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Effectiveness of predominant letterforms in different small type sizes:

Thai Universal Design font versus familiar Thai text fonts

Rachapoom Punsongserm

Faculty of Fine and Applied Arts, Thammasat University, Pathum Thani, Thailand
ORCID 0000-0002-2935-8052, pruchapo@tu.ac.th

Abstract: Earlier researchers have investigated and suggested how to design legibility for Thai letterforms that evolved into the Thai universal design typeface (Thai UD typeface), which supports Thai readers and visually impaired people. Prior researchers measured the letterforms of the Thai UD typeface for effectiveness on various psychological methodologies, such as blur simulation, short exposure, and distance threshold method. To continually investigate the effectiveness of the Thai UD typeface, in the present study, we tested its capability by adapting the methods involved in critical print size (CPS), letter acuity (LA), and reading acuity (RA) compared to familiar text typefaces. In the current study, we compared the effectiveness of three typefaces: FT Manifest UD (Thai UD typeface), Cordia New, and TH Sarabu New, which employed 36 Thai consonants in 15 different type sizes of the three typefaces. We presented the Thai characters to 32 Thai volunteers, including 12 males and 20 females between 18 and 62 years old, and we also divided the volunteers into three groups: adolescent adults, older adults, and graphic designers and related fields, into three different results. The Wilcoxon Signed Ranks Test showed that at a significance level of 0.05, the FT Manifest UD typeface was different in overall effectiveness from (better than) the Cordia New and TH Sara bun new typefaces. For the finding of each group, the FT Manifest UD typeface was different in effectiveness from (better than) the Cordia New and TH Sara bun new typefaces among the adolescent-young adults and the older adults. The finding for the graphic designers' group revealed that the FT Manifest UD typeface differed in effectiveness from (was better than) the TH Sarabu New typeface. However, the effectiveness of FT Manifest UD was similar to the Cordia New typeface. The study suggests that the most critical characteristics of FT Manifest UD provided better effectiveness than the other typefaces on various small type sizes. However, certain letterforms should be improved to enhance sufficient legibility for using the types in small and diminutive.

1. Introduction

There are several ongoing studies on the legibility of various typefaces in developed countries, especially Roman typefaces. However, the study of the legibility of the Thai typeface still needs to be made available. A comprehensive and in-depth analysis is needed to create new knowledge that meets the requirements of the current situation both in terms of people with visual impairment and the problem of the aging population in Thailand. There is still a lack of knowledge

to explain aspects of the Thai letterform that are suitable for diverse readers, especially those who are visually impaired and people with low vision. Although there are psychological studies on the efficiency of Thai typefaces (e.g., Rattanakasamsuk, 2013; Teeravarunyou & Laosirihongthong, 2003; Waleetorncheepsawat, Pungrassamee, Obama, & Ikeda, 2012), their authors did not discuss and recommend ways to improve and develop the suitable legibility of Thai letterforms. Such researchers only presented the results on which typefaces or typeface sizes were better than other typefaces. Notwithstanding, the literature needs more explanation concerning aspects of character morphology that influence visual letter recognition under different typefaces' testing conditions.

Research conducted by Punsongserm, Sunaga, & Ihara (2015, 2017a, 2017b, 2018a, 2018b) has shed light on the legibility of Thai typefaces, particularly in visually impaired conditions. Using a blur simulation and a short-exposure test method, the team analysed various typefaces and developed knowledge of letterform characteristics that facilitate reading under low visual acuity conditions. They also developed a basic understanding of typeface design principles for visually impaired individuals, leading to the creation of a prototype of the Thai universal design font (Thai UD font). The Thai UD font focuses on designing a specific character morphology that can aid visual letter recognition in low vision conditions. Following up on this research, Punsongserm (2019a, 2019b, 2020) measured the legibility of Thai UD letterforms using both a blur simulation and a short-exposure test method, with real words and pseudo-words, comparing them to Cordia New and TH Sarabun New typefaces. The results of this study showed that the Thai UD font was more effective in aiding legibility under low visual acuity conditions than conventional text fonts.

A recent study by Punsongserm (2023) compared the effectiveness of three typefaces (FT Manifest UD [Thai universal design font: Thai UD font], Cordia New, and TH Sarabun New) and used 36 Thai consonants in 15 different viewing distances (15 visual angles) of the three typefaces with the participation of various participant characteristics. The study suggests that the most critical characteristics of FT Manifest UD provided better effectiveness than the other typefaces on fixed font sizes varied by viewing distances. However, the studies did not encompass a comprehensive survey of other visual requirements, such as a study of the efficiency of differential print sizes from most minor to large. These factors may also impact legibility and demand further examination, which can provide valuable insights into the overall efficiency of the typefaces.

To further establish the legibility effectiveness of the Thai UD typeface in alternative conditions, in the present study, we aimed to measure the capability of the Thai UD typeface by adapting the methods involved critical print size (CPS), letter acuity (LA), and reading acuity (RA) throughout the measurement in different small type sizes compared to the same fonts used in the previous study (Cordia New and TH Sarabun New), as well as the same 36 Thai consonants and 15 visual angles (Punsongserm, 2023). This study will provide further insights into the effectiveness of the Thai UD typeface and its potential use in diverse contexts.

