Understanding Motivations and Barriers to Exercise among People with Blindness in India

Gesu India, Mohit Jain, and Manohar Swaminathan

Microsoft Research, Bangalore, India
{t-geind, mohja, manohar.swaminathan}@microsoft.com

Abstract. People with vision impairments (PVIs) have inferior physical fitness compared to sighted individuals. Several studies have been conducted to understand concerns, motivations, barriers, and experiences with exercise in the blind population. However, these studies have been limited to the developed regions. India is home to one-third of the world's blind population and hence it is crucial to understand exercise patterns among PVIs in India. In this work, we interviewed 24 Indian PVIs to uncover novel insights, including minimal use of exercise technology, crucial role of blind schools, and infrastructural and social barriers. We conclude the paper with design recommendations, such as exploiting the design space of restricted walking, emphasizing on schools for the blind, and forming support groups to promote exercises among PVIs.

Keywords: accessibility · blind · visual impairments · PVI · exercise · walking · motivation · barrier · ICTD · HCI4D · India · developing region.

1 Introduction

People with vision impairments engage in less physical exercises, and therefore have inferior physical fitness compared to sighted adults [6], [22]. Weit *et al.* [20] found that the odds of being obese or overweight for PVIs were 1.5 times greater than for sighted individuals. Several studies have been conducted to understand concerns, motivations, barriers, and experiences with exercise in the blind population, and also understand the role of technology in encouraging exercise among them [16], [17], [22]. They found PVIs face several barriers, including inaccessible fitness infrastructures, discouragement by parents due to safety concerns, limited social opportunities to exercise with a partner, lack of experience and interest, and misperceptions related to the importance of exercise [10], [16], [17].

This has triggered accessible exercise technologies to be an emerging area of research in the HCI and accessibility community [15], [23], [24]. To promote physical activities, several sports have been invented and/or made accessible for PVIs, such as goalball [2], beep baseball, and blind cricket. These sports use a combination of audio and vibrotactile-based stimuli to replace the visual stimuli. However, participation in these sports is very limited, due to safety concerns, lack of resources, and perceived requirement of athletic abilities and competence [17]. Exergames can mitigate these barriers, as they combine playful

video gaming with exercise and can be played indoors, thus motivating PVIs to engage in more exercising. Several accessible exergames have been developed, which are either accessible versions of famous exergames for sighted individuals (*e.g.*, VI-Tennis [11], Blind Hero [23]), or exergames specifically designed for PVIs (*e.g.*, Eyes-Free Yoga [15], Pet-N-Punch [13]). However, these exergames require expensive hardware, thus limiting their global adoption.

Importantly, research around understanding exercise among PVIs and accessible exercise technologies have been limited to the developed world. On the other hand, India is home to one-third of the world's blind population [3]. Due to the social, cultural, economic, and infrastructural differences, results from the developed regions cannot be generalized to the Indian settings. Thus, it is crucial to understand motivations, barriers, and role of technology in exercising among PVIs in the global south, to develop accessible exercise technologies for them.

In this paper, we conducted semi-structured interviews of 24 Indians with vision impairments, to understand their exercise patterns, motivations and barriers in performing exercise, their learning and experiences, and the role of technology in contributing to their exercise habits. We found novel insights, including minimal use and awareness of accessible exercise technologies, the pivotal role of blind schools in teaching accessible sports, and support structure of friends, family and peers to motivate individuals to be physically fit. We conclude with design recommendations to help accessible exercising in developing regions.

2 Study Design

2.1 Participants

Twenty four adults (5 female) with an average age of 25.4±5.6 years, participated in the study. Sixteen of them were blind since birth, and four (P4, P9, P16 and P20) had partial vision impairments. On average, participants had vision impairments for 21±8.9 years. The participants were from across India: 11 participants from Tier-1 cities, 6 from Tier-2 cities, and 7 from Tier-3 cities [21]. Four participants have post-graduate degrees, eleven have graduate, and seven have high school degrees. Participants have been using Android phones with TalkBack for 6.1±3.6 years and have access to the Internet; 8 participants owned low-range (below $150) smartphones, 12 mid-range ($150-$300) smartphones, and four high-range (above $300) smartphones. For mobility, all, except one, have been using a white cane for 9.6±7.0 years. A majority of participants (21) reported doing regular exercises (more than thrice a week).

