THE IMPACT OF A SCHOOL RUNNING PROGRAM ON HEALTH-RELATED PHYSICAL FITNESS AND SELF-EFFICACY IN YOUTH WITH SENSORY IMPAIRMENTS

CAROLINE MUELLER
Roanoke College

ELIZABETH ACKLEY-HOLBROOK
Roanoke College

Abstract

It has been well documented that youth with sensory impairments display lower levels of health-related fitness than their typically developing peers, yet few programs exist to enhance the physical activity levels of these youth, even at private or state-funded schools for the deaf and blind. The purpose of this descriptive study was to document the impact of a recently developed school running program on the health-related physical fitness and self-efficacy of students with sensory impairments. Following participation in the program, students displayed significant improvements in cardiovascular fitness and a shift in the types of barriers perceived to influence engagement in physical activities.

Keywords: *visual impairment; running; exercise*

Introduction

It has been well documented that individuals with vision or hearing impairments experience a disparate health profile compared to individuals without sensory impairments. Although speculative, patterns of poor fitness status and comorbidity documented in individuals with sensory impairments suggest a hypokinetic origin; that low levels of physical activity (PA) explicate the higher rates of functional decline and metabolic conditions observed in persons with visual or hearing disabilities. As a result of these patterns, previous authors have suggested that early PA intervention in youth with sensory impairments is critical for optimal social, emotional, and physiological development across the lifespan (Bouchard & Tetreault, 2000; Cervantes & Porretta, 2013; Ellis, Lieberman, Fittipauldi-Wert, & Dummer, 2005; Hartman, Visscher, & Houwen, 2007; Hyun-Kyoung, Ozturk, & Kozub, 2004; Lieberman & MacVicar, 2003; Perkins, Columna, Lieberman, Bailey, 2013). This paper describes the efficacy of one such intervention, a school-based cross-country running program, on parameters of health-related physical fitness (HRF) and self-efficacy for exercise.

Background

In seminal studies of youth with vision or hearing impairments, early motor skill development was noted as being delayed and less predictable in comparison to youth without sensory impairments (Adelson & Fraiberg, 1976; Drummer, Haubenstricker, & Stewart, 1996; Hartman, Houwen, & Visscher, 2011), leading to compromised motor development (gross and fine), balance and posture, and muscular strength throughout childhood (Adelson & Fraiberg, 1976; Bouchard & Tetreault, 2000; Haibach, Lieberman, & Pritchett, 2009; Jan, Robinson, Scott, & Kinnis, 1975; Murphy & O'Driscoll, 1989). In particular, several authors have identified weaknesses in the upper and lower limbs of youth with sensory impairments as a result of hesitance to engage in various postures during early childhood, including prone activities and crawling (Gkouvatzi, Mantis, & Pillianidis, 2010; Häkkinen, Holopainen, Kautianinen, Sillanpää, & Häkkinen, 2006; Wyatt & Ng, 1997). Throughout childhood and adolescence, youth with sensory impairments display lower levels of HRF than age-matched peers without vision or hearing impairments (Cumming, Goulding, & Baggley, 1971; Hartman et al., 2007; Hopkins, Gaeta, Thomas, & Hill, 1987; Kobberling, Jankowsi, & Leger, 1989; Lieberman & McHugh, 2001). By mid-adulthood, engagement in PA falls below the level recommended for improving health (Holbrook, Caputo, & Perry, 2009; Marmeleira, Laranjo, Marques, & Pereira, 2014), whereas by older adulthood, high rates of anxiety and depression develop concomitantly with poor functional capacity and mobility limitation (Dalton, Cruickshanks, Klein, Klein, Wiley, & Nondahl, 2003; Evans, Fletcher, & Wormald, 2006; Horvat, Ray, Croce, & Blasch, 2004; Kleinschmidt, Trunnell, Reading, White, Richardson, & Edwards,1995; Kvam, Loeb, & Tambs, 2007). Collectively, these cross-sectional patterns suggest a need to enhance health-producing levels of PA among individuals with sensory impairments while they are still young, as engagement in PA is known to track across the lifespan (Longmuir & Bar-Or, 2000).