The key characteristics of Thai letterforms that support legibility and visibility include (Punsongserm, 2019a, 2019b, 2020; Punsongserm et al., 2017b, 2018a):

*Figure 1. Key Characteristics of Thai Letterforms for Legibility Improvement.
(Source: Punsongserm, 2019a; Punsongserm, 2023)*
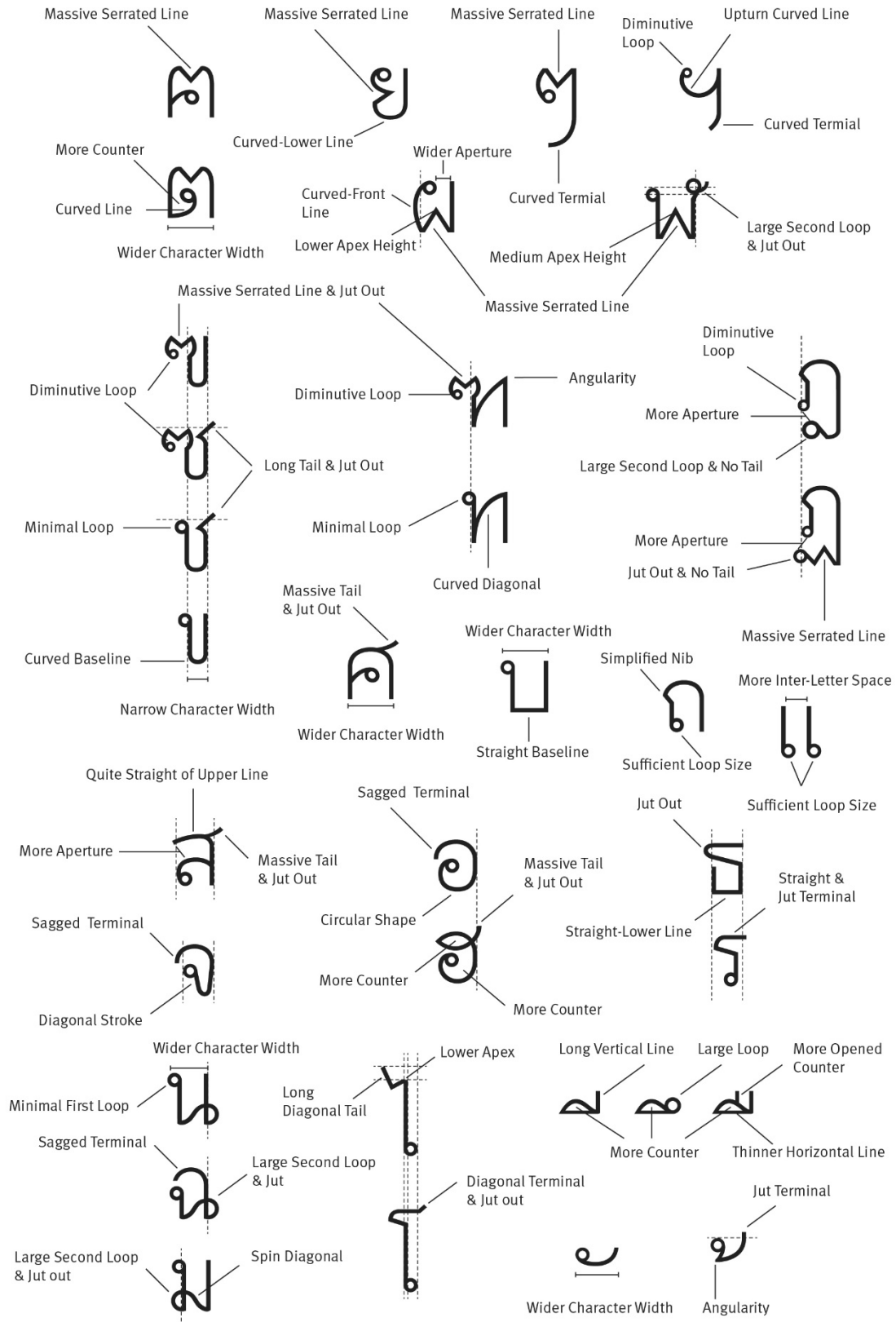
- The character shape, square or rounded

- The appearance of the typeface (type anatomy) refers to the clarity of the jagged lines as well as the protrusion of a loop, the end of the letter (terminal), and the size of a loop

- The character width is appropriately narrow or wide, which also affects the size of the counter (negative space)

- The stroke shapes (e.g., the upper line, the lower line, and the front line of the characters), straight or curved

- Characteristics at the end of the line (terminal aspect), horizontal or straight downward

Each letterform has different requirements for these features. To help distinguish the characters from each other easily, these different attributes or elements can be utilized to improve the typeface's legibility, as shown in Figure 1.

2. Methods

The present study involved the altering of the critical print size (CPS), letter acuity (LA), and reading acuity (RA) techniques. Several studies have suggested that the critical print size (CPS) is the minimum print size at which maximum reading speed (MRS) or maximum reading rate (MRR) can be attained (Arango et al., 2020; Cheong, Lovie-Kitchin, & Bowers, 2002; Mansfield, Legge, & Bane, 1996; Mansfield, West, & Dean, 2018; Rae, Latham, & Katsou, 2015; Legge, 2007). According to Legge (2007), CPS corresponds to the smallest print size on the reading-speed plateau, which can be effortlessly determined by the eye, especially for individuals with normal vision who usually show only minor variations in reading speed at large sizes. Xiong et al. (2018) suggested that when a detailed reading assessment is not feasible, simpler clinical measures such as letter acuity (LA) and reading acuity (RA) can be employed to forecast reading performance. LA represents the threshold print size for single-letter recognition. Modern LogMAR charts measure the smallest print size at which letters can be identified and corrected for the number of errors made throughout the test (Xiong et al., 2018). RA corresponds to the threshold print size for word recognition (Xiong et al., 2018). RA can typically be obtained using standard clinical reading tests (Radner, 2017; Rubin, 2013).

To evaluate the legibility of isolated characters, this method involves starting with the smallest unidentifiable character size and gradually increasing it to the standard sizes typically used in general. Although we did not assess reading speed using the CPS method, adapting these approaches allowed us to understand the average legibility across different character sizes, reflecting their diverse usage in real-world scenarios.

In the methods section of the present study, provide details on the materials used in the experiment, including selected letters, typefaces, type sizes, and apparatus. Additionally, provide information on the participants and the procedure.

