


Literature Review:

Sport and Physical Activity

for Children with Visual Impairments

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Introduction

Participation in sport and physical activity provides important physical, emotional, and mental benefits for children. This literature review examines how physical activity positively impacts children with a visual impairment, describes some of the barriers they face in participating in physical activity, explores solutions that have been recommended to remove those barriers, and reviews recommendations for improving teaching mechanisms. The research presented in this review demonstrates the importance of inclusive physical activity in promoting the lifelong wellbeing of children with visual impairment or blindness.

Physical Activity (PA) is defined as being any leisure or non-leisure body movement resulting in an increased energy output from a resting condition (Warburton, Nicol, & Bredin, 2006). Physical activity in childhood and adulthood is a modifiable risk factor for chronic diseases such as diabetes mellitus, obesity, hypertension, bone and joint diseases, depression, and many more. According to Warburton et al. (2006) being involved in physical activity was associated with a greater than 50% reduction in the risks of chronic diseases. Physical activity can aid in managing diabetes and to help regulate blood glucose levels and boost the body's sensitivity to insulin (Warburton et al., 2006). Regular physical activity can reduce the incidence of bone fractures due to increased bone mineral density from weight-bearing physical activity (Warburton et al., 2006). Other benefits of physical activity include improved weight control, increased good cholesterol, decreased bad cholesterol, reducing blood pressure and improving blood flow (Warburton et al., 2006). Routine PA also reduces stress, depression, anxiety and contributes to an overall improvement in psychological well-being (Warburton et al, 2006).

Physical activity can aid in and prevent psychiatric conditions such as depression, anxiety, low confidence and improve self-efficacy (Peluso & Guerra de Andrade, 2005). PA (Physical Activity) has been proven to improve overall mood, as well as positive improvements in self-esteem (Peluso & Guerra de Andrade, 2005). It has been stated that the reason PA improves mental health and improves psychiatric conditions are due to the social interactions often involved in PA and sport participation (Peluso & Guerra de Andrade, 2005). Individuals and children involved in PA and sport often gain social relationships with other individuals, teammates, and coaches (Peluso & Guerra de Andrade, 2005). These social relationships help to foster mutual support and play an important role in aiding the positive effects of PA on mental health (Peluso & Guerra de Andrade, 2005). Social interaction in children is important for child development and allows for expansion of empathy, communication skills, creativity, language skills and confidence (Peluso & Guerra de Andrade, 2005). Therefore, it is important for children to participate in PA and sport to allow for improvements of both physical and mental health.

The first set of physical activity guidelines for children was established in 2002 (Janssen & LeBlanc, 2010). According to these guidelines, children need to receive 60 minutes of moderate to vigorous PA (MVPA) per day. Furthermore, moderate activity included brisk walking, skating, and bike riding and vigorous physical activity included running, soccer, and basketball as examples. Janssen & LeBlanc (2010) indicated while 60 minutes per day is the goal, even the slightest physical activity still provides benefits. Moreover, as little as 2-3 hours per week of MVPA was associated with health benefits (Janssen & LeBlanc, 2010). The conclusion was that more physical activity was better and had more health benefits, but some PA was better than none (Warburton et al., 2006). According to the guidelines, aerobic exercise

should make up the majority of children's PA, but muscle and bone strengthening exercise needs to be included as well for at least three days per week.

Defining visual impairment

According to the World Health Organization (2019), there are 2 methods used for defining and classifying blindness and low vision in children. The first method refers to the anatomical site that is affected, such as the whole globe, cornea, lens, retina, optic nerve, and conditions where the eye appears normal (World Health Organization, 2019). The second method refers to the aetiological classification, defining blindness according to the underlying cause such as hereditary, intrauterine, perinatal, childhood, and unknown. Moreover, according to Gogate & Gilbert (2007), it appears that the most common anatomical area affected is the retina and the most common underlying causes is hereditary.

Next, children may be categorized depending on the severity of the visual impairment. Good vision is defined as a visual acuity of 20/20 as a standard. A person with 20/20 visual acuity can stand 20 feet away from a Snellen vision chart and can read what a normal person can read at 20 feet away. Blindness 1 or B1 is defined as a no light perception in either eye, or slight light perception with an inability to recognize the shape of a hand in any direction or distance (International Blind Sports Federation [IBSF], 2020). B2 is defined as a visual acuity of 20/600 and approximately 3-5% of vison remaining (IBSF, 2020; Dandona & Dandona, 2006). A visual acuity of 20/600 indicates that if an individual stands 20 feet away from the Snellen vision chart, the individual can see what a person with normal vision can see at 600 feet away. B3 is defined as a visual acuity between 20/600 and 20/200 and is considered partially sighted (IBSF,

2020). B4 is defined as a visual acuity between 20/200 and 20/80 and is less than 25% of normal vision (IBSF, 2020; Dandona & Dandona, 2006). In addition to the severity, it is also important to be aware that these visual acuities mentioned previously can occur in both eyes, one eye, and both eyes having different acuities (Dandona & Dandona, 2006). This makes each child unique in the presentation of their visual impairment.

