Use and underuse of mobility aids in individuals with visual impairment: a cross-sectional study of a Norwegian sample

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Abstract

Purpose: To examine the use and underuse of mobility aids in individuals with visual impairment.

Methods: A telephone survey including a probability sample of 736 adults who were members of the Norwegian Association of the Blind and Sighted (response rate: 61%). The interviews took place between January and May 2017, collecting information about access, use, underuse, and training in five types of mobility aids (white cane, guide dog, GPS, door-to-door transport, and sighted guide). For each mobility aid, we obtained data for underuse defined as non-use despite expecting benefits of use in terms of increased mobility or safety. Participants also answered questions about loneliness (Three-Item Loneliness Scale) and life satisfaction (Cantril's Ladder of Life Satisfaction).

Results: Of the participants, 69% reported using at least one type of mobility aid. Use of specific aids ranged from 12% for the GPS to 52% for door-to-door transport. Estimates of underuse ranged between 14% for door-to-door transport and 28% for GPS. Underuse was not related to lack of resources, as many non-users expecting benefits had access to mobility aids and had undergone training in its use. For example, 81% of the non-users of the white cane had access to a cane. In post-hoc analyses, non-users who expected benefits from use had lower life satisfaction compared with users.

Conclusions: Many individuals with visual impairment do not use mobility aids. Strategies that help visually impaired individuals overcome barriers to the use of mobility aids may improve their sense of safety, mobility, and quality of life.

Keywords: assistive technology; blindness; mobility aids; visual impairment; quality of life; underuse; white cane

Introduction

Visual impairment, i.e., low vision or blindness, affects about 1 billion of the world's population [1], and can occur at all ages and with different types of causes, severities, and progression rates. A vision loss may affect people's health and life in general. Previous studies have shown lower quality of life among people with visual impairment compared to the general population [2], as well as a higher prevalence of loneliness [3] and depression [4]. They are also more prone to falls and serious accidents [5], and many find it challenging to perform daily life activities, such as independent mobility and using transportation [6]. In fact, the ability to get around is one of the strongest predictors of social participation and quality of life in this population [7, 8].

Although universal design could be helpful [9], it has not been successfully implemented in society [10] and it may not eliminate all the mobility barriers that people with visual impairment experience. To ensure safe and independent mobility, many people with visual impairment may therefore need environmental adaptions or access to different types of mobility aids, such as special transportation services, human guide, and different types of assistive devices [11]. The most common types of assistive devices include white canes (long, short, folding, telescopic), guide dogs, and electronic travel aids (e.g., GPS) [11].

To design appropriate rehabilitation services, it is vital to obtain knowledge about the use and underuse of mobility aids in specific populations. According to the UNs human rights [13], people with visual impairment have a fundamental right to access appropriate mobility aids. Not only do mobility aids offer increased mobility and safety of those in need. For people with visual impairment, the use of mobility aids have been highlighted as a key strategy for promoting social participation and independent

living in this population [11], as well as having the potential to improve functioning and quality of life [14, 15]. However, we found in a previous qualitative study that some people with visual impairment abandoned or did not use mobility aids, despite expecting benefits of use in terms of increased mobility or safety [12]. In the present study, we have operationalized this as underuse.

Reasons for the underuse are multifactorial, and may be related to various psychosocial, cultural, and environmental factors, such as stigma and not wanting to signal the impairment in public [12, 16, 17]. Underuse could also be a matter of access and training in the use of mobility aids [16, 17]. In support of this reasoning, countries that provides a good quality of care and free assistive aids to anyone in need could have a lower prevalence of underuse of mobility aids compared with others. Norway is a high-income country with a unified, national delivery system, where everyone can apply for state-funded assistive aids if they have a medical diagnosis of a visual impairment [18]. This grants the individual legal rights to receive necessary and appropriate aids tailored to the individual's needs, free of charge [19]. The Norwegian state also covers costs related to proper fitting, maintenance, and training in how to use the aids correctly [20]. Because of this, we hypothesise that the use of mobility aids to be high in Norway and the degree of underuse to be low.