2.1. Test Materials

2.1.1. Selected Letters

In the present study, we used 36 consonant letters, as seen in Table 1. We employed the 36 letters based on their similarity, including Ko Kai /ก/-Tho Thung /ฎ/-Pho Samphao /ภ/, Kho Khwai /ค/-Kho Khon /ศ/-So Sala /ศ/, Do Dek /ด/-To Tao /ต/, No Nu /น/-Cho Ching /ฉ/-Mo Ma /ม/-Kho Rakhang /ฆ/, Kho Khai /ข/-Kho Khuat /ฃ/-Cho Chang /ช/-So So /ซ/, Tho Thahan /ท/-Tho

Nangmontho /ฑ/, Lo Ling /ล/-So Sua /ส/, O Ang /อ/-Ho-Nokhuk /ฮ/, Do Chada /ฎ/-To Patak /ฏ/, Bo Baimai /บ/-Po Pla /ป/, Pho Phung /ผ/-Fo Fa /ฝ/, Pho Phan /พ/-Fo Fan /ฟ/-Lo Chula /ฬ/, and Tho Thong /ธ/-Ro Rua /ร/, as well as characters that tend to be easily confused with other characters under specific conditions such as in low visual acuity, that is, Ho Hip /ห/, Yo Yak /ย/, and Cho Chan /จ/, as in the studies of Punsongserm et al. (2017a, 2017b).

2.1.2. Selected Typefaces

To assess the efficacy of Thai UD letterforms (FT Manifest UD), we conducted a comparative analysis of legibility, utilizing two commonly used Thai text fonts - Cordia New (Regular) and TH Sarabun New (Regular). These two fonts were also employed as comparative fonts in the previous study conducted by Punsongserm (2023).

Cordia New is derived from a font known as Tom Light, which was developed during the hot metal typesetting era and widely employed in the phototypesetting period (Punsongserm, 2010; Suveeranont, 2002). During the digital typesetting era, Tom Light was transformed into a digital font named EAC Tom Light on Mac OS and Cordia New (Cordia UPC) on Windows OS. These fonts have been incorporated into computers for decades and are extensively employed for document typing (Punsongserm, 2019a; 2019b).

In 2007, the Department of Intellectual Property (DIP) and Software Industry Promotion Agency (SIPA) held a Thai font competition. As a result, TH Saraban PSK font was one of the thirteen successful fonts chosen (Suveeranont, 2017). In 2010, the Council of Ministers officially recognized the thirteen fonts, including TH Sarabun PSK, as public fonts. They also instructed public agencies to use them, especially TH Sarabun PSK, in their official documents (NSTDA, 2018; Suveeranont, 2017). The TH Saraban PSK font was later modified in 2011 and released under a new name, 'TH Sarabun New' (Beartai, 2016).

2.1.3. Type Sizes

We measured the effectiveness of letterforms in a variety of different type sizes by using each typeface's 15 different physical sizes (Bo Baimai height), starting from 0.3339–5.0134 mm., as shown in Table 2. When designing typography, the point size measurement is commonly used to determine font-size units. However, different typefaces created in the same point size can impact the x-height size. To address this issue, Legge and Bigelow (2011: 19) have suggested using x-height measures, which are a convenient metric familiar to both typographers and vision researchers. Similarly, Punsongserm et al. (2017a) used Bo Baimai height measurements to define Thai-type sizes in their research. This method involves normalising by the character's height /บ/ (Bo Baimai) and accurately regulating the equalisation of character heights within any font. Therefore, we have also adopted the Bo Baimai height measurement (Punsongserm, 2019a; 2019b, 2020; Punsongserm et al., 2017a, 2017b, 2018a, 2018b; Punsongserm & Suvakunta, 2022a, 2022b) in millimetres to define physical type sizes. Table 2 shows the comparison of font sizes between physical sizes and visual angles calculated from the viewing distance from the monitor to the eyes at a distance of 400 mm, as well as the point sizes of the typefaces. Each step of the 15 physical sizes conformed to the visual angles in the previous study (Punsongserm, 2023), from the visual angle of 0.0477° (smallest, step 1) to the visual angle of 0.7162° (largest, step 15), as shown in Table 2.

Table 1. The 36-characters set varied by three typefaces used in the experiment (Punsongserm, 2023).

No.	Letter	FT Manifest UD	Cordia New	TH Sarabun New	No.	Letter	FT Manifest UD	Cordia New	TH Sarabun New
1	ก (Ko Kai)	ก	ก	ก	19	ล (Lo Ling)	ล	ล	ล
2	ถ (Tho Thung)	ถ	ถ	ถ	20	ส (So Sua)	ส	ส	ส
3	ภ (Pho Samphao)	ภ	ภ	ภ	21	อ (O Ang)	อ	อ	อ
4	ค (Kho Khwai)	ค	ค	ค	22	ฮ (Ho Nokhuk)	ฮ	ฮ	ฮ
5	ต (Kho Khon)	ต	ต	ต	23	ฏ (Do Chada)	ฎ	ฎ	ฎ
6	ศ (So Sala)	ศ	ศ	ศ	24	ฏ (To Patak)	ฏ	ฏ	ฏ
7	ด (Do Dek)	ด	ด	ด	25	บ (Bo Baimai)	บ	บ	บ
8	ต (To Tao)	ต	ต	ต	26	ป (Po Pla)	ป	ป	ป
9	น (No Nu)	น	น	น	27	ผ (Pho Phung)	ผ	ผ	ผ
10	ฉ (Cho Ching)	ฉ	ฉ	ฉ	28	ฝ (Fo Fa)	ฝ	ฝ	ฝ
11	ม (Mo Ma)	ม	ม	ม	29	พ (Pho Phan)	พ	พ	พ
12	ฆ (Kho Rakhang)	ฆ	ฆ	ฆ	30	ฟ (Fo Fan)	ฟ	ฟ	ฟ
13	ข (Kho Khai)	ข	ข	ข	31	ฬ (Lo Chula)	ฬ	ฬ	ฬ
14	ฃ (Kho Khuat)	ฃ	ฃ	ฃ	32	ธ (Tho Thong)	ธ	ธ	ธ
15	ช (Cho Chang)	ช	ช	ช	33	ร (Ro Rua)	ร	ร	ร
16	ซ (So So)	ซ	ซ	ซ	34	ห (Ho Hip)	ห	ห	ห
17	ฑ (Tho Thahan)	ฑ	ฑ	ฑ	35	ย (Yo Yak)	ย	ย	ย
18	ฒ (Tho Nangmontho)	ฒ	ฒ	ฒ	36	จ (Cho Chan)	จ	จ	จ

Table 2. The comparison of type sizes among physical sizes, visual angles, and point sizes.