Barriers to physical activity for children with visual impairments

It is important for children with a visual impairment to participate in physical activity to maintain health throughout their lives. However, children with a visual impairment do not have equal opportunities to participate in PA and become more sedentary compared to sighted children (Perkins, Columna, Lieberman, & Bailey, 2013). There is an array of barriers that prevent children with a visual impairment from participating in sport and PA. These barriers include the lack of sport opportunities, lack of knowledge from physical education teachers, lack of appropriate facilities, and a lack of parental knowledge of PA resources (Perkins et al., 2013).

In the study conducted by Perkins and colleagues in 2013, the aim was to evaluate the parent's perceptions of PA for their children with a visual impairment. Children aged 3 to 18 were encouraged to participate via a convenience sample that was taken from a local organization of the association for the blind and visually impaired. Parents were contacted via telephone and received an explanation of the purpose of the study. Overall, there were 11 parent participants, 2 participant's children had a mild disability along with their visual impairment. There were 8 children overall, with 5 being female and 3 being male (Perkins et al.,

2013). It was also noted in this study that 5 children were classified as blind, and 3 were classified as having a visual acuity of 20/200 (Perkins et al., 2013).

Once the participants were selected in the Perkins et al. (2013) study, the parents underwent a one-on-one semi-structured interview that lasted roughly 60-90 minutes. The interviews were audio recorded to ensure accuracy, validity of content, and to allow for future analysis. Sample interview questions were included in the article, and a few examples include:

1) How often do you participate in physical activity with your child, and what types of activities do you do?
2) Where does recreation involving the whole family or some of the family take place?
3) Who usually takes part in these activities?

Perkins et al. (2013) was able to establish themes and subthemes after the research was conducted and analyzed. It was evident that the parents wanted their children to learn activities similar to their children's sighted peers and to be physically fit throughout life (Perkins et al., 2013). The parents also thought that by participating in PA their children would gain confidence and make new friends (Perkins et al., 2013). The parents listed multiple barriers for their children with visual impairments when it came to be participating in physical activity, such as lack of opportunities, lack of communication, and lack of physical activity educator's expertise on visual impairments (Perkins et al., 2013). They also stated that they needed to expend a considerable amount of time searching for recreational opportunities for their children with a visual impairment. The participants also noted that lack of communication with physical education teachers was a barrier to their children's activity, and that if there was

better communication that they could work on certain skills at home to aid them at school (Perkins et al., 2013). Finally, the parents in the Perkins et al. (2013) study stated that the physical education teachers lacked knowledge on making PA more inclusive for children with a visual impairment, and that the teachers were geared towards working with sighted children.

The parental participants provided solutions to these barriers in the Perkins et al. (2013) study. They discussed the importance of making adaptations for children with visual impairments and giving precise and descriptive directions during physical education instruction. They suggested that teachers need to learn how to make PA more inclusive and learn to adapt activities so that children with a visual impairment can participate, since a lack of knowledge leads to low expectations for these children (Perkins et al., 2013). The parents also noted that children with a visual impairment need the opportunity to experience physical activities, or else they will not know whether they enjoy them (Perkins et al., 2013).

Finally, a potential barrier to PA for children with visual impairments relates to "dignity of risk." Ball et al. (2021) introduced this concept and how it impacts children with visual impairments in physical education. The central argument is that all children must learn to make informed decisions about reasonable risk, no matter their perceived abilities;
physical education is a setting where risk may be significant, but sheltering children from physical activity because of perceived risk can have lasting effects such as a lack of self-determination and independence (Ball et al., 2021). Quoting other research, the authors explain that individuals with visual impairments report feelings of invisibility, worthlessness, and being ignored when they are not involved in activities with their peers (Ball et al., 2021). Furthermore, when exclusion from physical activity is supported by teachers and other

influential people in a child's life, the child receives the message that exclusion from such activities is acceptable and even desirable (Ball et al., 2021). The concept of dignity of risk emphasizes that life experiences come with risk, and individuals, no matter their age or ability, should be supported to experience success and failure (Ball et al., 2021). The authors conclude that students with visual impairments should be provided the opportunity to make their own decisions when it comes to assessing risk. At the same time, vision specialists and/or physical educators can make precautions to ensure adequate safety (Ball et al., 2021).

Physical fitness of children with visual impairments

Significant research has been conducted into the physical fitness levels of children with visual impairments or blindness. This research has consistently found that children with visual impairments or blindness have lower physical activity levels than children with full sight, which correlates with lower physical fitness levels. Studies have also observed the link between visual impairment and blindness in children and reduced motor skill development, which further serves to negatively impact their physical activity levels.