2.2 Methodology and Data Analysis

We conducted IRB-approved semi-structured, in-depth interviews of the 24 participants to learn about their current exercise habits, experiences with physical activities since childhood, associated motivations, barriers and influencing factors, and use of technology in exercising. We also collected demographic information. Two local NGOs helped us in recruitment, by circulating the recruitment

email in their respective networks and WhatsApp groups. All interviews were conducted remotely by the first author in English, over Google Meet. They were audio-recorded and later transcribed with the consent of the participants. The interview lasted for 30–75 mins; participants were paid 500 INR.

We analyzed the interview transcripts using an inductive and iterative approach. Three authors participated in the coding process and iterated upon the codes until consensus was reached. Over the course of the analysis, we (1) discussed coding plans, (2) developed a preliminary codebook, (3) reviewed the codebook and refined/edited codes, and (4) finalized categories and themes.

3 Findings

3.1 Physical and Mental Fitness

Participants acknowledged improving physical fitness as their primary motivation for regularly participating in exercises. They considered exercise to be crucial for a healthy life and strive to integrate fitness activities into their daily routine.

> *"I have a love-hate relationship with physical activities. People say that it makes them feel very fresh, but I feel very sweaty and sticky. Still, I do it, as it's just something that I know it's healthy for me."* - P2.

Most participants (21) performed preliminary physical activities, such as (brisk) walking and stretching, regularly. Only four of them had fitness goals, such as improving body stamina, strengthening arms/legs, *etc.*, and hence were engaged in strenuous activities like martial arts, squat and rope skipping. Apart from fitness reasons, participants varied physical activities to reduce monotony. P18 attended weekly lessons in dance, yoga, martial arts, and aerobics, to minimize boredom. Moreover, growing concerns about their declining health after quitting exercise led participants to re-engage in fitness activities. E.g.:

> *"I left school at 16, and stopped exercising. I was healthy back then. Later, my health got a little upset, so I started exercising at home."* - P1.

Participants mentioned the benefits of exercise on mental health, and the importance of mental health in general, quoting "*a healthy mind in a healthy body*". Further, they were also engaged in mental health exercises, like meditation.

> *"Meditation, which I do as part of yoga, makes my mind free."* - P1.

Besides physical and mental impact, performing regular exercises has helped in boosting self-defence morale for female participants. Two participants who actively participate in blind sports mentioned social interactions that happened in and out of the playfields, as the key motivator. P20 was proud about finishing a marathon, his newly discovered potential, which boosted his self-confidence.

> *"It was amazing for me that I won! It changed my life! I thought, if seven days of exercise can be so worthwhile, I should keep doing it."* - P20.

3.2 Family, Friends and Peer Support

Participants reported support of family members, friends, and peers to be crucial in sustaining fitness routine, as they taught them the benefits of regular exercising. Their family members helped them by providing verbal encouragement,

purchasing fitness equipment (treadmill, weights, *etc.*), and assisting them in attending fitness classes and sports events. At times, the parents of our participants not only encouraged, but also forced them to exercise.

> *"I didn't like* (doing) *any physical activity. I was not interested. But I started doing it because my parents wanted me to. They were concerned about my physical health. They got me a treadmill when I was 12."* - P2.

Five participants were accompanied by their friend or a family member for their daily yoga, walking or workout sessions. This also helped in strengthening the relationship between them. Due to the time commitment by their sighted peers, our participants felt more '*accountable*' towards their own health.

> *"My dad asks me to join him for evening walks. We talk about things that happened that day. I also made him install this step counter app and now we track each other's step count records."* - P16.

Although peer and family support helped PVIs, a few participants reported lacking motivation due to the absence of it. A participant mentioned being limited to indoor exercises, due to the lack of "*company for outdoor walks or for playing games"* (similar to [16]). Failure to gain support from family members to continue playing sports after losing eyesight led P16 to stop playing, while P19 continues to play (blind) cricket but with internal conflicts.

> *"I lost my eye while playing, with a cricket ball. My parents started hating cricket and did not want me to play anymore. That was very difficult for me. They wanted me to play chess, other indoor games. Later, they were convinced that blind sports are helping me mingle with people."* - P19.