In the total population of people with visual impairment, knowledge about the use and underuse of different types of mobility aids is limited. For GPS, specialised transportation services, and human guide, we have been unable to identify any estimates from studies involving population samples. Furthermore, estimates of use for the white cane and guide dog have varied across different countries. For white cane, estimates have varied from 4% in the United States to 44% in the Netherlands [21-24]. For guide

dog, estimates have varied from 1% in France to 14% in the Netherlands [20-22, 25]. To our knowledge, no study has examined use and underuse of mobility aids in the Norwegian population of people with visual impairment.

Therefore, the aim of this study was to estimate the use and underuse of mobility aids in individuals with visual impairment. To estimate underuse, we have operationalised this as a lack of use, despite the person believing that regular use would provide better mobility or safety.

Material and Methods

Design and participants

The present study is a part of a larger cross-sectional study about serious life events and mental health in people with visual impairment in Norway. A telephone survey was conducted between January and May 2017, in a nationwide probability sample of adult members from the Norwegian Association of the Blind and Partially Sighted. All members aged 18 years or older were eligible to participate if they had a diagnosis of visual impairment and were able to speak and understand the Norwegian language. When applying for membership, the individual had to present a medical documentation of visual impairment or an irreversible eye condition causing visual impairment. Data were collected by structured telephone interviews. The telephone interviews and the randomisation were conducted by employees at a professional interview company. The interview guide covered a broad range of topics, including mental health, quality of life, serious life events, coping, living conditions, and the use of mobility aids. Each interview took on average 30 minutes to complete.

As most members were of old age (Mean: 72 years), age-stratified sampling was

used to involve the entire visual impairment population. First, the study population was divided into four age groups (years: 18–35, 36–50, 51–65, ≥ 66) and then an equal number of members across the different age groups were randomly asked to participate. Of the 1216 contacted, 736 (61%) participated by completing the interview. A flow chart of the sample selection is provided elsewhere [26].

Measures

Mobility aids

The questions concerning mobility aids are based on findings from a previous qualitative study [12], and created in cooperation with the Norwegian Association for the Blind and Partially Sighted. We chose to obtain information about the most commonly used mobility aids at that time point. First, the participants were asked questions about their access and use of five different types of mobility aids (i.e. white cane, guide dog, GPS, door-to-door transportation, sighted guide/assistant). For white cane, guide dog, and GPS, the participants were also asked to indicate whether they had undergone training in its use. In the present study, access is defined as having the tool available at home or being registered as a service user. Training refers to people undergoing courses at public rehabilitation services or courses arranged by the Norwegian Association of the Blind and Partially Sighted.

To obtain information about underuse, the following two questions were asked to non-users of a particular mobility aid: (1) "*Do you expect increased mobility in your daily life if you had used the following mobility aid more actively*?" and (2) "*Do you expect increased safety or feel less exposed to dangers if you had used the following mobility aid more actively*?"

For each of the five mobility aids, those participants who reported using the aid were classified as "*users"*; otherwise, they were classified as "*non-users"*. Non-users of a specific aid who responded "*yes*" to at least one question about expected benefits of use were classified as "*non-users expecting benefits"*. The term "*underuse"* refers to the latter category.

Quality of life

Quality of life involved measures of loneliness and life satisfaction. Information about the participant's loneliness were obtained by the Three-Item Loneliness Scale [27]. The scale involved three questions related to missing close friendships, feelings of social exclusion, and feelings of social isolation. The response categories were "hardly ever" (1), "sometimes" (2), and "often" (3). We then calculated a sum score, ranging from 3 to 9, were higher scores means higher levels of loneliness. To measure the participant's life satisfaction, we used the Cantril's Ladder of Life Satisfaction [28]. The participants were asked to imagine a ladder with 10 steps, with 1 representing the worst life possible and 10 the best life possible. In the analyses, the scales were treated as untransformed, continuous variables.

Sociodemographic and vision-related information

Data were collected about the participant's age, gender, education (years: < 14, ≥ 14), marital status (married/cohabitant, other statuses not involving married/cohabitant (single, divorced, widowed)), employment (employed, not employed, retired), place of residence (rural, urban), self-reported severity of vision loss (blind, moderate/severe), and having other impairments in addition to vision loss (no, yes). We also created an "*onset-age of vision loss*" variable by subtracting the participant's age with the number

of years since onset of vision loss. The variable was either treated as a continuous variable or dichotomized into "*congenital*" and "*acquired"* vision loss.