A study conducted by Lieberman, Byrne, Mattern, Watt & Fernandez-Vivo (2010) sought to determine health-related fitness levels in children with a visual impairment. Using the Brockport Physical Fitness Test (BPFT), the passing rates on five subsets of the test were compared to see which subsets were the weakest in children with a visual impairment. Lieberman et al. (2010) had a total of 152 children with 91 being boys and 61 being girls, with an age range of 10-17. The participants ranged from a visual impairment category of B1 to B4 (previously defined in an earlier section). The BPFT included:

1) Sit and reach test to determine flexibility
2) One mile run to measure cardiovascular fitness
3) Push-up test to determine upper body musculature endurance
4) Curl-up test to evaluate abdominal musculature endurance
5) Two site skinfold measure to estimate body composition

The study found there were no significant results between boys and girls on any component of health-related fitness (Liberman et al., 2010). The authors concluded that there were weaknesses among all the children tested, and that upper-body strength, cardiovascular endurance, and body composition were areas of concern for children with visual impairments (Liberman et al., 2010).

A study conducted by Houwen, Hartman & Visscher (2010) aimed to identify the differences in motor skills and physical fitness between children with and without a visual impairment (Houwen et al., 2010). The study included 60 children with 40 boys and 20 girls between the ages of 6-12 years of age living in the Netherlands. Using the Eurofit European Test of Physical Fitness (Council of Europe, 1998), the children were tested on cardiovascular endurance, muscle endurance, strength, flexibility, power, speed and coordination, as well as body mass (Houwen et al., 2010). The study found that there were significant differences between the children with and without visual impairments. The children with a visual impairment had significantly lower speed, cardiovascular endurance and strength compared to the children without a visual impairment, as well as higher level of body fat (Houwen et al., 2010). The other items tested were not found to be significant (Houwen et al., 2010). The study concluded that

delayed motor skill acquisition occurred with children with a visual impairment as early as primary school.

Participation in physical activity by children with visual impairments

In general, individuals with a disability are less physically fit and participate in less physical activity compared to individuals without any disabilities (Holbrook, Caputo, Perry, Fuller, & Morgan, 2009). Decreased PA in individuals with a disability increases the risk of health complications (Holbrook et al., 2009). As discussed above, studies also indicate that children with a visual impairment have lower levels of cardiovascular fitness, unhealthy body composition, and low levels of PA compared to sighted children (Holbrook et al., 2009).

A study conducted by Houwen, Hartman, & Visscher (2009) aimed to examine the PA levels of children with and without a visual impairment, and the variables that would impact the differences. These variables included examining the severity of visual impairment, body composition, and the interrelationships of children with and without visual impairments. The 48 children involved in the study were recruited from an educational organization and were between the ages of 6 to 12 years (Houwen et al., 2009). The children wore accelerometer monitors on their hips during all waking hours for eight consecutive weeks (Houwen et al., 2008). The accelerometer monitors were used to measure PA and were set to record movement counts in 1-minute timeframes (Houwen et al., 2009).

Houwen et al. (2009) concluded that children with a visual impairment spent less time in light or moderate to vigorous PA, and more time being sedentary, compared to sighted

children. They also concluded that the children with a visual impairment who had a better visual acuity (between 20/60 and 20/200) spent less time being sedentary and more time engaging in some form of PA compared to the children that had lower visual acuities (Houwen et al., 2009). Significant differences in body composition were found. The children with a higher Body Mass Index (BMI) and higher fat percentages were had a more sedentary lifestyle and were less physically fit (Houwen et al., 2009). The authors noted that it is important to ensure that children with a visual impairment engage in physical activity and to reduce being sedentary to ensure a healthy lifestyle.

Another compelling study that measured the activity levels of visually impaired children was conducted by Aslan, Basakci, & Kitis (2012). This study included gender and level of vision as variables. The study involved 30 children between the ages of 8-16, of which 11 were girls and 19 were boys (Aslan et al., 2012). The children were recruited from a special primary/secondary school for the blind, and the children had no other disabilities or communication restrictions (Aslan et al., 2012). The children were evaluated using a 24-hour activity diary, where they would record their PA for two weekdays and one weekend day within the same week (Aslan et al., 2012). A one-mile run/walk test was also used to assess the children on their cardiorespiratory fitness, where they were assisted by a sighted partner when running or walking (Aslan et al., 2012).

The results for the Aslan et al. (2012) study concluded that there were significant differences between the boys and girls. It was particularly evident that boys with lower vision spent more time in light and moderate PA compared to girls with low vision in the study (Aslan

et al., 2012). It was also noted that none of the children—boys or girls—engaged in vigorous PA (Aslan et al., 2012) necessary for certain health benefits. No significant results were observed between children with low vision or blindness when it came to the total amount of time spent in total PA, or the time spent in light, moderate, or vigorous PA (Aslan et al., 2012).