3.3 Stigmatization by Society

A broad range of social factors influenced the exercising behavior of our participants. Negative perceptions and stereotyping associated with vision impairment [4] was one of the main barriers. For instance, P2 explained her internalized social stigma related to white cane, resulting her not been able to walk independently till adulthood, thus curtailing her exercise options.

> *"There was a lot of stigma around white cane, a lot of internalized ableism. As a child, my only motivation was to look less blind. Using a cane would make me look more blind. Hence, I never used it."* - P2.

Due to similar reasons, P18 stopped her classical dance training, and P16 stopped walking on the streets as he was once mistaken for a beggar.

The perception of sighted people that PVIs are always in need of their assistance, acted as a barrier as well. P2 shared her experience:

> *"In college, everyone would always be concerned about me walking on my own. I would always get interrupted with them providing help. I have to explain 'I'm only walking, I don't need you to take me anywhere.' "* - P2.

To minimize such unwanted help offerings by strangers, P17 mentioned taking phone calls in public places, thinking "*people won't come, or offer help, when they see I am on a phone call.*" On the contrary, P4 shared his experience of not receiving help from people on the road, when in need. This resulted in him

going out for walks only with his sighted friends, thus curtailing his opportunity for independent outdoor exploration, and limiting it to walking indoors.

3.4 Role of Technology

We use the term *technology* to refer to a variety of support tools, similar to [16], including smartphone apps, fitness bands and treadmills. In spite of the regular exercising behaviour of 21 participants, we found them using technology minimally to support that. Ten participants reported not using any technology to help with their exercises; eight participants reported using an app to track step count, heart rate, calories burned (Google Fit (3), Pedometer (2), Samsung Health (2), etc.); seven used apps to keep them engaged during the (monotonous) exercise routines (YouTube (4), Netflix (2), Spotify (2), Audible (2), *etc.*).

> *"When I walk on the terrace, I usually call someone on the phone... That walk is not boring anymore."* - P2.

Moreover, seven participants wanted to track their walking, but were unaware of self-tracking phone apps which can help them with their physical fitness goals.

Affordability is a key factor in choosing technology by our participants. Only four participants owned phones costing more than US$300 (considered high-range in India), two participants owned health-tracking wearable devices, and two participants mentioned having access to a treadmill. Most of the apps reported by our participants were free apps, except paid video-streaming services and subscription-based audio-book apps used by four participants. Interestingly, most participants reported walking regularly, mainly because it is accessible, and does not require any additional equipment/infrastructure.

Even when the technology was available, participants complained about the missing accessibility component. For instance, three participants tried using Cult.Fit app to access exercise-related video tutorials:

> *"I tried Cult.Fit but unfortunately, they don't tell me what to do. They just keep on doing the exercises, so for me, it's of no use. I still use their app for meditation since those instructions are accessible, maybe because everyone has to close their eyes during meditation* (laugh)". - P10.

3.5 Importance of Educational Institutions

In developed countries, children with vision impairments attend mainstream schools (also known as integrated/inclusive schools) with trained educators [19]. In contrast, in India, 40% of children with vision impairments in the age group of 5-19 years do not attend any school [18], while the rest mainly attend schools for the blind [9], [14]. Out of our 24 participants, 18 attended schools for the blind, while 6 (four of them had low vision) attended mainstream schools. In India, most children who attend schools for the blind have to reside in the school hostel, to receive holistic training, including orientation, mobility, personal care, independent living, and physical well-being, in addition to schooling [9].

A key characteristic of schools for the blind, relevant to our study, is the emphasis on physical exercises and outdoor games. Participants who studied

in schools for the blind mentioned playing freely in grounds with their school friends. They were introduced/trained in one or more of these activities in school: yoga, blind cricket, blind football, kho-kho, kabaddi, handball, discus throw, basketball, cycling, and running. The positive perception towards physical fitness and enjoyment of playing team sports were seeded during their childhood years.

> *"I studied in a residential school. We had a compulsory physical education class every day 8:30 to 9. Also, the wardens, the teachers used to encourage us to play more. I played Kabaddi and Hide-and-Seek."* - P17.

In contrast, participants who attended integrated school, faced difficulty:

> *"There was a subject called physical training. I did whatever the teacher told, like stretching my hands and legs. Everyone else after doing these exercises would leave to play... I sat alone in the class."* - P20.