After-school programs have been identified as a promising solution to PA augmentation in previously inactive youth with and without sensory impairments (Beets, Beighle, Erwin, & Huberty, 2009; Blessing, McCrimmon, Stovall, & Williford, 1993; Cervantes & Porretta, 2013). Unmistakably, sport and recreational programs serve as natural outlets for promoting PA participation and enhancing social skills. Yet despite the ease of accessibility to recreational programming among nonsensory impaired youth, children and adolescents with sensory impairments experience unique barriers to participation in exercise-based programs, even when participating in programs at schools for deaf and blind (Cervantes & Porretta, 2013). In an effort to expand school-based recreational programming, minimize PA barriers among students and facilitate enjoyment in health-producing levels of recreational activity, a School for the Deaf and Blind in the southeastern United States recently added a cross-country program to their afterschool athletics offerings (previously limited to, soccer, volleyball, basketball, goal ball, and track and field). As one of five-known programs for youth with sensory impairments, the efficacy of school-based running programs for improving PA participation, affect, and HRF is not well understood. In an effort to provide information to practitioners regarding the value of running-based recreational opportunities for youth with sensory impairments, the purpose of this study was to describe the impact of the school-based cross-country running program on the HRF status and self-efficacy of participants.

Methods

Permission for this study was granted by the Institutional Review Board at a college in the southeastern United States. Assessments of participating students' pre- and postseason affect (e.g., PA self-efficacy and barriers to PA) and HRF status were conducted at a School for the Deaf and Blind in close proximity to the college. Evaluations were completed by a university faculty member and three undergraduate students who were trained in data collection procedures, Fitnessgram test administration, and adaptive instruction for assessing the parameters of interest in youth with vision and hearing impairments.

Participants

Of the 12 youth athletes participating on the cross-country team, child assent and parental informed consent was obtained from 11 participants (8 males, 3 females; age = 14 $\pm$ 2.61 years). For descriptive purposes, the disability status of each athlete was defined according to the International Classification for Disease (ICD) schematic (World Health Organization, 2010). Among athletes with a visual impairment, two reported having no light perception (ICD = 5), five reported having light perception (ICD 2-4), and one reported having travel vision (ICD = 1). Three students reported having no visual impairment but were hearing impaired. No concomitant physical or cognitive impairments were reported by participants.

Procedures

Prior to the athletes' first practice session, the college research team traveled to the school to gather preseason information regarding the participants' perceived barriers to PA, PA self-efficacy, and HRF. Participants completed the Physical Activity Barriers Questionnaire for the Blind or Visually Impaired (Lee, Zhu, Ackley-Holbrook, Brower & McMurray, 2014) and the Self-Efficacy for Exercise Questionnaire (Resnick & Spellbring, 2000). For students needing an adaptive format, coaching assistants administered the questionnaires verbally on an individual student basis.

To evaluate HRF, participants performed a series of assessments from the Fitnessgram Test Battery (Meredith & Welk, 2010), encompassing body composition, muscular endurance, muscular strength, flexibility, and cardiovascular endurance. To assess body composition, participants underwent assessments of height, body mass, waist circumference, and skinfold thicknesses (triceps and calf). Muscular fitness was evaluated using assessments of modified pull-ups and curl-ups. In order to adhere to Fitnessgram guidelines, the curl-up test was guided for participants with visual impairment using tactile place cards as indicators of curl-up distance, and hand signals were used to indicate cadence for participants with hearing impairment. Flexibility was evaluated using the back saver sit-and-reach test, and a one-mile walk/run was completed on an outside athletic field in order to evaluate cardiovascular endurance. For participants needing assistance during the mile run, guide runners with tether lines were available (coaching or research assistants) and were instructed to allow the student-athlete to dictate running pace.

The 14-week cross-country season began on the day following the preseason assessment. Student-athletes ran together four days per week and, at various points in the season, competed in two races with nonsensory impaired runners from surrounding middle and high schools in the region. At the conclusion of the season, the research team returned to the school to evaluate postseason affect and HRF status using methods identical to the pretest assessment.

Data Analysis

Due to the small sample size anticipated *a priori*, descriptive statistics and exploratory paired *t*-tests were performed to examine changes in affect (i.e., PA self-efficacy, barriers to PA) and the fitness-related indices of interest. For all exploratory comparisons, significance was established at $p < 0.05$.