Step	Physical Size (mm)	Visual Angle (deg.) at Distance 400 mm	Point Size (pt)		
			FT Manifest UD	Cordia New	TH Sarabun New
1	0.3339	0.0477° (0° 2' 0.86'')	2.87	2.37	2.42
2	0.3584	0.0512° (0° 3' 0.07'')	3.05	2.54	2.58
3	0.3857	0.0551° (0° 3' 0.31'')	3.29	2.72	2.78
4	0.4179	0.0597° (0° 3' 0.58'')	3.54	2.95	3.03
5	0.4557	0.0651° (0° 3' 0.91'')	3.90	3.23	3.29
6	0.5012	0.0716° (0° 4' 0.30'')	4.25	3.54	3.61
7	0.5572	0.0796° (0° 4' 0.77'')	4.76	4.00	4.04
8	0.6265	0.0895° (0° 5' 0.37'')	5.31	4.43	4.53
9	0.7161	0.1023° (0° 6' 0.14'')	6.10	5.04	5.15
10	0.8358	0.1194° (0° 7' 0.16'')	7.10	5.90	6.00
11	1.0024	0.1432° (0° 8' 0.59'')	8.48	7.08	7.20
12	1.2530	0.1790° (0° 10' 0.74'')	10.66	8.87	9.06
13	1.6709	0.2387° (0° 14' 0.32'')	14.20	11.82	12.05
14	2.5067	0.3581° (0° 21' 0.49'')	21.25	17.70	18.05
15	5.0134	0.7162° (0° 42' 0.97'')	42.50	35.50	36.18

2.1.4. Apparatus

The equipment used in the experiment included:

- A controller laptop computer

- An observer 27-inch monitor (BenQ BL2711U) with eye care mode, flicker-free technology, and low blue light reduction displayed with a resolution of 1920 x 1080 pixels and a refresh rate of 60 Hz. The luminous intensity of the display was 258 cd/m^2

- A chinrest for maintaining the viewing distance between an observer and the monitor displaying the characters

- A standard working table for supporting installing a monitor and chin rest, with a comfortable chair

The test material contained characters differing in letters, typefaces, and type sizes (according to Table 1 and Table 2). Each character varied in letters, typefaces, and sizes and was displayed on the centre of the monitor. We displayed the 36 characters set in black (#000000) on a white (#FFFFFF) background as stimuli that differ in typeface (three typefaces) and type size (15 sizes), representing 1,620 trials in the experiment for each participant.

2.2. Participants

We have invited 32 Thai participants who had participated in a study conducted by Punsongserm (2023) for the current investigation. All 32 volunteers have kindly agreed to participate in the experiment, and after thoroughly explaining the study's objective and procedure, each one has signed a consent form.

A sample of 32 Thai volunteers with various near visual acuity (average = LogMAR 0.203), including 12 males and 20 females between 18 and 62 years old (average = 39.25 years), participated in this study. We divided the 32 volunteers into three groups, including the adolescent-adults group, the older adults group, and the graphic designers and related fields group. The adolescent-adults group with normal visual acuity included five males and seven females between 18 and 40 years old (average = 28.30 years). The older adults group with low visual acuity (average = LogMAR 0.59) included one male and nine females between 52 and 62 years old (average = 56 years). The graphic designers and related fields group with normal or slightly low visual acuity (average = LogMAR 0.06) included six males and four females between 25 and 55 years old (average = 35.60 years). Table 3 shows each participant's age, gender, educational background, occupation, and visual acuity. Graphic designers and related fields have a higher choice of using and reading typefaces in their work. Therefore, we infer that they have higher letter recognition than other people.

2.3. Procedure

The experimental process started by measuring the quality of near vision (near vision acuity test) of each participant with a mobile application for eye measurement, Smart Optometry. The viewing distance from the mobile phone to the participant's eyes was approximately 400 mm. The results for adolescents-adults (between 18 and 40 years old) with eye quality in LogMAR 0.0 and seniors (between 52 and 62 years old) showed their visual quality value in the range of LogMAR 0.4–0.7, and the group of graphic designers (between 25 and 55 years old) had their visual quality value in the range of LogMAR 0.0–0.2 (as shown in Table 3).

We used multiple degrees of the participants' visual acuity without corrected-to-normal visual acuity to elicit the intrinsic effectiveness of the typefaces on various visual acuity in participants' normal and low visual acuity.

In determining the experimental conditions, the approximate distance from the eyes of the participants to the monitor was 400 mm, with the chin rest as a barrier. In conducting the experiment and collecting data, a dark room was used to eliminate luminous disturbances from sources other than monitors.

In the experiment, a participant sat on a comfortable chair and used the chin rest correctly. We randomly selected typefaces (one out of three) and a set of the same characters (varied in 15 different sizes). We asked the participants to look at the smallest character size (Bo Baimai height = 0.3339 mm, step 1) shown on the monitor, which was a size that could not be read. We asked a participant to look at a total of 15 sizes according to Table 2 (step 2) leading up to the largest size (Bo Baimai height = 0.3584–5.0134 mm, step 2–15). We asked participants to read aloud the letter shown for each character reading, and we recorded the participant's answers. If a participant could not identify any letter they saw, they could inform us that they "cannot read." We collected data with the other character sets in the same procedure, using 36-characters sets, to cover the three selected typefaces.

Table 3. Age, gender, educational background, occupation, and visual acuity of participants.