Missing data

We had missing data due to non-response. Additionally, there were missing responses on questions related to underuse, ranging from 21 to 49% across the five types of mobility aids. The missing data emerged from filter errors in the interview guide; hence, some participants reporting "no" to question about mobility aid use did not receive the opportunity to answer the underuse questions. We chose to treat the missing data as complete cases, as we expect the data to be missing completely at random. Apart from that, the study had no missing data.

Statistical analysis

We used Stata Version 16 (Stata Corp., Texas, USA) for all statistical analyses. The significance level was set at $p = 0.05$. Descriptive statistics included means, standard deviations, percentages, and tetrachoric correlations. For each of the five mobility aids, the proportion of use and underuse of mobility aids was estimated with corresponding 95% confidence intervals (CIs).

In post-hoc analyses, we created five new variables; one for each type of mobility aid. The variables had the following two categories: users (0) and non-users expecting benefits from use (1). We have chosen to restrict our analysis to these two categories, as the aim of service delivery systems is to get all individuals in need of a particular mobility aid to start using it in daily life.

We then performed two types of analyses. By using log-Poisson generalized linear models, we first examined the probability of being a non-user expecting benefits

relative to regular users on various sociodemographic and vision-related characteristics. The independent variables included age (years: 18–35, 36–50, 51–65, ≥ 66), gender, education (years: < 14 vs. ≥ 14), marital status (married/cohabitant, yes vs. no), self-reported severity of impairment (continuous), onset-age of vision loss (acquired vs. congenital), and other impairments in addition to vision loss (yes vs. no). In fully adjusted models, the variables were entered into one block. The results were presented as proportion ratios (PRs) and 95% CIs. Second, we carried out independent sample t-tests to examine differences between users and non-users expecting benefits in their mean scores of loneliness and life satisfaction.

Ethics

The study was carried out in accordance with principles of anonymized data, and approved by the Regional Committee for Medical and Health Research Ethics (Reference number: 2016/1615A). No identifying information was collected. The participants were informed about all aspects of the study, including potential risks and the voluntary nature of the survey, and consented by completing the survey. Those with subjective psychological distress, were offered referrals to psychological counselling after the interview.

Results

Our sample included 736 participants (response rate: 61%). Non-responders were more likely to be younger or older compared to the responders. Table 1 shows the characteristics of the study population [Table 1 here]. The participants had a mean age of 51 years (SD: 1.7; range: 18–95). Most participants were females (55%), had less than 14 years of education, and resided in urban areas. Forty percent were employed, and 47% were married or had a cohabitant. The onset-age of vision loss ranged from 0

to 76 years (Mean: 19 years), and was primarily caused by diseases (50%), followed by congenital causes (43%), and injuries (7%). Twenty-five percent had self-reported blindness, and the remaining 75% had self-reported moderate-to-severe visual impairment. Roughly one-third of participants had other impairments in addition to the vision loss.

Use of mobility aids

Estimates of use of mobility aids are displayed in Table 2 [Table 2 here]. A total of 69% of participants used at least one type of mobility aid. The most frequently used type of mobility aid was found for door-to-door transport (52%), followed by the white cane (38%), sighted guide/assistant (28%), guide dog (13%), and GPS (12%). The rate of use for the different types of mobility aids was highest in the three youngest age groups (range p-values: < 0.001–0.17), and among participants with blindness versus moderate-to-severe visual impairment (range p-values: < 0.001–0.006).

Most participants reported using more than one type of mobility aid. Of the users, 29% used one type of aid, 60% used two or three types, and 11% used four or five types. The strongest correlations were observed between transport services and sighted guide (r = 0.54), between white cane and transport services (r = 0.53), and between white cane and guide dog (r = 0.50).