Results

Results of the affective and HRF assessments are displayed in Tables 1 and 2, respectively. In relation to participant affect, no significant differences were observed relative to PA self-efficacy ($t(7) = .84$, p=.43) nor barriers to PA ($t(7) = .21$, p=.21) from pre- to postseason. When examined descriptively, the types of barriers perceived to hinder participation in PA shifted from externally focused factors ("unexpected obstacles") to primarily internally focused factors ("motivation") following the program. No significant differences ($p > .05$) were observed between pre- and post-season indices of body composition (mass, skinfold thickness, body fat, waist circumference, body mass index), muscular fitness (curl-up, pull-up), nor flexibility (sit-and-reach). While significant differences were not observed for VO_2max ($p = .87$),

Table 1
Impact of a School Running Program on Affect in Youth with Sensory Impairment (n = 8)

Affective Domains	Preseason	Postseason	Pre-Post *p*
PA Self-Efficacy	44.7 ± 25.1	52.9 ± 21.3	.428
Barriers to PA	75.0 ± 27.8	65.2 ± 23.1	.212

Note. All values displayed as mean ± standard deviation; not all athletes completed this portion of the assessment.

one-mile run time improved significantly from preseason (12.76 ± 3.05 minutes) to postseason (11.02 ± 2.95 minutes), $t(9) = 3.82$, $p = .004$. Despite a lack of significant findings overall, improvements in the attainment of Healthy Fitness Zone criteria were observed relative to cardiovascular fitness (VO_2max), body composition (percent body fat), muscular strength (modified pull-up), and total body fitness (as indicated by the ability to attain Healthy Fitness Zone status in four or more assessments; see Figure 1).

Discussion

It is generally accepted that youth who regularly engage in physical education classes or participate in school-based athletics are more inclined to be physically active later in life (Ponchillia, Strause, & Ponchillia, 2002). In an effort to describe the potential for school-based running programs to serve as viable options for youth with sensory impairments to engage in health-producing levels of PA, the current study served to describe the impact of a school-based running program on the exercise self-efficacy, perceived barriers to PA, and HRF of participating youth with sensory impairments.

Barriers to Physical Activity and Exercise Self-Efficacy

In addition to the PA barriers commonly reported among the general population, including restriction of time, inconvenience, inadequate knowledge of exercise, lack of motivation or confidence in oneself, and lack of access to recreational areas (Zunft et al., 1999), individuals with disabilities experience concomitant barriers which make access to health-promoting levels of PA even more challenging (Lee et al., 2014; Rimmer, Braddock, & Pitetti, 1996). Common barriers to PA reported by youth with sensory impairments include inadequate programming, lack of educator knowledge, inadequate motor skill, low parental expectation, and lower standards of performance (Lieberman & McHugh, 2001; Perkins et al., 2013; Shapiro & Martin, 2010: Skaggs & Hopper, 1996; Stuart, Lieberman, & Hand, 2006). In the current study, participants identified "unexpected obstacles," "weather (too hot or cold)," and "a lack of availability of activities" as the most substantial barriers to PA participation prior to engagement in the running program. When viewed collectively, these barriers indicate a relatively external locus of control, suggesting that extrinsic factors were commonly perceived as having a notable impact on PA prior to participating in the running program. While statistically significant reductions in perceived barriers to PA were not observed following participation in the running program, participants in the current study experienced a shift in the locus of control involving perceived barriers to PA, reporting "lack of motivation," "lack of time," and "inconvenience in preparing themselves" as primary barriers. Although speculative, this shift in the types of barriers perceived by

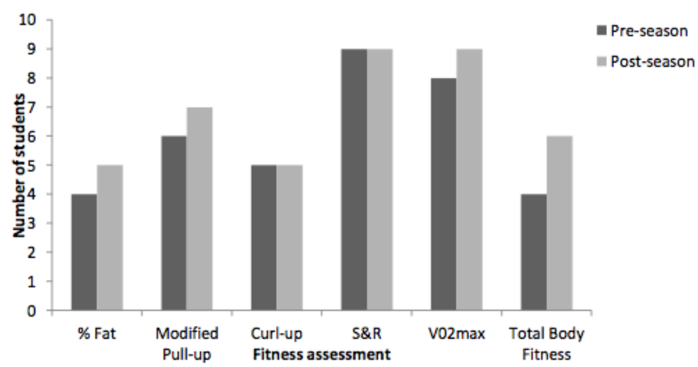

Figure 1. Fitnessgram Healthy Fitness Zone attainment rates from pre-season to post-season