Ayvazoglu, Oh, & Kozub (2006) organized a study to evaluate the PA levels in children with a visual impairment from a family perspective. Ayvazoglu et al. (2012) describes how PA is an important preventative measure for other adulthood diseases and conditions, such as osteoporosis. Moreover, PA contributes to an improved quality of life, increased attention, improved mental health, and the development of skills to aid in activities of daily living (Ayvazoglu et al., 2012). However, there are often barriers that children with a visual impairment face when trying to reap these benefits of PA, and often cannot engage in any meaningful activities (Ayvazoglu et al., 2012). The barriers then contribute to poor balance, delayed motor development, poor coordination, and ineffective gait in children with a visual impairment (Ayvazoglu et al., 2012). Therefore, Ayvazoglu et al. (2012) wanted to look at the PA levels of parents, since it is potentially linked to the patterns found in their children.

Six school aged children from five different families who had a visual impairment, along with their siblings (without impairment) and parents were included in this study (Ayvazoglu et al., 2012). The children were recruited from a School for the Blind, and the children had no other pre-existing disability (Ayvazoglu et al., 2012). Two of the children were classified as B1, one child was classified as B2, and the other three children were classified as B3 (Ayvazoglu et al., 2012). These definitions can be found in an earlier section of this paper for reference. All

children, their siblings, and their parents wore activity monitors for a period of one week, except for when sleeping and when in water (Ayvazoglu et al., 2012). Parents and the children with a visual impairment were also interviewed to determine how they felt regarding PA, and any potential barriers to participating in PA (Ayvazoglu et al., 2012).

The results from the Ayvazoglu et al. (2012) study indicated that the older children with a visual impairment were less active than the younger children with a visual impairment. It was also noted that none of the parents participated in moderate to vigorous PA together with their child with a visual impairment (Ayvazoglu et al., 2012). Siblings were found to participate in moderate to vigorous PA with their sibling with the visual impairment (Ayvazoglu et al., 2012). After the interview was conducted, the parents stated that PA for their children was important, but they were concerned over the safety of their child with a visual impairment (Ayvazoglu et al., 2012). The parents concluded that they felt more protective over their child with a visual impairment compared to their children who had full vision (Ayvazoglu et al., 2012). The parents wanted the school to teach their children with a visual impairment about PA and opportunities in the community, and the parents wanted to become more aware on how to find opportunities and resources themselves (Ayvazoglu et al., 2012).

Overall, research regarding physical activity participation in children with a visual impairment finds common conclusions. Children with a visual impairment engage in less physical activity and adopt a more sedentary lifestyle. This sedentary lifestyle can lead to an increased risk of health-related concerns, and as well as decreased motor skills such as balance, coordination, and gait efficiency. There are many barriers that prevent children with a visual

impairment from engaging in PA, and lack of opportunities and knowledge for these children hinder them from engaging in PA. Children with a lower visual acuity are especially vulnerable to a sedentary lifestyle compared to those with higher visual acuity. Sex differences between girls as boys also impact engagement in some forms of PA. These issues need to be addressed to increase PA in children with visual impairments in order to help them develop proficient motor skills that can be carried into adulthood and ultimately support lifelong health and wellbeing.

Motor skill learning and development in children with visual impairment

Motor skills are the ability to make an intentional movement with certainty using the body's musculature and can involve large muscles (gross motor) and small muscles (fine motor) (Wagner, Haibach, & Lieberman, 2013). Children with high motor skills and competency are more likely participate in PA than a child with low motor skills and competency (Wagner et al., 2013). Moreover, there is evidence to suggest that children with a visual impairment are typically behind in motor skill acquisition and competency compared to sighted peers (Wagner et al., 2013). The research suggests that there needs to be a greater focus on teaching motor skills to children with a visual impairment to help them develop proficient and competent gross motor skills and fine motor skills.

In a study conducted by Wagner et al. (2013), investigated the efficacy of teaching gross motor skills to children with a visual impairment to develop their motor skill competencies. The study also aimed to determine any difference between the motor skills of children with a visual impairment and children without a visual impairment (Wagner et al., 2013). A total of 23

children with a visual impairment were included in this study with 14 being boys and 9 being girls with a mean age of 10 years (Wagner et al., 2013). Another 28 children without a visual impairment were also included as controls with 15 being boys and 13 being girls with a mean age of 9.4 years (Wagner et al., 2013). All children were recruited from local schools.

Wagner et al. (2013) used the Test of Gross Motor Development – Second Edition (TGMD-2) to determine the children's gross motor skills in the visual impaired group and the control group of sighted children. The TGMD-2 covers six locomotor skills (running, galloping, hopping, leaping, jumping, and sliding), as well as six control skills (striking, dribbling, catching, kicking, throwing, and rolling) (Wagner et al., 2013). The researchers recorded these skills with an HD flip video to assess each child's performance and analyze the results (Wagner et al., 2013).