Underuse of mobility aids

In Table 2, we also present the prevalence of underuse of mobility aids, defined as non-users expecting benefits of use. For GPS and sighted guide, 28% and 25% of non-users, reported that they expected benefits of use, respectively. Expectations of benefits of use were also prevalent among non-users of guide dog (21%), white cane (16%), and door-

to-door transport (14%).

Relation to access and training of mobility aids

Figure 1 shows the percentage of access and training of mobility aids among non-users expecting benefits from use [Figure 1 here]. Underuse was not necessarily a matter of access or training. Of non-users expecting the white cane to increase mobility or safety, 81% had access to a cane, and 52% had undergone training. A large percentage of non-users expecting benefits had also access to and/or training in the use of the GPS (access: 42%, training: 14%), door-to-door transportation (access: 49%), and sighted guide (access: 21%). Four percent of non-users had access to a guide dog, and 18% had undergone guide dog training (Figure 1).

Results from post-hoc analyses

Sociodemographic and vision-related factors

The associations of underuse with various sociodemographic and vision-related factors are shown in the online appendices [Appendix 2 to 6 here]. In the fully adjusted models, being of middle age, lower education, and having acquired vision loss were statistically significantly associated with underuse for at least two of five mobility aids. Furthermore, the degree of underuse existed across all degrees of visual impairment, but the probability became higher except for GPS, the likelihood of underuse significantly decreased with increasing self-rated severity of visual impairment.

Associations with quality of life

The sample had a mean score (SD) of 4.9 (1.9) for loneliness and 7.8 (2.0) for life satisfaction. Table 3 shows the associations between mobility aid use and outcomes of

quality of life [Table 3 here]. Non-users expecting benefits of use had generally lower levels of life satisfaction compared with regular users for the white cane (Mean (SD): 6.5 (2.1) versus 7.0 (2.0), p = 0.04), guide dog (Mean (SD): 6.3 (2.1) versus 6.9 (2.0), p = 0.06), and GPS (Mean (SD): 6.5 (2.1) versus 7.1 (1.8), p = 0.03). Also, higher mean scores on loneliness were found among non-users who expected benefits of a guide dog compared with guide dog users (Mean (SD): 5.9 (1.9) versus 5.0 (1.9), p = 0.001). No other differences were found (Table 3).

Discussion

We obtained data from a large probability sample of people with visual impairment to estimate the use and underuse of mobility aids. We found varying estimates of use, ranging from 12% for GPS to 52% for door-to-door transportation. Estimates of underuse ranged from 14% for door-to-door transportation to 28% for GPS. Underuse was not related to lack of resources, as many non-users expecting benefits of use had access to the specific mobility aid and had relatively high degree of training in its use.

The percentage using a white cane, guide dog, or GPS are high in a global context, of which one in ten people in need have access to assistive technology [28]. Furthermore, our estimates for the use of the white cane (38%) and guide dog (13%) are equal to or higher compared to estimates from other western countries, such as France [21], the Netherlands [22], the United Kingdom [23], and the United States [24, 25]. Therefore, our results agree to our initial hypothesis, suggesting a relatively high usage of mobility aids among people with visual impairment in Norway.

Despite a high degree of use relative to other countries, there was still a high degree of underuse. Our results of easy access to mobility aids and relatively high proportion of participants who have undergone training in its use suggest other

explanations for the underuse than lack of resources. A plausible hypothesis is related to stigma and the fear of labelling [12, 16, 17, 30, 31]. In the present study, many non-users had access to the white cane. The white cane is a barrier to other humans and a visible symbol of blindness, disability, and helplessness [30]. Using the cane may attract unwanted public attention and highlight differences associated with stigma, making people self-conscious, and induce feelings of vulnerability and embarrassment [31]. To maintain self-respect, some individuals choose to use their cane only in situations where it is necessary or take the risk of accidents by abandoning or rejecting their cane [12].

The reluctance to use appropriate mobility aids, and particularly the white cane, could also be linked to aspects of identity and the process of adapting to vision loss. These hypotheses are supported by our findings of high degree of underuse in older age groups and those with late-life vision loss. The ability to adapt to the vision loss and to learn new skills and technologies may be greater at a younger age. Also, a vision loss may have different meanings to different people. Some may identify themselves as visually impaired. In these cases, the individual is more likely to perceive the white cane as helpful and as a positive resource [30, 32]. Others are in a transition phase or identify themselves as sighted. These people may be less likely to acknowledge the emotional impact of a vision loss [32]. If not being emotionally ready, people may be more reluctant to be open about their impairment in public and avoid using mobility aids, especially in environments where they know others [33].

