, 95% 1.79 to 2.64) compared with children who fell off the slide in a public playground.

Effect of playground surface and season. To determine the effect of season on playground surface injury rates, Branson et al analyzed data from student incident report forms at elementary schools in the Canadian province of Alberta.[19] Equipment on which injuries occurred most frequently were the monkey bars (32.1%) and the slide (12.7%). Most injuries were of low severity (63.2%), and the most common injuries observed were abrasions, bruises, and inflammation (44.8%). Playground surface types included natural rock, crushed rock, poured-in-place, and rubber crumb. Compared with natural rock, rubber crumb surfacing had a significantly lower rate of injury in the spring (rate ratio of 0.34, 95% CI 0.12 to 0.98). No other season-surface comparisons were statistically significant.

Discussion

The results of this rapid systematic review demonstrate that playgrounds are a common site of pediatric injury, especially among children earlier in their development. The prevalence of playground-related injuries among included studies ranged from 2% to 34% (median 10%). Most of the injury types examined were low severity. These findings suggest that although playgrounds are a common location of childhood injuries, these injuries are relatively low in frequency and severity. It is important to note that it is possible to reduce playground injuries simply with adult supervision.[27]

Although playground activity was the leading cause of pediatric injury in some studies, other studies demonstrated that rates of serious injury can be greater from activities such as playing at home or cycling. In 2010, transport injuries were the top cause of death in Canadian children aged 0 to 14 years.[13] With respect to fractures, more were caused by motor vehicle collisions, cycling, or leisure activities than by playground falls.[25] Moreover, while TBI ranks as the fifth most common injury occurring in playgrounds, children are still more at risk of suffering TBI while at home, at school, or in traffic.[17,29] Likewise, dental traumas are caused more often by simply slipping and falling, ocular injuries occur more frequently at home than on playgrounds, and genitourinary injuries are caused more often by using sporting equipment or falling from furniture.[18,23,28]

Furthermore, low-severity injuries account for 63% of injuries on Canadian playgrounds.[19] About 30% of playground injuries are severe enough to prompt a medical consultation, while less than 2% require transportation by ambulance.[19] In the United States, of all the children who visited an emergency department between 2001 and 2013 for playground-related injuries, more than 95% were treated and released without requiring further hospitalization.[14] These findings suggest that while playground injuries do occur, they are mainly associated with minor musculoskeletal injuries, cuts, and bruises (ie, minor injuries that necessitate little or no medical attention). In a minority of cases, injuries lead to emergency department visits, but rarely to hospitalization. In this modern orthopedic era, only a small proportion of children with playground-related injuries are likely to suffer any long-term sequelae.

Any decision to limit playground activity should be made in light of both the risks and the benefits. Play promotes interaction between children, which stimulates the

development of social skills such as conflict sensitivity, conflict resolution, sharing, turn-taking, negotiation, leadership, and maintaining peer relationships.[11,37-39] Free play also has psychological benefits: children enjoy it and it appears to reduce anxiety.[8,37,38] Play develops many qualities such as creativity, resilience, confidence, imagination, independence, self-control, and risk perception and management.[9,40-42] It is important to note that risky play does not imply the child is in danger, but rather that there is a situation where the outcome is unknown and children must decide on a course of action.[43,44] Being active on playgrounds also has benefits for physical health and is linked to better bone health, increased physical fitness, lower body mass index, a more favourable lipid profile, lower blood pressure, and protection against future chronic diseases.[45,46] Simply playing outside rather than inside increases physical activity in children, and the availability of parks and recreational facilities is also positively linked to physical activity.[47,48] Physical activity behaviour learned in childhood often carries on into adulthood.[4-6] Last, play at recess has been shown to be predictive of school achievement and the performance of cognitive tasks such as language, problem solving, and mathematic skills.[49,50]

Limitations and strengths

Certain limitations warrant cautious interpretation of this review of playground injury data. First, most studies were based on emergency department databases, so the total number of playground injuries might be underrepresented. Thus, more studies of playground injuries through direct observation are needed to increase our knowledge of these injuries. Next, surprisingly, none of the studies defined what they considered to be a playground, so their observations might not be comparable. The only key word we used to identify articles that reported playground-related injuries was *playground*. As we excluded articles published more than 5 years before our review, we might have missed useful articles. Also, data extraction was performed by a single coder. Finally, a rapid systematic review methodology (rather than systematic review) was used to optimize time and resources while preserving essential information. Therefore, minimal critical appraisal and evaluation of variations in the research design of the included studies were performed in order to weigh the included articles. Despite these limitations, this review has several strengths. We conducted a comprehensive search in 3 online databases and the gray literature, we systematically applied selection and extraction criteria, and we included studies performed in any country. Also, as this review identified a large number of articles published only over a 5-year period, it shows that it could be possible to conduct a larger review that could include a thorough meta-analysis.

Conclusion

The prevalence of playground-related injuries among included studies ranged from 2% to 34%, with a median of 10%. Although playgrounds are a common location for childhood injuries, these injuries are relatively low in frequency and severity. The risk of injury from playground activity must be weighed against the benefits that such activity provides for children. Playgrounds are a place where they can socialize, develop emotional intelligence, and reduce the risks of physical inactivity at a very low cost. Given the current state of physical and mental health among children, it is counterintuitive to isolate playground injuries as a serious cause for parental concern. More effort should be made to evaluate the relative risk associated with various forms of play and to provide an objective measure from which parents can make an informed choice. It could also be interesting to conduct a similar review that would try to explore how we could further decrease the risk of injuries in playgrounds by looking at the effect of numerous factors such as playground design, setting, and parental supervision.

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Contributors

Mr N. Bergeron, Ms C. Bergeron, and **Dr Lapointe** participated in designing the study protocol, collected data, carried out the initial analyses, and reviewed and revised the final version of the manuscript. **Dr Kriellaars, Mr Aubertin,** and **Ms Tanenbaum** thought of the idea of conducting the rapid review, participated in designing the study protocol, edited the manuscript, and reviewed and revised the final version of the manuscript. **Dr Fleet** was the principal supervisor of the project, contributed to the original idea of conducting the rapid review with other co-authors, and participated in designing the study protocol, writing the initial manuscript drafts with co-authors, and reviewing and revising the final version of the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Competing interests

None declared

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