Table 2
Impact of a School Running Program on Health-Related Fitness Status in Youth with Sensory Impairment (n = 11)

	Preseason			Postseason			Pre-post
Component of Fitness	VI	HI	Total	VI	HI	Total	*p*
Body Composition							
Waist Circumference (in)	30.6 ± 5.9	28.8 ± 4.1	27.7 ± 8.2	29.2 ± 4.1	29.5 ± 3.2	27.3 ± 7.8	.338
Body Mass Index (kg/m²)	22.1 ± 4.7	22.3 ± 6.2	20.4 ± 6.5	22.1 ± 4.1	23.1 ± 5.9	20.9 ± 6.4	.402
Body Fat (%)	27.2 ± 9.6	20.9 ± 13.9	24.2 ± 10.7	22.2 ± 8.9	19.4 ± 10.8	20.4 ± 8.9	.096
Skinfold Sum (mm)	31.2 ± 15.6	27.5 ± 19.1	27.5 ± 19.0	28.7 ± 12.6	24.5 ± 14.9	26.3 ± 12.2	.123
Muscular Fitness							
Curl-Ups	25.0 ± 20.3	21.7 ± 7.2	23.6 ± 14.8	34.3 ± 27.5	14.7 ± 5.8	28.8 ± 22.3	.217
Modified Pull-Ups	8.1 ± 7.0	14.0 ± 6.2	9.0 ± 6.5	9.6 ± 7.9	8.0 ± 2.0	9.1 ± 6.2	.748
Flexibility							
Sit-and-Reach Right (in)	10.4 ± 2.9	10.1 ± 0.1	9.5 ± 3.1	9.3 ± 2.7	10.3 ± 0.3	9.1 ± 2.9	.252
Sit-and-Reach Left (in)	10.2 ± 3.0	10.3 ± 0.7	9.4 ± 3.2	9.8 ± 2.6	10.6 ± 0.9	9.4 ± 2.9	.718
Cardiovascular Fitness							
One-Mile Walk/Run (min)	13.5 ± 3.4	11.2 ± 1.9	12.0 ± 3.9	11.9 ± 2.8	8.9 ± 1.6	10.5 ± 3.5	.004
V02max (ml/kg/min)	45.0 ± 5.1	42.2 ± 6.5	40.9 ± 12.2	42.7 ±5.4	44.9 ± 6.8	40.3 ± 11.7	.868

Note. All values displayed as mean ± standard deviation; VI = Visual impairment; HI = Hearing impairment participants as impacting PA participation may signify that, as the season progressed, the impact of extrinsic barriers to PA participation declined while exercise self-efficacy for exercise improved. As school-based PA programs have been shown to increase a child's level of PA while increasing exercise self-efficacy concurrently (Cervantes & Porretta, 2013), this hypothesis seems plausible.

In regard to exercise self-efficacy, previous authors have reported that typically developing youth report lower ratings of self-efficacy for exercise when they believe they are not well-suited for an activity, will be exposed to criticism or shame, or are bored by the program (Rees et al., 2006). In the current study, preseason assessments of exercise self-efficacy indicated similar responses, with "exercising alone" as an additional substantive factor. As previous authors have indicated that youth with visual impairment place a low importance on athleticism (Shapiro et al., 2008), opportunities to engage youth with sensory impairments in organized recreational outlets may foster an appreciation for involvement in PAs. Moreover, as parents of youth with disabilities reportedly exude lower expectations of their children's athletic pursuits (Skaggs & Hopper, 1996; Stuart et al., 2006), it is possible that parental perceptions of their child's capacity to engage in PAs may also improve as a result of after-school programming.

Health-Related Physical Fitness

Prior to participating in the running program, students displayed a healthier profile of physical fitness compared to what is generally observed in similarly-aged youth with vision or hearing impairment (Ackley-Holbrook, Caputo, & Perry, *in review*; Ellis, 2001). Although speculative, this observation may suggest that the students who elected to participate in the running program had been previously engaged in athletics or were more prone to exercise compared to the typical population of youth sensory impairments. When considering the potential for improving health status, the *theory of diminishing returns* postulates that the least physically fit individuals exude the greatest potential for improved health status; therefore by engaging a relatively physically fit sample of participants in the running program, it is possible that the effect of the program on HRF (as well as exercise self-efficacy) may have been reduced. In light of this possibility, small (albeit nonstatistically significant) improvements in HRF assessment scores and HFZ attainment rates were observed across the domains of fitness in the postseason. Specifically, while performance on the flexibility assessment remained stable from preseason to postseason, HFZ attainment rates improved in relation to cardiovascular fitness, muscular fitness, and body composition. With the exception of CV fitness (which illustrated significant beneficial change), these changes in HFZ attainment were accompanied by nonsignificant improvements in assessment performance scores (see Table 2).