The results for Wagner et al. (2013) study were broken down into two components tested from the TGMD-2, which was locomotion and object control. The children with a visual impairment showed significantly lower locomotor skill competency compared to the control group (Wagner et al., 2013). Furthermore, children with a visual impairment were worse in all locomotor skills tested in the study (Wagner et al., 2013). The authors explained that the difference in the running skill between both groups had to do with arm opposition to legs, flight period, landing position of the children with a visual impairment, and how these traits lacked proficiency (Wagner et al., 2013). Object control was also significantly worse in children with a visual impairment, and they performed worse on all object control skills in the study (Wagner et al., 2013).

Anthony (2013) also looked at the development of motor skills in children with a visual impairment. Anthony (2013) stated that vision normally plays an important role in the acquisition of motor skills in young children, via observation, but children with a visual impairment do not have the opportunity to observe actions and to mimic them to learn motor skills. Consequently, children with a visual impairment are more likely to experience delays in developing motor skills, especially in the early infancy/toddler years (Anthony, 2013). These delays include a lack of cruising along furniture, walking independently, and walking up/downstairs like typical sighted babies do (Anthony, 2013). Anthony (2013) concluded that it is crucial to introduce motor skill development in the early years of a child's life who has a visual impairment to avoid motor development delays.

A study by Brambring (2006) aimed to identify at what age do children with a visual impairment acquire their gross motor skills. This study involved two boys and two girls with visual impairments and no other underlying conditions. Out of the four children, three were completely blind and one had minimal light perception (Brambring, 2006). The gross motor skills acquired by age were compared to the standards of sighted children acquiring the same motor skills (Brambring, 2006). Moreover, the author used an instrument they had developed for this study specifically for children with a visual impairment (Brambring, 2006). The children in this study were tested on 29 gross motor skills that were common to the scale for children with a visual impairment (Brambring, 2006).

Brambring (2006) was able to conclude that 87% of the observed skills executed by the children with a visual impairment were delayed in the age of acquisition. Furthermore, the

delay varied from skill to skill and from child to child (Brambring, 2006). The delays were further categorized and broken down for further analysis, such as slight, strong, or extreme delays (Brambring, 2006). In this study, 13.8% of the observable delays were categorized as slight, 45% were categorized as strong, and 28% were categorized as extreme (Brambring, 2006). Overall, the study supported the claim that motor skills are delayed in children with a visual impairment and such delays need to be addressed.

Brambring (2006) proposed five primary functions and two secondary functions of vision in the acquisition of movement, which for a child with a visual impairment may cause the delay of acquiring gross motor skills:

- Primary Functions
    - Giving the child an incentive to move
    - Allowing the child to perceive their environment and the relationships of objects within it
    - Protecting the child by allowing them to anticipate dangers
    - Enabling control of movement
    - Proving the child feedback on their motor performance
- Secondary Function
    - Providing social feedback through observation of the reactions of others
    - Observing and imitating the movements of others

Aki, Atasavun, Turan, and Kayihan (2007) conducted a study looking at training programs for children with a visual impairment and how they impact motor skill development,

based on the evidence that locomotor milestones of children with a visual impairment are significantly delayed and need to be addressed. The study included 40 children with low vision from a primary school for the blind. Of the 40 children, 20 were randomly placed in a Training group and the other 20 were placed in a Home Training group (Aki et al., 2007). The Training group program was run by a physiotherapist while the Home Training group program was run by parents (Aki et al., 2007). The 20 children in each group comprised of 50% boys and 50% girls with a mean age of 8 years (Aki et al., 2007). The children also needed to be free of any other pre-existing disability to participate in this study and be categorized as having low vision (Aki et al., 2007).

To evaluate low vision acuity in the children, the Snellen Chart was used (Aki et al., 2007). The Snellen Chart contains letters of the alphabet arranged by line, with each line of the letters increasing in size from the bottom to the top of the chart (Aki et al., 2007). The children stood 20 feet away from the chart and were directed to read the smallest written line they could (Aki et al., 2007). To assess the motor skills of the children, the Bruininks Oseretsky Motor Proficiency Test – Short Form was used (Aki et al., 2007). The Bruininks Oseretsky Motor Proficiency Test – Short Form tested the following conditions:

1) Running speed and ability
2) Balance
3) Bilateral coordination
4) Strength
5) Upper limb coordination

6) Response speed
7) Visual motor control
8) Upper limb speed and dexterity

The Training group program run by the physiotherapist worked on the development of these test skills mentioned above (Aki et al., 2007). The Training group program ran for 3 months and was applied 3 days a week for an hour per session (Aki et al., 2007).