Our findings of lower life satisfaction among non-users expecting benefits from use compared to regular users could be explained by that using mobility aids increases the participant's quality of life. This is consistent with the literature, suggesting a possible relationship although the quality of evidence is considered low [14]. The causal

relationship could also be reversed; hence, people who are satisfied with their life are generally more likely to use mobility aids in situations where they believe this would have increased their mobility or safety.

Strengths and limitations

Strengths of this study were a large nationwide probability sample and the use of interviews to include individuals who might not responded to postal surveys. By oversampling younger adults, we were able to obtain accurate data for the entire population of people with visual impairment. The response rate of 61% is relatively high, and minimizes the likelihood of non-response bias [34].

The study had certain limitations. First, our sample was recruited from a member organisation for the blind and partially sighted, which may question the representativeness of the participants. Compared with census data from Statistics Norway [35], gender, employment, and place of residence did not differ for our study participants, but their their level of education was higher (Higher education: 46% versus 30%). Second, oversampling of young people can make our data less representative for the elderly population. There were some differences in use and underuse with regards to age, but the differences were only small and had minor impact on our findings. Precise estimates of the whole population of people with visual impairment can be obtained if having accurate information on the population's age distribution. Third, we had limited information about the non-responders, and do not know how non-responding might have influenced our results. Fourth, this study relied on cross-sectional data, which restricted our ability to make any causal inferences. Fifth, use and underuse was classified in our study based on the participant's own evaluations, which may differ from those made by professionals in this field. Lastly, the inclusion of dichotomous

response categories limited our ability to obtain detailed information relating to access, training, and use of the different mobility aids, as well as to study reasons for using and not using them.

Implications

Our results show that a high proportion of non-users of mobility aids believe they would benefit from using it. Underuse of mobility aids may not only influence visually impaired people's mobility and safety, but it may also affect their quality of life.

A successful integration of mobility aids in people's daily life cannot be achieved by sufficient accessibility or training in the use of mobility aids alone. Based on previous qualitative evidence [12, 30, 31], we hypothesise that the high degree of underuse may be explained by stigma. For individuals who have already received access to mobility aids, user support and close follow up are crucial, and these individuals should be encouraged to use their assistive aids in situations where it can increase their mobility or safety. Sometimes it is about overcoming the fear of labelling. Education or other strategies aiming towards changing the general public's attitudes of assistive aids, and more broadly views regarding disability, are needed to improve the adoption of such aids.

Reluctance to use mobility aids may have deeper existential roots, and because of stigma or other psychosocial or cultural issues, some individuals struggle to adapt and incorporate the aid into their identity and self-image [30]. The rehabilitation professionals and others involved in the provision and training of mobility aids are recommended to look beyond the functional opportunities of mobility aids to also focus on the person's readiness to use mobility aids and their values, attitudes, and emotional responses when using them. This will require the professional to be sensitive to the

user’s lived experiences, and to be alert of the social and cultural meanings of mobility aids and disability in general.

Conclusion

In our sample of 736 people with visual impairment, there was a high rate of use of the different mobility aids, with the door-to-door transportation, white cane, and sighted guide being the most commonly used aids. We also found high rates of underuse and hypothesised that this was related to stigma and the adaptation process. Non-users who expected benefits from using mobility aids were less satisfied with their life in general. Strategies that reduce stigma associated with the use of mobility aids are recommended, including community and sharing of knowledge among potential users. The general population's attitudes towards minority groups and diversity can also be important and should always be on society's agenda.

To provide better insights into the underuse issue, future research is needed to explore the lived experiences of people with visual impairment, and reasons why they choose to use or not to use different types of mobility aids. In particular, studies should examine how stigma and emotional readiness may affect the likelihood of using mobility aids, preferably by using prospective study designs.