Conclusions

It has been reported that physical inactivity is nearly twice as prevalent among Americans with disabilities compared to similarly aged peers without a disability (Rimmer, 2007). In many populations with disabilities, this lack of engagement in PA has been shown to originate during childhood and adolescent years, critical times for physical, social, and psychological development (Adelson & Fraiberg, 1976; Bouchard & Tetreault, 2000; Hartman et al., 2007). School-based recreation has been shown to increase engagement in PA during childhood and thus has the potential to impact lifelong participation in PA (Cervantes & Porretta, 2013; Ponchillia et al., 2002). In light of this, the average public school offers nearly a dozen organized sports for student participation throughout the year. Whereas private schools for youth with sensory impairments also offer after-school recreational programs, opportunities are generally more limited (typically including cheerleading, goal ball, beep-ball, wrestling, and track and field). As such, a need exists to enhance the availability of adaptive school-based PA programs for youth with sensory impairments, and the incorporation of activities that can be continued across the lifespan is essential. Findings from the current investigation indicate that long distance running, initiated through an after-school running program, has the potential to enhance PA participation at a level that improves both affect and HRF status in youth with sensory impairments.

While the small, overtly fit sample observed in this study reduced the ability to scrutinize the data statistically and by type or severity of sensory impairment, a significant limitation to the current investigation was the inability to obtain formal records of practice attendance and program specifics from coaches (i.e., daily run duration or mileage). Relatively common in the translation of practice to research, this lack of formal data inhibited our ability to examine the relationship between program adherence and estimated energy expenditure on changes in HRF and exercise self-efficacy. In recognizing the evident limitations of making these types of inferences in such a small sample, knowledge regarding the dose-response association between program adherence and health outcomes as it relates to youth with sensory impairments is valuable, as it currently does not exist in the literature.

Despite a lack of statistical significance in pre- to postseason affect and HRF, participation in the school-based running program appears to have minimized some barriers to PA among participants with sensory impairments, while concurrently increasing the number of athletes who were able to attain HFZ criteria across the five domains of HRF. Moreover, as perceived barriers to PA appeared to shift from primarily extrinsically focused factors (i.e., unexpected obstacles) to more internally controlled factors (i.e., motivation), a semi-structured running program may serve as a means to enable youth to transcend a variety of common barriers to PA during the critical years of physical, social, and psychological development. As such, future programs should focus on recruiting students who may not otherwise participate in athletics. Not only would this strategy enable a group of youth to be introduced to a sport with lifelong participation potential, but from a research perspective, it would also allow the effects of after-school running programs on HRF to be maximized.

Acknowledgment: The authors would like to acknowledge Ms. Leah Hall and Ms. Lillian Judge for their role in data collection and analysis procedures, and Mr. Greg Hanson for his involvement in participant recruitment for this study.

References

Ackley-Holbrook, E., Caputo, J., & Perry, T. (*in review*). *Health-related fitness status of youth with visual impairment: A ten-year update*.

Adelson, E., & Fraiberg, S. (1976). Sensory deficit and motor development in infants blind from birth. In Z. S. Jastrzembsak (Ed.), *The effects of blindness and other impairments on early development* (pp. 1–15). Washington D.C.: The American Council for the Blind.

Beets, M. W., Beighle, A., Erwin, H. E., & Huberty, J. L. (2009). After-school program impact on physical activity and fitness: A meta-analysis. *American Journal of Preventive Medicine, 36*(6), 527–537.

Blessing, D. L., McCrimmon, D., Stovall, J., & Williford, H. N. (1993). The effects of regular exercise programs for visually impaired and sighted schoolchildren. *Journal of Visual Impairment and Blindness, 87*, 50–52.

Bouchard, D., & Tetreault, S. (2000). The motor development of sighted children and children with moderate low vision aged 8-13. *Journal of Visual Impairment and Blindness, 94*(9), 564–574.