The Aki et al. (2007) study concluded that the motor skills in the children from the Training group program significantly improved on the eight components of the Bruininks Oseretsky Motor Proficiency Test – Short Form. The Home Training group program also saw improvements in the eight components, but the improvements were not as significant as the program run by a professional physiotherapist instead of parents (Aki et al., 2007). The study demonstrated that the motor skills needed for daily living activities can be improved when knowledgeable individuals aid in the development of the skills for children with a visual impairment (Aki et al., 2007). Activities done at home can also improve motor skill development in children with a visual impairment, but parents may lack the understanding of how to teach the necessary skills (Aki et al., 2007).

Assessing movement skills of children with visual impairments

As children with visual impairments tend to struggle with fundamental motor skills across their lifetime, frequent assessment is required (Brian et al., 2021). However, the time required to conduct full batteries of movement tests can be problematic. For instance, Brian et

al. (2021 observed that the full battery of 13 tests required by the Test of Gross Motor Development-3 is time-consuming to administer and score. Brian et al. (2021) therefore conducted a study to explore the psychometric properties of three, six-skill versions of the TGMD-3 with children with visual impairments. A total of 302 children participated (B1 = 27%, B2 = 20%, B3 = 38%, B4 = 15%) and the researchers examined the relationships between the motor skills and latent traits across the models.

Brian et al. (2021) found that scores from all three brief versions had acceptable global fit. They concluded that all three brief versions of the TGMD-3 could provide an efficient way to evaluate formative and summative gains with students in a manner that converges with the full battery (Brian et al, 2021). Consequently the researchers asserted that any of them could be used to evaluate physical education and activity programs and the extent to which students are making gains, thereby helping to support maximation of learning and meeting program goals.

Some assessment tests have been developed for specific sports and activities. One example is soccer, known more broadly in the world as football. Soccer (football) is one of the most popular sports for individuals with visual impairments worldwide. While there is growing interest toward developing blind soccer at both the grassroot and national levels, Pennell et al. (2022) recognized that no soccer-based talent identification or skill assessment had been developed or vetted in the United States. They designed a study to investigate the immediate measurement properties of scores from a novel soccer assessment in amateur skilled adolescents with visual impairments. A total of 57 adolescents with visual impairments completed the Blind Football Skills Test for Adolescents with Visual Impairments (BFST-AVI)

composed of five soccer-related tasks. The results suggested that total and individual assessment scores had acceptable levels of reliability and validity. Pennell et al. (2022) concluded that the BFST-AVI can be adopted immediately by grassroot organizations, national governing bodies, coaches, adapted and general physical educators, and associated practitioners for talent identification or general motor skill assessment purposes for amateur-skilled adolescents with visual impairments.

Learning characteristics of children with visual impairments

Physical activity is important for every individual to engage in, especially those with a disability (Lieberman, Ponchillia, & Ponchillia, 2013). Physical activity is often introduced in childhood to build proficiency in motor and sport skills (Lieberman et al., 2013), and childhood is the most crucial time for individuals to participate in PA as this is when the skills needed for activities of daily living are necessary (Lieberman et al., 2013). It is harder to learn important gross and fine motor skills in adulthood, though improvements can occur at a slower rate (Lieberman et al., 2013).

Most children have opportunities to learn through “incidental learning” that happens unconsciously through the visual observation of people and activities (Lieberman et al., 2013). Indeed, individuals learn the most about their surroundings through vision, and as much as 80% of learning is visual (Lieberman et al., 2013). This means that children with visual impairments do not have the opportunity to learn “incidentally” and must be taught in a verbal way or using their other senses (Lieberman et al., 2013). The use of their other senses is crucial for teaching PA and sport skills to children with a visual impairment (Lieberman et al., 2013).

Holbrook and Rosenblum (2017) also discuss how children with visual impairments learn and the senses they rely on. Hearing provides information about their environment, but it is incomplete: without vision they cannot perceive sounds as danger or harmless unless told (Holbrook and Rosenblum, 2017). Touch also provides information about their environment, but it requires that things be within their reach, and it often requires verbal confirmation (Holbrook and Rosenblum, 2017). Other learning characteristics for children with visual impairments include:

1) The need for concrete experience
2) Learning by doing
3) Unifying experiences

The need for concrete experience indicates that children with a visual impairment need a variety of experiences with real concrete objects to learn about the environment (Holbrook and Rosenblum, 2017). Exploring the objects in a tactual way provides a meaningful learning experience (Holbrook and Rosenblum, 2017). Learning by doing means that the child with a visual impairment needs to physically participate in the activity rather than just being verbally told about it (Holbrook and Rosenblum, 2017). Unifying experiences allow children with a visual impairment to tie concepts together and develop an experience into its whole part (Holbrook and Rosenblum, 2017).