Participant No.	Sub-Participant No.	Age	Gender	Highest Educational Qualification Obtained	Occupation	Near Visual Acuity (LogMAR)
				Adolescent-Young Adults		
1	1	18	Female	High School, Grade 12	Undergraduate Student	0.0
2	2	21	Female	High School, Grade 12	Undergraduate Student	0.0
3	3	22	Female	High School, Grade 12	Undergraduate Student	0.0
4	4	23	Male	High School, Grade 12	Factory Worker	0.0
5	5	23	Male	High School, Grade 12	Undergraduate Student	0.0
6	6	25	Male	High School, Grade 12	Supermarket Staff	0.0
7	7	28	Male	Bachelor's Degree (Political and Administrative Science)	Municipal Staff, Tax Improvement Department	0.0
8	8	30	Male	Junior High School, Grade 9	Self-Employed	0.0
9	9	34	Female	Bachelor's Degree (Business Administration)	Financial Staff	0.0
10	10	37	Female	Bachelor's Degree (Interdisciplinary Studies of Social Science)	Library Staff	0.0
11	11	39	Female	Bachelor's Degree (Accounting)	Book Centre Staff	0.0
12	12	40	Female	Junior High School, Grade 9	Cleaning Staff	0.0
		28.3		*Average of Age and Visual Acuity*		*0.0*

Table 3. Continued.

Participant No.	Sub-Participant No.	Age	Gender	Highest Educational Qualification Obtained	Occupation	Near Visual Acuity (LogMAR)
				Older Adults		
13	1	52	Female	Late Elementary School, Grade 6	Cleaning Staff	0.7
14	2	53	Female	Junior High School, Grade 9	Book Centre Staff	0.7
15	3	53	Female	High School, Grade 12	Cleaning Staff	0.7
16	4	54	Male	Bachelor's Degree (Marketing)	Churchwarden	0.7
17	5	55	Female	Junior High School, Grade 9	Housewife	0.5
18	6	56	Female	Junior High School, Grade 9	Housewife	0.4
19	7	57	Female	High School, Grade 12	Member of Agricultural Cooperatives Board	0.7
20	8	58	Female	Late Elementary School, Grade 6	Former Book Salesman	0.4
21	9	60	Female	Late Elementary School, Grade 6	Unemployed	0.7
22	10	62	Female	High Vocational Certificate (Accounting)	Grocer	0.4
		56		*Average of Age and Visual Acuity*		*0.59*

Table 3. Continued.

Participant No.	Sub-Participant No.	Age	Gender	Highest Educational Qualification Obtained	Occupation	Near Visual Acuity (LogMAR)
				Graphic Designers and Related Fields		
23	1	25	Female	Bachelor's Degree (Multimedia Design)	Freelance Graphic Designer	0.0
24	2	25	Female	Bachelor's Degree (Information Technology)	Publication Designer	0.0
25	3	30	Female	Bachelor's Degree (Industrial Crafts Design)	Corporate Communication Media Designer	0.0
26	4	32	Male	Bachelor's Degree (Industrial Crafts Design)	Freelance Designer	0.0
27	5	32	Male	Bachelor's Degree (Animation Design)	Graphics and Animation Teacher	0.0
28	6	34	Male	Bachelor's Degree (Computer Graphics)	Publication Design Teacher	0.2
29	7	35	Female	Master's Degree (Public Relations)	Publicist/Public Media Creator	0.0
30	8	42	Male	Bachelor's Degree (Business Computer)	Publication/ Sign Graphic Designer	0.2
31	9	46	Male	Junior High School, Grade 9	Sign Graphic Designer	0.0
32	10	55	Male	Master's Degree (Art and Design)	Graphic Designer/ Guest Lecturer	0.2
		35.6		*Average of Age and Visual Acuity*		*0.06*
		39.25		**Average of Age and Visual Acuity (Overall)**		**0.203**

3. Results

The results section of our report comprises both the overall comparative effectiveness findings and the classified findings presented by each letter to demonstrate the relative effectiveness of the three typefaces.

3.1. Comparative Effectiveness: Overall

To test the hypothesis, we used Wilcoxon Signed Ranks Test, a two-way discriminant nonparametric statistical analysis used to test the differences between the two groups. In this study, we used it to test which typefaces had different levels of effectiveness, which were tested in pairs (e.g., Cordia New – FT Manifest UD and TH Sarabun New – FT Manifest UD). The result for all 32 participants is presented in Table 4, as well as the findings separated by groups of participants into:

- the adolescent-young adults (12 participants), Table 5,

- the older adults (10 participants), Table 6, and

- the graphic designers and related fields (10 participants), Table 7.

In the results for all participants (32 people), we considered using a paired test by Wilcoxon Signed Ranks Test to test which fonts have different levels of effectiveness. The results in Table 4 in the Ranks and Test Statistics section show that at a significance level of 0.05, the FT Manifest UD typeface was different in overall effectiveness from (better than) the Cordia New and TH Sarabun New typefaces.

The data presented in Table 4 suggests that the FT Manifest UD typeface may have performed better than the Cordia New and TH Sarabun New typefaces. Negative ranks (Cordia New < FT Manifest UD) indicate that Cordia New received higher values (N=24, Mean Rank = 20.25, Sum of Ranks = 486), while positive ranks (Cordia New > FT Manifest UD) received lower values (N=12, Mean Rank = 15, Sum of Ranks = 180). Similarly, negative ranks (TH Sarabun New < FT Manifest UD) show that TH Sarabun New received higher values (N=28, Mean Rank = 19.57, Sum of Ranks = 548), while positive ranks (TH Sarabun New > FT Manifest UD) received lower values (N=7, Mean Rank = 11.71, Sum of Ranks = 82). These results suggest that the FT Manifest UD typeface could have been more effective than either Cordia New or TH Sarabun New typefaces.

When splitting the results into three case-specific groups of participants, the findings showed that at a significance level of 0.05, the FT Manifest UD typeface was different in effectiveness from (better than) the Cordia New and TH Sarabun New typefaces among the adolescent-young adults and the older adults (see Table 5 and Table 6, respectively). In contrast, the finding for the graphic designers and related fields revealed that the FT Manifest UD typeface differed in effectiveness from (was better than) the TH Sarabun New typeface. However, the effectiveness of FT Manifest UD was similar to the Cordia New typeface (see Table 7).

Table 4. The overall results of ranks and test statistics for FT Manifest UD compared with Cordia New and TH Sarabun New.