Cervantes, C. M., & Porretta, D. L. (2013). Impact of after school programming on physical activity among adolescents with visual impairments. *Adapted Physical Activity Quarterly, 29*, 127–146.

Cumming, G. R., Goulding, D., & Baggley, G. (1971). Working capacity of deaf, visually, and mentally handicapped children. *Archives of Disease in Childhood, 46*, 490–494.

Dalton, D., Cruickshangks, K. J., Klein, B. E., Klein, R., Wiley, T. L., & Nondahl, D. M. (2003). The impact of hearing loss on quality of life in older adults. *Gerontologist, 43*(5), 661–668.

Dummer, G. M., Haubenstricker, J. L., & Stewart, D. A. (1996). Motor skill performances of children who are deaf. *Adapted Physical Activity Quarterly*, 13, 400–414.

Ellis, M. K. (2001). The influence of parents hearing level and residential status on health-related physical fitness and community sports involvement of deaf children. *PALAESTRA*, *17*(1), 44–49.

Ellis, M. K., Lieberman, L. J., Fittipauldi-Wert, J., & Dummer, G. M. (2005). Health-related fitness of deaf children- how do they measure up? *PALAESTRA, 21*(3), 36-43.

Evans, J. R., Fletcher, A. E., & Wormald, R. P. L. (2006). Depression and anxiety in visually impaired older people. *Opthamology, 114*(2), 283–288.

Gkouvatzi, A. N., Mantis, K., & Pillianidis, T. (2010). The impact of hearing loss degree and age on upper limb coordination ability in hearing, deaf, and hard of hearing pupils. *Studies in Physical Culture and Tourism, 17*(2), 147–155.

Gronmo, S. J., & Augestad, L. B. (2000). Physical activity, self-concept, and global self-worth of blind youths in Norway and France. *Journal of Visual Impairment and Blindness, 94*(8), 522–527.

Haibach, P., Lieberman, L., & Pritchett, J. (2009) Balance in adolescents with and without visual impairments. *Insight: Research and Practice in Visual Impairment and Blindness, 4*(3), 112–123.

Häkkinen, A., Holopainen, E., Kautiainen, H., & Sillanpää, Häkkinen, K. (2006). Neuromuscular function and balance of prepubertal and pubertal blind and sighted boys. *Acta Pædiatrica, 95*, 12771283.

Hartman, E., Visscher, C., & Houwen, S. (2007). The effect of age on physical fitness of deaf elementary school children. *Pediatric Exercise Science, 19*, 267–278.

Holbrook, E. A., Caputo, J. L., Perry, T. L., Fuller, D. K., & Morgan, D. W. (2009) Physical activity, body composition, and perceived quality of life in adults with visual impairments. *Journal of Visual Impairment and Blindness*, *103*(1), 17–29.

Hopkins, W. G., Gaeta, H., Thomas, A. C., & Hill, M. (1987) Physical fitness of blind and sighted children. *European Journal of Applied Physiology, 56*, 69–73.

Horvat, M., Ray, C., Croce, R., & Blasch, B. (2004). A comparison of isokinetic muscle strength and power in visually impaired and sighted individuals. *Isokinetics and Exercise Science, 12*, 179–183.

Hyun-Kyou, O., Ozturk, M. A., & Kozub, F. M. (2004) Physical activity and social engagement patterns during physical education of youth with visual impairments. *Review: Rehabilitation Education for Blindness and Visual Impairment, 36*(1), 39–48.

Jan, J., Robinson, G., Scott, E., & Kinnis, C. (1975). Hypotonia in the blind child. *Developmental Medicine and Child Neurology, 17*, 35–40.

Kleinschmidt, J. J., Trunnell, E. P., Reading, J. C., White, G. L., Richardson, G. E., & Edwards, M. E. (1995). The role of control in depression, anxiety, and life satisfaction among visually impaired older adults. *Journal of Health Education, 26*(1), 26–36.

Kobberling, G., Jankowski, L., & Leger, L. (1989). Energy cost of locomotion in blind adolescents. *Adapted Physical Activity Quarterly*, *5*, 58–67.

Kvam, M. H., Loeb, M., & Tambs, K. (2007) Mental health in deaf adults: symptoms of anxiety and depression among hearing and deaf individuals. *Journal of Deaf Studies and Deaf Education, 12*(1), 1–7.