Adaptations and modifications for teaching, learning, and play

Adaptations and modifications for skills are necessary when teaching children with visual impairments. Farrenkopf, McGregor, Kapperman, & Kelly (2017) recognize that there are three general modifications for sport and activities that can be made to make it more inclusive for children with a visual impairment. These modifications include environmental adaptations, teaching adaptations, and adaptation to the activity (Farrenkopf et al., 2017).

Environmental adaptations are modifications to the sporting equipment, or the field that the sport or activity is performed on (Farrenkopf et al., 2017). A common adaptation to the equipment used in visually impaired sport and activity are beeping equipment (Farrenkopf et al., 2017). This beeping equipment includes balls that have bells in them, or equipment that makes a loud sound to capture the attention of children with a visual impairment (Farrenkopf et al., 2017). Another common adaptation is using large and brightly coloured equipment to enhance the visibility (Farrenkopf et al., 2017). The playing field can be adapted by involving brightly colored pilons or tape to indicate an area, or a sound source to indicate a target (such as a goal or a basketball hoop) (Farrenkopf et al., 2017).

Teaching adaptations include the use of physical guidance and tactile modelling paired with verbal instruction or demonstration (Farrenkopf et al., 2017). Physical guidance involves placing the child's body or sport specific body part though the motion and movement of the skill (Farrenkopf et al., 2017). This guidance allows the child to get the feeling and rhythm of the movement being instructed (O'Connell, Lieberman, & Petersen, 2006). Moreover, allowing for a kinesthetic cue regarding the desired movement and leads to the increased understanding of the skill (O'Connell et al., 2006).

Tactile modelling involves the child with a visual impairment examining and touching the object in order to learn and understand a skill, or feeling the body structure of an instructor to feel their motion (Farrenkopf et al., 2017). Giving the child the opportunity to feel and determine the direction of a movement will aid in the learning of the desired skill (O'Connell et al., 2006). For example, by feeling the hips of an instructor, the child can comprehend the idea of how the hips should rotate for a skill or desired movement (O'Connell et al., 2006). Both physical guidance and tactile modeling should be coupled with a verbal explanation (Farrenkopf et al., 2017).

Wagner et al. (2013) provide similar suggestions for teaching gross motor skills to children with a visual impairment. They suggest that any given skill needs to be demonstrated with both a full body demonstration and verbal description, and once a child understands the skill at a basic level, the components of the skill should be broken down and taught separately (Wagner et al., 2013). They also suggest that physical guidance and/or tactile modelling can be useful (Wagner et al., 2013). Physical guidance involves moving the child through the motion of the skill, while tactile modelling involves having the child feel someone going through the motion of the skill (Wagner et al., 2013). Again, in both approaches, verbal description should be included, and once the smaller components are understood, the child can then put all the skills together to perform the whole skill (Wagner et al., 2013).

The last adaptation that Farrenkopf et al. (2017) suggested was adapting the activity itself. The activity can be modified to allow children with a visual impairment to participate on a level playing field (Farrenkopf et al., 2017). The amount of sport specific adaptation varies by

visual acuity, where individuals who are B1 may be allowed different adaptations compared to someone who is B3 (Farrenkopf et al., 2017). An example of a sport that has different adaptations depending upon visual acuity includes high level running. Individuals who are classified as B1 or B2 may use a running guide, where both the runner and the guide hold a rope tether; individuals who are B3 do not have access to a running guide (Farrenkopf et al., 2017).

Swimming is another sport that is very accessible to individuals with visual impairments and relatively easy to adapt. For an individual with a visual impairment, simple modifications include helping them to stay in their lane and letting them know when they are near the end of the lane (Farrenkopf et al., 2017). Tapping the swimmer with a tap stick when they are approaching the end of the lane/edge of the pool is one method (Farrenkopf et al., 2017). The ropes indicating the lanes can also be visually enhanced via bright colour or larger rope to aid the swimmer (Farrenkopf et al., 2017).

It is important to adapt PA and sport for individuals and children with a visual impairment. Children with a visual impairment can engage in any PA or sport they desire if they have the right modification and adaptation (O'Connell et al., 2006). With appropriate adaptations, children with a visual impairment can acquire and develop the motor skills they need (O'Connell et al., 2006). It is essential to educate teachers, parents, and other sport leaders how to modify sport to make it meaningful for children with a visual impairment (O'Connell et al., 2006).

Preparing those who work with children with visual impairments

Preparing teachers of students with visual impairments (TVIs) and orientation and mobility (O&M) specialists is an important part of supporting physical education and activity for children and youth with visual impairments. However, there is some question as to the depth and quality of preparation of professionals who work in this sphere.