This highlights the importance of peer support and trained instructors, which are available by default in schools for the blind.

Moving to adulthood, participants highlighted the importance of being associated with a university or higher-education institution, in order to have infrastructural support for games and exercising, including gyms, pools, and trainers.

> *"Playing cricket was a happy thing during my graduation. Every evening, we used to play. At times, my sighted friends would cover their eyes and play."* - P19. *"My hostel had a gym. I used to do treadmill daily."* - P2.

However, such facilities are available only in elite institutions. Moreover, to access these facilities, individuals need to be either residents or stay in close proximity to be able to travel for utilizing these facilities. For instance, P14 complained that he could not continue sports after school, as his college had minimal infrastructure:

> *"In my blind school, we used to play cricket daily... also handball. Now I don't play. It stopped when I left school and joined college."* - P14.

3.6 Access to City Infrastructure

Though usage of smartphone apps for exercise was minimal, we found participants using navigation apps (like Google Maps) frequently in combination with exploration apps (like Lazarillo, Nearby Explorer) to hear updates on landmarks in their route. Seven participants mentioned walking outside their homes regularly, and six participants shared their eagerness to walk outdoors but were unable to because of "*bad road*" and/or "*unavailability of nearby parks*". Thirteen participants complained about the poor road infrastructure.

> *"I don't go out for any leisure walk because unfortunately Bangalore city is not that accessible. The roads, especially the footpaths, are not proper, there are too many pits and drainages."* - P10.

Poor road infrastructure hinders walking, the most common exercise among PVIs. Even apps supporting neighbourhood exploration to encourage people to walk on the road, are of limited relevance for PVIs in India. Moreover, participants stated their struggles in finding other city infrastructures to support physical activities, including accessible playgrounds and player communities. *E.g.*,

> *"Even when I have a* (tennis) *court, it's very difficult to find someone to play with me."* - P19.

The infrastructure needs expressed by our participants are minimal, which are taken for granted in developed countries, such as open public spaces, parks, and accessible roads, to pursue basic physical activities, including walking, jogging and games requiring minimal equipment (blind cricket, blind football). The availability of such spaces may attract other PVIs, thus enabling team sports.

3.7 Impact of COVID-19

The pandemic severely impacted our participants, uncovering barriers in their pursuit to physical fitness. To fight COVID-19, the government of India has been imposing restricted mobility, forcing people to stay at home. This negatively impacted the already fragile outdoor movement of our participants.

> *"I used to go to the football camp, but that stopped due to COVID."*-P6.
> *"I used to go for a walk outside daily morning with my family members, mostly to a park which have some gym equipment. I walked and also used those equipments. But yeah, now we stopped due to COVID."* - P15.

The pandemic triggered participants' concern about their physical health. Eight participants expressed decline in their physical and mental health due to the COVID-forced sedentary lifestyle. To counter this, participants mentioned changing their eating habits to improve health, and walking throughout the day in and around their homes as a form of physical activity.

4 Discussion and Design Implications

In this paper, we studied the exercise patterns of PVIs in India and factors influencing it, by conducting semi-structured interviews of 24 adults with visual impairments. We discovered patterns that were novel and/or in contrast to previous findings [16], [17], such as intrinsic motivation, minimal use of technology, infrastructural and societal barriers, role of blind schools, and support of friends, family, and peers. Prior exercise-related work for blind people has been restricted to developed regions, which assumes accessible road infrastructure and prevalence of latest technologies, which are not true for India. Thus, the novel findings of our work have potential to influence the design of accessible physical activities for a majority of the global blind population living in developing regions.

Next, we briefly discuss design implications for accessible exercising.

Minimal Technological Solution: In spite of our participants being well-educated and technology-friendly, we found their investment in exercise-related technology to be minimal. Ten of them did not even use their phones to help with their exercising, and a majority of them were unaware of existence of such apps. Prior work in resource-rich environments has investigated a range of technologies for self-tracking and exergames [11], [12], [13], [15], [16] involving body sensors, depth cameras, and smart exercise equipment. However, such technologies are not affordable for our participants. Enabling accessible exercise technology in the Indian context requires a novel approach, which increases awareness about the influential role of technology in exercises, may be in their educational/workplace

settings, and exploits existing technologies (like inbuilt smartphone sensors). For instance, VStroll [7] uses smartphone sensors to promote walking among PVIs, by enabling them to virtually explore real-world locations while walking.