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Declaration of interest

The authors report no conflicts of interest.

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Appendices

Appendix 1. Questions related to access, training, use, and underuse of five types of mobility aids.

We will now ask you questions about assistive aids and its use.

Do you have access to:

White cane	☐ yes ☐ no
Guide dog	☐ yes ☐ no
GPS	☐ yes ☐ no
Door-to-door transportation	☐ yes ☐ no
Sighted guide/assistant	☐ yes ☐ no

Have you undergone training in using:

White cane	☐ yes ☐ no
Guide dog	☐ yes ☐ no
GPS	☐ yes ☐ no

Do you use actively:

White cane	☐ yes ☐ no
Guide dog	☐ yes ☐ no
GPS	☐ yes ☐ no
Door-to-door transportation	☐ yes ☐ no
Sighted guide/assistant	☐ yes ☐ no

(For each assistive aid the participant report not using):

Do you expect increased mobility in your daily life if you had used the following mobility aid more actively?

White cane ☐ yes ☐ no

Guide dog ☐ yes ☐ no

GPS ☐ yes ☐ no

Door-to-door transportation ☐ yes ☐ no

Sighted guide/assistant ☐ yes ☐ no

(For each assistive aid the participant report not using):

Do you expect increased safety or feel less exposed to dangers if you had used the following mobility aid more actively?

White cane ☐ yes ☐ no

Guide dog ☐ yes ☐ no

GPS ☐ yes ☐ no

Door-to-door transportation ☐ yes ☐ no

Sighted guide/assistant ☐ yes ☐ no

Appendix 2. Associated factors of underutilization of white cane among individuals with visual impairment.

Table 4. Associations with underuse of the white cane in the visual impairment population (N = 374), estimated using regression models.

	Unadjusted		Fully adjusted	
Covariates	PR (95% CI)	p-value	PR (95% CI)	p-value
Age groups				
18–35 years	Reference		Reference	
36–50 years	1.20 (0.75–1.94)	0.44	1.03 (0.66–1.63)	0.89
51–65 years	0.86 (0.51–1.43)	0.56	0.77 (0.48–1.23)	0.27
≥ 66 years	0.71 (0.39–1.29)	0.26	0.69 (0.39–1.22)	0.20
Females vs. males	1.49 (1.03–2.16)	0.04	1.30 (0.90–1.87)	0.16
Education, ≥ 14 years vs. < 14	1.55 (1.07–2.24)	0.02	1.40 (0.98–1.96)	0.06
Married/cohabitant, yes vs. no	1.20 (0.84–1.70)	0.31	1.28 (0.93–1.78)	0.13
Severity of VI (continuous)	0.43 (0.35–0.54)	< 0.001	0.50 (0.38–0.60)	< 0.001
Acquired vs. congenital VI	1.56 (1.06–2.29)	0.02	1.24 (0.84–1.85)	0.28
Other impairments, yes vs. no	1.35 (0.95–1.95)	0.10	1.17 (0.84–1.62)	0.35

Note. VI: visual impairment; PR: percentage ratios.

Appendix 3. Associated factors of underutilization of guide dog among individuals with visual impairment.

Table 5. Associations with underuse of guide dog in the visual impairment population (N = 170), estimated using regression models.

	Unadjusted		Fully adjusted	
Covariates	PR (95% CI)	p-value	PR (95% CI)	p-value
Age groups				
18–35 years	Reference		Reference	
36–50 years	0.97 (0.60–1.58)	0.92	1.02 (0.65–1.61)	0.94
51–65 years	0.97 (0.60–1.58)	0.90	0.98 (0.65–1.49)	0.93
≥ 66 years	0.94 (0.54–1.62)	0.82	0.98 (0.62–1.57)	0.94
Females vs. males	0.85 (0.61–1.18)	0.32	0.91 (0.66–1.25)	0.55
Education, < 14 vs. ≥ 14 years	1.51 (1.04–2.19)	0.03	1.20 (0.84–1.71)	0.33
Married/cohabitant, no vs. yes	0.70 (0.50–0.99)	0.05	0.76 (0.55–1.06)	0.10
Severity of VI (continuous)	0.62 (0.50–0.77)	< 0.001	0.73 (0.59–0.90)	0.003
Acquired vs. congenital VI	1.97 (1.33–2.92)	0.001	1.73 (1.18–2.53)	0.005
Other impairments, yes vs. no	1.93 (1.40–2.67)	< 0.001	1.57 (1.13–2.18)	0.007

Note. VI: visual impairment; PR: percentage ratios.