Sladewski et al. (2022) conducted an online study to understand what TVIs and O&M specialists learned and experienced in their professional preparation programs regarding physical education, physical activity, and sport for students with visual impairments. A total of 68 TVIs and O&M specialists participated in the study. The results showed that 60% of the participants did not feel that their professional preparation program provided an adequate amount of time discussing accommodations for students with visual impairments in physical education and physical activity; 80% felt they learned very little or nothing at all in their courses related to physical activity, physical education, and sport; and 79% felt they learned very little or nothing at all in their practicum experiences. Of the study participants, 72% indicated that they wished that they had learned more about physical activity, physical education, and sport.

Sladewski et al (2022) concluded that TVIs and O&M specialists are not adequately prepared to assist physical education teachers in making physical activity, physical education, and sport accessible to students with visual impairments. They further concluded that professional preparation programs could include more information on making physical activity, physical education, and sport accessible to students with visual impairments.

According to research, programs to prepare teachers and specialists must also address the topic of bullying. A literature review of bullying in physical education of youth with visual

impairments by Ball et al. (2022) examined studies on bullying in physical education for school-age children with visual impairments. The results revealed that of the 114 participants across 14 selected studies, 86% experienced social–relational bullying, 64% experienced verbal bullying, and 21% experienced physical bullying. Children with visual impairments were bullied in physical education class by their teachers (50%), paraeducators (7%), and their peers (93%). The bullying occurred in class (93%), in the locker room (21%), and at various locations outside of class. The results of the review suggested a general need to educate teachers and paraeducators about proper modifications to class structure, assessment practices, and sports and physical activity to reduce bullying (Ball et al., 2022). Teaching self-advocacy to children with visual impairments may also help to minimize bullying and help with peer acceptance and support in the classroom (Ball et al., 2022).

Finally, physical education and activity programming for children with visual impairments must address self-perception of motor skill competence. Along with lower levels of motor competence and physical activity, children with visual impairments typically have lower perceived motor competence compared to their peers without visual impairments. Following a hypothesis that their low perception of their own motor competence affects their participation in physical activity, Brian et al. (2020) had 138 youth with visual impairments (81 boys, 57 girls) complete the Test of Gross Motor Development-3, the Test of Perceived Physical Competence-VI, and the Physical Activity Questionnaire. The results showed that their locomotor skills predicted their own perceived motor competence, which in turn predicted their physical activity. However, there was no significant relationship between their actual locomotor skills and their physical activity. The conclusion was that their perceived

motor competence mediated the path between their locomotor skills and their physical activity (Brian et al, 2020). That is, they were physically active not simply based on having fundamental movement skills, but because they also perceived themselves as having the necessary skills. This finding suggests the need to target both perceived motor competence and actual motor competence in intervention strategies to increase physical activity in youth with visual impairments.

Summary

This literature review has explored the importance of physical activity for children who are blind or visually impaired. It has also looked at the barriers they face in physical activity and sport and the important role of skill development, skill assessment, adaptations, and teacher preparation.

The research shows that children with a visual impairment spend more time being sedentary and less time being physically active compared to sighted children (Perkins et al., 2013). This lack of PA seen in children with a visual impairment can contribute to many health-related concerns (Perkins et al., 2013; Liberman et al., 2010). While motor skills and physical fitness are crucial in the activities of daily living and the sport, children with a visual impairment can face large barriers in developing the skills and fitness to accomplish even everyday tasks. Lack of opportunity, communication, and physical education teacher's knowledge on inclusive PA have been shown to be significant barriers (Ayvazoglu et al., 2012). These barriers inhibit children who are visually impaired from receiving the proper PA they need to experience health benefits, and therefore they need to be addressed (Ayvazoglu et al., 2012).

This review also examined the motor skills of children who are visually impaired compared to sighted children. Significant research has been conducted into the locomotor and object control skills of children with visual impairments, and the research demonstrates that most children with a visual impairment have delayed motor skill acquisition (Wagner et al., 2013; Anthony, 2013). Both locomotor and object control motor skills have been shown to be severely lacking and underdeveloped, leading children with a visual impairment to perform worse on skills such as balance, coordination, throwing, catching, and many more skills needed for activities of daily living (Wagner et al., 2013; Anthony, 2013). However, it has also been shown that if these motor skills are worked on appropriately, children with a visual impairment can improve their motor skills (Wagner et al., 2013; Anthony, 2013).

One important approach for improving PA and motor skills in children with a visual impairment is adaptation. By adapting PA and sport, children with a visual impairment can participate to a greater degree and improve their skillset to become proficient in motor skills and activities of daily living (Farrenkopf et al., 2017). Furthermore, adapting the environment, methods of teaching, and the activity itself can foster a better learning experiences for children with a visual impairment and provide more meaningful opportunities (Farrenkopf et al., 2017). It is important to become aware of inclusive physical activity, and how to execute it for children with a visual impairment so that fitness can be promoted and adopted throughout their entire lives.

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