Ranks			N	Mean Rank	Sum of Ranks
Cordia New - FT Manifest UD	Negative Ranks		24[a]	20.25	486
	Positive Ranks		12[b]	15	180
	Ties		0[c]		
	Total		36		
TH Sarabun New - FT Manifest UD	Negative Ranks		28[d]	19.57	548
	Positive Ranks		7[e]	11.71	82
	Ties		1[f]		
	Total		36		

a. Cordia New < FT Manifest UD d. TH Sarabun New < FT Manifest UD
b. Cordia New > FT Manifest UD e. TH Sarabun New > FT Manifest UD
c. Cordia New = FT Manifest UD f. TH Sarabun New = FT Manifest UD

Test Statistics[a]	Cordia New – FT Manifest UD	TH Sarabun New – FT Manifest UD
Z	-2.404[b]	-3.818[b]
Asymp. Sig. (2-tailed)	0.016	0.000

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks

Based on the results in Table 5, it can be inferred that the FT Manifest UD typeface was more effective for adolescent-young adults compared to Cordia New and TH Sarabun New typefaces. This is supported by the negative ranks (Cordia New < FT Manifest UD), where Cordia New received more values (N=25, Mean Rank = 20.34, Sum of Ranks = 580.50), while the positive ranks (Cordia New > FT Manifest UD) received fewer values (N=10, Mean Rank = 12.15, Sum of Ranks = 121.50). A similar pattern is observed between TH Sarabun New and FT Manifest UD, where the negative ranks (TH Sarabun New < FT Manifest UD) showed that Cordia New received more values (N=29, Mean Rank = 17.91, Sum of Ranks = 519.50), whereas the positive ranks (TH Sarabun New > FT Manifest UD) received fewer values (N=5, Mean Rank = 15.10, Sum of Ranks = 75.50).

Table 6 reveals that the FT Manifest UD typeface was more effective for older adults than the Cordia New and TH Sarabun New typefaces. This is supported by the negative ranks (Cordia New < FT Manifest UD), where Cordia New received more values (N=23, Mean Rank = 19.24, Sum of Ranks = 442.50), while the positive ranks (Cordia New > FT Manifest UD) received fewer values (N=11, Mean Rank = 13.86, Sum of Ranks = 152.50). Similarly, the negative ranks (TH Sarabun New < FT Manifest UD) showed that Cordia New received more values (N=29, Mean Rank = 20.07, Sum of Ranks = 582), and the positive ranks (TH Sarabun New > FT Manifest UD) received fewer values (N=7, Mean Rank = 12, Sum of Ranks = 84).

Table 7 suggests that, when comparing Cordia New and FT Manifest UD, Cordia New received more values (N=20, Mean Rank = 19.93, Sum of Ranks = 398.50) in the negative ranks (Cordia New < FT Manifest UD), whereas it received fewer values (N=16, Mean Rank = 16.72, Sum of Ranks = 267.50) in the positive ranks (Cordia New > FT Manifest UD). Similarly, when comparing TH Sarabun New and FT Manifest UD, TH Sarabun New received more values (N=24, Mean Rank = 20.13, Sum of Ranks = 483) in the negative ranks (TH Sarabun New < FT Manifest UD), whereas it received fewer values (N=12, Mean Rank = 15.25, Sum of Ranks = 183) in the positive ranks (TH Sarabun New > FT Manifest UD). These findings suggest that the FT Manifest UD typeface was more effective than the TH Sarabun New typeface for graphic designers and related fields. However, the effectiveness of FT Manifest UD was similar to that of the Cordia New.

Table 5. The results of ranks and test statistics for FT Manifest UD compared with Cordia New and TH Sarabun New, the adolescent-young adults.

Ranks		N	Mean Rank	Sum of Ranks
Cordia New - FT Manifest UD	Negative Ranks	25[a]	20.34	508.50
	Positive Ranks	10[b]	12.15	121.50
	Ties	1[c]		
	Total	36		
TH Sarabun New - FT Manifest UD	Negative Ranks	29[d]	17.91	519.50
	Positive Ranks	5[e]	15.10	75.50
	Ties	2[f]		
	Total	36		

a. Cordia New < FT Manifest UD   d. TH Sarabun New < FT Manifest UD
b. Cordia New > FT Manifest UD   e. TH Sarabun New > FT Manifest UD
c. Cordia New = FT Manifest UD   f. TH Sarabun New = FT Manifest UD

Test Statistics[a]	Cordia New – FT Manifest UD	TH Sarabun New – FT Manifest UD
Z	-3.172[b]	-3.798[b]
Asymp. Sig. (2-tailed)	0.002	0.000

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks

Table 6. The results of ranks and test statistics for FT Manifest UD compared with Cordia New and TH Sarabun New, the older adults.

Ranks		N	Mean Rank	Sum of Ranks
Cordia New - FT Manifest UD	Negative Ranks	23[a]	19.24	442.50
	Positive Ranks	11[b]	13.86	152.50
	Ties	2[c]		
	Total	36		
TH Sarabun New - FT Manifest UD	Negative Ranks	29[d]	20.07	582
	Positive Ranks	7[e]	12	84
	Ties	0[f]		
	Total	36		

a. Cordia New < FT Manifest UD
b. Cordia New > FT Manifest UD
c. Cordia New = FT Manifest UD
d. TH Sarabun New < FT Manifest UD
e. TH Sarabun New > FT Manifest UD
f. TH Sarabun New = FT Manifest UD

Test Statistics[a]	Cordia New – FT Manifest UD	TH Sarabun New – FT Manifest UD
Z	-2.483[b]	-3.923[b]
Asymp. Sig. (2-tailed)	0.013	0.000

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks

Table 7. The results of ranks and test statistics for FT Manifest UD compared with Cordia New and TH Sarabun New, the graphic designers and related fields.