Appendix 4. Associated factors of underutilization of GPS among individuals with visual impairment.

Table 6. Associations with the underuse of GPS in the visual impairment population (N = 217), estimated using regression models.

	Unadjusted		Fully adjusted	
Covariates	PR (95% CI)	p-value	PR (95% CI)	p-value
Age groups				
18–35 years	Reference		Reference	
36–50 years	1.70 (1.15–2.51)	0.008	1.61 (1.10–2.34)	0.01
51–65 years	1.85 (1.25–2.73)	0.002	1.70 (1.16–2.50)	0.007
≥ 66 years	1.80 (1.18–2.75)	0.007	1.58 (1.02–2.44)	0.04
Females vs. males	0.97 (0.78–1.22)	0.81	1.01 (0.81–1.27)	0.90
Education, < 14 vs. ≥ 14 years	1.26 (1.00–1.59)	0.05	1.21 (0.96–1.51)	0.11
Married/cohabitant, no vs. yes	1.00 (0.80–1.25)	0.99	0.95 (0.77–1.18)	0.67
Severity of VI (continuous)	1.06 (0.91–1.23)	0.47	1.10 (0.95–1.26)	0.21
Acquired vs. congenital VI	1.56 (1.22–2.00)	< 0.001	1.47 (1.15–1.87)	0.002
Other impairments, yes vs. no	1.11 (0.89–1.40)	0.36	1.07 (0.87–1.33)	0.52

Note. VI: visual impairment; PR: percentage ratios.

Appendix 5. Associated factors of underutilization of door-to-door transportation among individuals with visual impairment.

Table 7. Associations with the underuse of door-to-door transportation in the visual impairment population (N = 469), estimated using regression models.

	Unadjusted		Fully adjusted	
Covariates	PR (95% CI)	p-value	PR (95% CI)	p-value
Age groups				
18–35 years	Reference		Reference	
36–50 years	1.86 (0.91–3.80)	0.09	1.71 (0.82–3.54)	0.15
51–65 years	2.30 (1.15–4.58)	0.02	2.11 (1.05–4.23)	0.04
≥ 66 years	1.60 (0.75–3.42)	0.22	1.39 (0.65–2.97)	0.39
Females vs. males	0.92 (0.62–1.35)	0.66	0.84 (0.58–1.22)	0.36
Education, < 14 vs. ≥ 14 years	1.61 (1.06–2.45)	0.03	1.80 (1.17–2.79)	0.008
Married/cohabitant, no vs. yes	1.58 (1.06–2.33)	0.02	1.68 (1.12–2.54)	0.01
Severity of VI (continuous)	0.59 (0.46–0.77)	< 0.001	0.62 (0.48–0.80)	< 0.001
Acquired vs. congenital VI	1.28 (0.86–1.90)	0.23	1.06 (0.71–1.57)	0.79
Other impairments, yes vs. no	0.83 (0.55–1.25)	0.38	0.84 (0.56–1.26)	0.41

Note. VI: visual impairment; PR: percentage ratios.

Appendix 6. Associated factors of underutilization of human guide among individuals with visual impairment.

Table 8. Associations with the underuse of human guide in the visual impairment population (N = 321), estimated using regression models.