Schools for Blind: A majority of PVIs in India attend schools for the blind, instead of inclusive school. Prior work has reported various shortcomings of such blind schools especially with respect to lack of access to STEM education [8]. However, from the perspective of learning life-skills and physical activities, the role played by such special schools need further research. On the flip side, to make inclusive schools accessible, it should have well-trained instructors to teach accessible sports/exercises, and provide peer support to PVIs [22]. A hybrid approach, wherein blind children attend schools for the blind during their early years of education and transition to an integrated school setting, is worth exploring.

Restricted Walking: Walking was the most common exercise among our participants. Health experts recommend 150 minutes of brisk walking per week [1]. However, due to poor road infrastructure and safety concerns, walking in restricted spaces – home, terrace, nearby parks – is the only viable option for our participants. There is scope to design future apps that can provide engaging experience to PVIs while they walk in such restricted spaces (similar to [7]).

Family and Peer Support: Prior work in developed regions found that with the increase in vision loss, parents' expectations for their children's ability to be physically active decreased [17]. In contrast, friends and family not only motivated our participants to take part in physical activities, but also enabled it by facilitating their transportation to attend sports events and fitness classes. However, non-availability of such support systems acted as barrier to pursue these activities. Hence, efforts to enhance exercise behavior of PVIs in India should consider creating and optimally utilizing such support groups.

Limitations: This study was conducted during COVID-19 outbreak in India and restricted the recruitment of participants via email/WhatsApp. As a result, we could not recruit PVIs who are illiterate, or do not have phones (for instance, older adults) or Internet connectivity. In addition, participants of our study predominantly represent the middle-income, urban population of India, usually considered as the early adopters of technology. Reduced access to education and technology create barriers to physical fitness for PVIs [5], thus findings from our work cannot be generalised to the entire population of PVIs in India.

5 Conclusion

We emphasize the specificity of our study here as a reminder that this study is at best a first step towards characterizing exercising patterns among PVIs outside of the developed regions context. We found novel insights which are in sharp contrast to prior findings from the developed world. Our participants minimally used exercise technology with no/rare access to fitness bands and exergames, studied in special schools for blind instead of inclusive schools, and faced severe infrastructural and social barriers. An understanding of such differences can help with a global exploration of issues around exercise and accessibility.

References

1. CDC: How much physical activity do adults need? (2019), https://www.cdc.gov/physicalactivity/basics/adults/index.htm
2. Çolak, T., Bamaç, B., Aydin, M., Meriç, B., Özbek, A.: Physical fitness levels of blind and visually impaired goalball team players. Isokinetics and exercise science **12**(4), 247–252 (2004)
3. Correspondent, H.: Number of blind to come down by 4m as india set to change blindness definition (2017), https://bit.ly/3aXHKB7
4. Dawn, R.: The portrayal of disability in indian culture: An attempt at categorization (01 2015)
5. Dwyer, A.: Factors That Increase Physical Activity in Youth Who Are Visually Impiared. Kinesiology, Sport Studies, and Physical Education Synthesis Projects (May 2017), https://digitalcommons.brockport.edu/pes_synthesis/22
6. Hopkins, W.G., Gaeta, H., Thomas, A.C., Hill, P.N.: Physical fitness of blind and sighted children. European Journal of Applied Physiology and Occupational Physiology **56**(1), 69–73 (Jan 1987). https://doi.org/10.1007/BF00696379, https://doi.org/10.1007/BF00696379
7. India, G., Jain, M., Karya, P., Diwakar, N., Swaminathan, M.: Vstroll: An audio-based virtual exploration to encourage walking among people with vision impairments. In: ASSETS 2021. ACM (October 2021)
8. India, G., Ramakrishna, G., Pal, J., Swaminathan, M.: Conceptual learning through accessible play: Project torino and computational thinking for blind children in india. In: ICTD 2020 (June 2020)
9. Kumar, P.: Evolving role of special schools for children with visual impairment in india (2019), https://ncert.nic.in/pdf/publication/journalsandperiodicals/ journalofindianeducation/JIE_May_18.pdf
10. Lieberman, L.J., McHugh, E.: Health-related fitness of children who are visually impaired. Journal of Visual Impairment & Blindness **95**(5), 272–287 (2001), https://doi.org/10.1177/0145482X0109500503
11. Morelli, T., Foley, J., Columna, L., Lieberman, L., Folmer, E.: Vi-tennis: A vibrotactile/audio exergame for players who are visually impaired. In: FDG '10. p. 147–154. ACM, New York, NY, USA (2010), https://doi.org/10.1145/1822348.1822368
12. Morelli, T., Foley, J., Folmer, E.: Vi-bowling: A tactile spatial exergame for individuals with visual impairments. In: ASSETS '10. p. 179–186. ACM, New York, NY, USA (2010), https://doi.org/10.1145/1878803.1878836
13. Morelli, T., Foley, J., Lieberman, L., Folmer, E.: Pet-n-punch: upper body tactile/audio exergame to engage children with visual impairments into physical activity," presented at the. In: Proceedings of Graphics Interface 2011 (2011)
14. NAB: Nan department of education (2019), https://www.nabindia.org/education/
15. Rector, K., Bennett, C.L., Kientz, J.A.: Eyes-free yoga: An exergame using depth cameras for blind amp; low vision exercise. In: ASSETS '13. ACM, New York, NY, USA (2013), https://doi.org/10.1145/2513383.2513392
16. Rector, K., Milne, L., Ladner, R.E., Friedman, B., Kientz, J.A.: Exploring the opportunities and challenges with exercise technologies for people who are blind or low-vision. In: ASSETS '15. p. 203–214. ACM, New York, NY, USA (2015), https://doi.org/10.1145/2700648.2809846
17. Stuart, M.E., Lieberman, L., Hand, K.E.: Beliefs about physical activity among children who are visually impaired and their parents.