Lee, M., Zhu, W., Ackley-Holbrook, E., Brower, D., & McMurray, B. (2014). Development and validation of the Physical Activity Barrier Scale for Persons who are Blind or Visually Impaired. *Disability and Health Journal,* 7(3), 309–317.

Lieberman, L. J., & MacVicar, J. M. (2003). Play and recreational habits of youths who are deaf-blind. *Journal of Visual Impairment and Blindness, 97*(12), 755–768.

Lieberman, L. J., & McHugh, E. (2001). Health-related fitness of children who are visually impaired. *Journal of Visual Impairment and Blindness*, *95*, 272–287.

Longmuir, P. E., & Bar-Or, O. (2000). Factors influencing the physical activity levels of youths with physical and sensory disabilities. *Physical Activity Quarterly, 17*, 40–53.

Marmeleira, J., Laranjo, L., Marques, O., & Pereira, C. (2014). Physical activity patterns in adults who are blind as assessed by accelerometry. *Adapted Physical Activity Quarterly, 31*, 283–296.

Meredith, M. D., & Welk, G. J. (Eds). (2010) *FitnessGram and ActivityGram test administration manual* (4th ed.). Champaign, IL: Human Kinetics.

Murphy, F., & O'Driscoll, M. (1989). Observations on the motor development of visually impaired children: interpretations from video recordings. *Physiotherapy, 75*, 505–508.

Perkins, K., Columna, L., Lieberman, L., & Bailey, J. (2013). Parents' perceptions of physical activity of their children with visual impairments. *Journal of Visual Impairments and Blindness*, *107*(2), 131–142.

Ponchillia, P., Strause, B., & Ponchillia, S. (2002). Athletes with visual impairment: Attributes and sport participation. *Journal of Visual Impairment and Blindness, 96*(4), 267-272.

Rees, R., Kavanagh, J., Harden, A., Shepherd, J., Brunton, G., & Olliver, S. et al. (2006). Young people and physical activity: A systematic review matching their views to effective interventions. *Health Education Research*, *21*(6), 806-825.

Resnick, B., & Spellbring, A. (2000). Understanding what motivates older adults to exercise. *Journal of Gerontological Nursing, 26*, 17–21.

Rimmer, J. H. (2007). Physical activity among adults with a disability, United States, 2005. *Morbidity and Mortality Weekly Report, 56*(39), 1021–1024.

Rimmer, J. H., Braddock, D., & Pitetti, K. H. (1996). Research on physical activity and disability: an emerging national priority. *Medicine and Science in Sports and Exercise, 28*(11), 1366–1372.

Shapiro, D. R., & Martin, J. J., (2010). Multidimensional physical self-concept of athletes with disabilities. *Adapted Physical Activity Quarterly*, *27*, 294–307.

Shapiro, D. R., Moffett, A., Lieberman, L., & Dummer, G. M. (2008). Domain-specific rating of importance and global self-worth of children with visual impairments. *Journal of Visual Impairment and Blindness, 102*(4), 232–244.

Skaggs, S., & Hopper, C. (1996) individuals with visual impairments: a review of psychomotor behavior. *Adapted Physical Activity Quarterly, 13*, 16–26.

Stuart, M. E., Lieberman, L. J., & Hand K. (2006). Parent-child beliefs about physical activity: An examination of families of children with visual impairments. *Journal of Visual Impairment and Blindness, 100*(4), 223–234.

Williams, C. A., & Armstrong, N. (1996). Peak aerobic fitness of visually impaired and sighted adolescent girls. *Journal of Visual Impairment and Blindness, 90*(6), 495–500.

World Health Organization. (2010). *ICD- 10: International statistical classification of diseases and related health problems* (10th rev. ed.). New York: World Health Organization.

Wyatt, L., & Ng, G. Y. (1997). The effect of visual impairment on the strength of children's hip and knee extensors. *Journal of Visual Impairment and Blindness, 91*(1), 40–46.

Zunft, H. J., Friebe, D., Seppelt, B., Widhalm, K., Winter, A. M., Vaz de Almeida, M., ... Gibney, M. (1999). Perceived benefits and barriers to physical activity in a nationally representative sample in the European Union. *Public Health Nutrition*, *2*(1a) 153–160.

Caroline Mueller is an undergraduate research assistant in the Department of Health and Human Performance at Roanoke College.

Elizabeth Ackley-Holbrook is an assistant professor in the Department of Health and Human Performance at Roanoke College.