Ranks		N	Mean Rank	Sum of Ranks
Cordia New - FT Manifest UD	Negative Ranks	20[a]	19.93	398.50
	Positive Ranks	16[b]	16.72	267.50
	Ties	0[c]		
	Total	36		
TH Sarabun New - FT Manifest UD	Negative Ranks	24[d]	20.13	483
	Positive Ranks	12[e]	15.25	183
	Ties	0[f]		
	Total	36		

a. Cordia New < FT Manifest UD   d. TH Sarabun New < FT Manifest UD
b. Cordia New > FT Manifest UD   e. TH Sarabun New > FT Manifest UD
c. Cordia New = FT Manifest UD   f. TH Sarabun New = FT Manifest UD

Test Statistics[a]	Cordia New – FT Manifest UD	TH Sarabun New – FT Manifest UD
Z	-1.030[b]	-2.359[b]
Asymp. Sig. (2-tailed)	0.303	0.018

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks

3.2. Comparative Effectiveness: Classified by Letters

The findings of each letter are in Table 8, which shows the mean values of the percentage of correct response rates comparing FT Manifest UD, Cordia New, and TH Sarabun New. We calculated each mean value from the percentage of correct response rate of each character's finding of visual angles from levels 1–15 (0.0477°–0.7162°), as shown in Table 2. We applied the Wilcoxon Signed Ranks Test method at a significance level of 0.05 (see Table 9) to test the differences among the typefaces.

Table 8. Mean of correct response's percentage, classified by letters.

No.	Letter	Mean of Correct Response's Percentage		
		FT Manifest UD	Cordia New	TH Sarabun New
1	ก (Ko Kai)	38.96	33.75	36.04
2	ถ (Tho Thung)	35.83	34.58	33.75
3	ภ (Pho Samphao)	39.17	41.25	32.92
4	ค (Kho Khwai)	35.63	34.36	36.88
5	ต (Kho Khon)	33.54	26.25	22.09
6	ศ (So Sala)	43.33	40.84	38.33
7	ด (Do Dek)	32.50	30.83	32.08
8	ต (To Tao)	34.38	27.71	24.79
9	น (No Nu)	42.71	43.55	41.04
10	ฉ (Cho Ching)	40.63	34.17	36.25
11	ม (Mo Ma)	42.92	38.96	41.04
12	ฆ (Kho Rakhang)	31.67	31.46	29.79
13	ข (Kho Khai)	30.42	31.46	32.71
14	ฃ (Kho Khuat)	25.83	22.71	17.50
15	ช (Cho Chang)	40.84	26.67	30.63
16	ซ (So So)	30.41	21.25	24.79
17	ท (Tho Thahan)	30.41	21.25	24.79
18	ฑ (Tho Nangmontho)	36.04	35.63	28.54
19	ล (Lo Ling)	32.09	35.21	35.83
20	ส (So Sua)	39.79	37.29	37.50
21	อ (O Ang)	33.75	27.71	36.46
22	ฮ (Ho Nokhuk)	34.58	36.46	32.92
23	ฎ (Do Chada)	30.84	32.29	28.96
24	ฏ (To Patak)	37.71	30.84	29.58
25	บ (Bo Baimai)	38.13	36.25	35.21
26	ป (Po Pla)	52.09	51.88	47.50
27	ผ (Pho Phung)	36.25	38.75	35.63
28	ฝ (Fo Fa)	42.08	40.63	38.13
29	พ (Pho Phan)	37.50	38.70	31.88
30	ฟ (Fo Fan)	47.29	50.42	43.75
31	ฬ (Lo Chula)	44.17	40.83	26.46
32	ธ (Tho Thong)	37.29	31.46	32.92
33	ร (Ro Rua)	41.46	32.09	36.53
34	ห (Ho Hip)	33.96	36.88	36.67
35	ย (Yo Yak)	29.79	36.26	34.17
36	จ (Cho Chan)	38.54	41.25	38.96

Table 9 shows the summary of FT Manifest UD effectiveness by letter, indicating that the characters of the FT Manifest UD are more effective than Cordia New and TH Sarabun New, such as Kho Khon /ฅ/, To Tao /ต/, Cho Ching /ฉ/, Cho Chang /ช/, To Patak /ฏ/, Lo Chula /ฬ/, and Ro Rua /ร/ (Table 9: No.5, 8, 10, 15, 24, 31, and 33).

These results are consistent with the research hypothesis, specifically in the letter features of Kho Khon /ฅ/, To Tao /ต/, Cho Ching /ฉ/, Cho Chang /ช/, To Patak /ฏ/, Lo Chula /ฬ/, and Ro Rua /ร/, that design of letters based on the theoretical framework can provide better legibility than other typefaces in the test.

Also, the characters Ko Kai /ก/, Mo Ma /ม/, So So /ซ/, So Sua /ส/, O Ang /อ/, and Tho Thong /ธ/ of FT Manifest UD had higher effectiveness than the characters of Cordia New (Table 9: No. 1, 11, 16, 20, 21, and 32), besides the characters Pho Samphao /ภ/, So Sala /ศ/, No Nu /น/, Kho Khuat /ข/, Tho Nangmontho /ฑ/, Bo Baimai /บ/, Po Pla /ป/, Pho Phan /พ/, and Fo Fan /ฟ/ of FT Manifest UD that had higher effectiveness than the characters of TH Sarabun New (Table 9: No. 3, 6, 9, 14, 18, 25, 26, 29, and 30).

There was no difference in the findings of FT Manifest UD, Cordia New, and TH Sarabun New for the characters Tho Thung /ฐ/, Kho Khwai /ค/, Do Dek /ด/, Kho Rakhang /ฆ/, Kho Khai /ข/, Tho Nangmontho /ฑ/, Lo Ling /ล/, Ho Nokhuk /ฮ/, Do Chada /ฎ/, Pho Phung /ผ/, Fo Fa /ฝ/, Ho Hip /ห/, and Cho Chan /จ/ (Table 9: No. 2, 4, 7, 12, 13, 17, 19, 22, 23, 27, 28, 34, and 36).