	Unadjusted		Fully adjusted	
Covariates	PR (95% CI)	p-value	PR (95% CI)	p-value
Age groups				
18–35 years	Reference		Reference	
36–50 years	1.71 (0.98–2.96)	0.06	1.55 (0.90–2.68)	0.12
51–65 years	2.62 (1.58–4.35)	< 0.001	2.37 (1.45–3.87)	0.001
≥ 66 years	1.29 (0.69–2.43)	0.43	1.16 (0.62–2.15)	0.64
Females vs. males	0.80 (0.59–1.08)	0.14	0.76 (0.57–1.00)	0.05
Education, < 14 vs. ≥ 14 years	1.21 (0.89–1.66)	0.23	1.21 (0.88–1.65)	0.24
Married/cohabitant, no vs. yes	1.27 (0.94–1.70)	0.12	1.19 (0.88–1.61)	0.26
Severity of VI (continuous)	0.63 (0.52–0.76)	0.001	0.66 (0.55–0.80)	< 0.001
Acquired vs. congenital VI	1.28 (0.94–1.74)	0.12	1.10 (0.82–1.48)	0.53
Other impairments, yes vs. no	0.90 (0.66–1.23)	0.51	0.89 (0.66–1.21)	0.45

Note. VI: visual impairment; PR: percentage ratios.

Table 1. Characteristics of the visual impairment population (N = 736).

Characteristics	N (%)
Age	
18–35 years	157 (21.3)
36–50 years	186 (25.3)
51–65 years	200 (27.2)
≥ 66 years	193 (26.2)
Female gender	403 (54.8)
Higher education (≥ 14 years)	335 (45.5)
Residing in urban areas	337 (45.8)
Marital status	
Married/having cohabitant	347 (47.1)
Other	260 (35.3)
Employment status	
Employed	295 (40.1)
Not employed	271 (36.8)
Retired	170 (23.1)
Onset-age of vision loss	
Congenital	345 (46.9)
Acquired	391 (53.1)
Severity of impairment§	
Blind	186 (25.3)
Moderate-to-severe	550 (74.7)
Having other impairments	
No	478 (64.6)
Yes	258 (35.1)

Note. §: '*How good is your current vision (better-seeing eye, with glasses or contact lenses)*'.

Table 2. Use and underuse of mobility aids in the visual impairment population (N = 736).

	Users		Non-users expecting benefits from use[#]	
Type of aid	N/total	% (95% CI)	N/total	% (95% CI)
White cane	280/736	38.0 (34.5–41.7)	94/575	16.4 (13.4–19.6)
Guide dog	93/736	12.6 (10.3–15.3)	77/375	20.5 (16.6–25.0)
GPS	90/736	12.2 (10.0–14.8)	127/447	28.4 (24.3–32.8)
Transport	385/736	52.3 (48.6–56.0)	84/585	14.4 (11.6–17.5)
Sighted guide	208/736	28.3 (25.0–31.7)	113/462	24.5 (20.6–28.6)

Note. CI: confidence interval; #: missing data ranging from 21 to 49 percent for the different types of mobility aids.

Table 3. Differences between non-users expecting benefits and regular users on various indicators of quality of life.

		Loneliness		Life satisfaction	
Type of mobility aid	N	Mean (SD)	t, p-value	Mean (SD)	t, p-value
White cane			−1.04 p = 0.30		2.11, p = 0.04
Users	280	5.0 (1.9)		7.0 (2.0)	
Non-users with benefits	94	5.3 (1.9)		6.5 (2.1)	
Guide dog			−3.32, p = 0.001		1.91, p = 0.06
Users	93	5.0 (1.9)		6.9 (2.0)	
Non-users with benefits	77	5.9 (1.9)		6.3 (2.1)	
GPS			−1.11, p = 0.27		2.26, p = 0.03
Users	90	4.9 (1.9)		7.1 (1.8)	
Non-users with benefits	127	5.2 (1.9)		6.5 (2.1)	
Door-to-door transport			−0.42, p = 0.67		0.13, p = 0.90
Users	385	5.1 (1.9)		6.8 (2.1)	
Non-users with benefits	84	5.2 (1.9)		6.7 (2.0)	
Sighted guide			−0.74, p = 0.46		1.22, p = 0.22
Users	208	5.2 (1.9)		6.9 (2.0)	
Non-users with benefits	113	5.3 (1.8)		6.6 (2.1)	

Figure 1. The percentage of access and training in the use of mobility aids among non-users expecting benefits from use.

Alt Text: Non-users expecting benefits of use had a high degree of access and training in using the different mobility aids, especially for the white cane, of which 81 percent had access to a cane and 52 percent had training in its use.