Journal of Visual Impairment & Blindness **100**(4), 223–234 (2006), https://doi.org/10.1177/0145482X0610000405
18. UNESCO: N for nose: State of the education report for india 2019: Children with disabilities (2019), https://en.unesco.org/news/n-nose-state-education-report-india-2019-children-disabilities
19. View, S.: Where do children who are blind or visually impaired go to school? (2015), https://sandysview1.wordpress.com/2015/06/04/where-do-children-who-are-blind-or-visually-impaired-go-to-school/
20. Weil, E.: Obesity among adults with disabling conditions. JAMA **288**(10), 1265 (Sep 2002), https://doi.org/10.1001/jama.288.10.1265
21. Wikipedia: Classification of indian cities (2020), https://en.wikipedia.org/wiki/Classification_Indian_cities
22. Williams, C., Armstrong, N., Eves, N., Faulkner, A.: Peak aerobic fitness of visually impaired and sighted adolescent girls. Journal of visual impairment & blindness **90**(6), 495–500 (1996)
23. Yuan, B., Folmer, E.: Blind hero: Enabling guitar hero for the visually impaired. In: ASSETS '08. p. 169–176. ACM, New York, NY, USA (2008), https://doi.org/10.1145/1414471.1414503
24. Zhu, Y., Wang, C., Liu, W., Lv, Y.: Running guide: Design of a marathon navigation system for visually impaired people. In: Chinese CHI '19. p. 7–15. ACM, New York, NY, USA (2019), https://doi.org/10.1145/3332169.3333579

A Codebook

Theme/Code	Count	**Theme/Code**	Count
Access to City Infrastructure (24.11%)	**116**	**Family, Friends and Peer Support (13.92%)**	**67**
Poor road infrastructure	50	Friends and peer support	25
Public fitness infrastructure	45	Family support	21
Safety concerns on roads	21	Exercise partner	21
Physical and Mental Health (20.58%)	**99**	**Role of Technology (12.26%)**	**59**
Exercise habits	66	Exercise-related apps	46
Improved physical health	17	Accessibility issues	13
Improved mental health	16	**Stigmatization by Society (9.14%)**	**44**
Importance of Educational Institution (15.8%)	**76**	Disability stigma	44
Sports/exercises in school	40	**Impact of COVID (4.15%)**	**20**
Schools for the blind	36	Impact of COVID	20

Table 1. Codebook from our analysis of interview transcripts. The codebook shows seven themes (bold), 15 codes, prevalence (%) for each theme, and the total count of each theme and code.