In addition, the effectiveness of FT Manifest UD was equivalent to Cordia New for the characters Pho Samphao /ภ/, So Sala /ศ/, No Nu /น/, Kho Khuat /ข/, Tho Nangmontho /ฑ/, Bo Baimai /บ/, Po Pla /ป/, and Pho Phan /พ/ (Table 9: No. 3, 6, 9, 14, 18, 25, 26, and 29), whereas the effectiveness of FT Manifest UD was equivalent to TH Sarabun New for the characters Ko Kai /ก/, Mo Ma /ม/, So So /ซ/, So Sua /ส/, O Ang /อ/, and Tho Thong /ธ/ (Table 9: No. 1, 11, 16, 20, 21, and 32).

In contrast, the character Yo Yak /ย/ of FT Manifest UD had a lower effectiveness than the character Yo Yak /ย/ of Cordia New and TH Sarabun New (Table 9: No. 35). The character Fo Fan /ฟ/ of FT Manifest UD also had a lower effectiveness than the character Fo Fan /ฟ/ of Cordia New (Table 9: No. 30).

Santayayon et al. (2011) suggested that the minimum size for young and older adults should be 2 mm at a viewing distance of 50 cm. This type of size is easy to read. The recommended type size corresponds to the visual angle of 0.2292° (Punsongserm & Suvakunta, 2022b). The visual angle of 0.2292° approximates to a visual angle of 0.2387° in the current study, as shown in Table 2, step 13 (physical sizes = 1.6709 mm). We selected the findings of the visual angle of 0.2387° (Table 10). The results showed that most letterforms of FT Manifest UD had a higher correct response rate than the other typefaces, particularly in the characters Kho Khuat /ข/, Cho Chang /ช/, So So /ซ/, and To Patak /ฏ/.

Table 9. Summary of the effectiveness of FT Manifest UD (Thai UD typeface), classified by letters.

No.	Letter	Effectiveness of FT Manifest UD		
		Higher (than)	No Difference (with)	Lower (than)
1	ก (Ko Kai)	C	T	-
2	ฐ (Tho Thung)	-	C, T	-
3	ภ (Pho Samphao)	T	C	-
4	ค (Kho Khwai)	-	C, T	-
5	ฅ (Kho Khon)	C, T	-	-
6	ศ (So Sala)	T	C	-
7	ด (Do Dek)	-	C, T	-
8	ต (To Tao)	C, T	-	-
9	น (No Nu)	T	C	-
10	ฉ (Cho Ching)	C, T	-	-
11	ม (Mo Ma)	C	T	-
12	ฆ (Kho Rakhang)	-	C, T	-
13	ข (Kho Khai)	-	C, T	-
14	ฃ (Kho Khuat)	T	C	-
15	ช (Cho Chang)	C, T	-	-
16	ซ (So So)	C	T	-
17	ท (Tho Thahan)	-	C, T	-
18	ฑ (Tho Nangmontho)	T	C	-
19	ล (Lo Ling)	-	C, T	-
20	ส (So Sua)	C	T	-
21	อ (O Ang)	C	T	-
22	ฮ (Ho Nokhuk)	-	C, T	-
23	ฎ (Do Chada)	-	C, T	-
24	ฏ (To Patak)	C, T	-	-
25	บ (Bo Baimai)	T	C	-
26	ป (Po Pla)	T	C	-
27	ผ (Pho Phung)	-	C, T	-
28	ฝ (Fo Fa)	-	C, T	-
29	พ (Pho Phan)	T	C	-
30	ฟ (Fo Fan)	T	-	C
31	ฬ (Lo Chula)	C, T	-	-
32	ธ (Tho Thong)	C	T	-
33	ร (Ro Rua)	C, T	-	-
34	ห (Ho Hip)	-	C, T	-
35	ย (Yo Yak)	-	-	C, T
36	จ (Cho Chan)	-	C, T	-
	C = Cordia New			
	T = TH Sarabun New			

Table 10. Percentage of correct response at visual angle of 0.2387°, classified by letters.

No.	Letter	Percentage of Correct Response at Visual Angle of 0.2387°		
		FT Manifest UD	Cordia New	TH Sarabun New
1	ก (Ko Kai)	93.75	81.25	84.37
2	ถ (Tho Thung)	87.50	87.50	90.63
3	ภ (Pho Samphao)	87.50	93.75	87.50
4	ค (Kho Khwai)	90.63	90.63	87.50
5	ฅ (Kho Khon)	87.50	81.25	68.75
6	ศ (So Sala)	93.75	87.50	90.63
7	ด (Do Dek)	90.63	87.50	90.63
8	ต (To Tao)	93.75	84.38	71.88
9	น (No Nu)	93.75	93.75	90.63
10	ฉ (Cho Ching)	93.75	78.13	90.63
11	ม (Mo Ma)	90.63	93.75	93.75
12	ฆ (Kho Rakhang)	93.75	81.25	87.50
13	ข (Kho Khai)	87.50	84.38	75
14	ฃ (Kho Khuat)	**93.75**	68.75	43.75
15	ช (Cho Chang)	**90.63**	71.88	68.75
16	ซ (So So)	**90.63**	53.13	50
17	ท (Tho Thahan)	87.50	90.63	90.63
18	ฑ (Tho Nangmontho)	90.63	90.63	84.38
19	ล (Lo Ling)	84.38	84.38	90.63
20	ส (So Sua)	93.75	93.75	93.75
21	อ (O Ang)	93.75	81.25	90.63
22	ฮ (Ho Nokhuk)	93.75	90.63	81.25
23	ฏ (Do Chada)	75	75	75
24	ฏ (To Patak)	**81.25**	50	62.50
25	บ (Bo Baimai)	90.63	81.25	90.63
26	ป (Po Pla)	93.75	96.88	90.63
27	ผ (Pho Phung)	90.63	93.75	93.75
28	ฝ (Fo Fa)	93.75	93.75	93.75
29	พ (Pho Phan)	90.63	90.88	87.50
30	ฟ (Fo Fan)	96.88	93.75	93.75
31	ฬ (Lo Chula)	93.75	93.75	84.38
32	ธ (Tho Thong)	87.50	87.50	87.50
33	ร (Ro Rua)	93.75	87.50	87.50
34	ห (Ho Hip)	90.63	93.75	84.38
35	ย (Yo Yak)	90.63	90.63	90.63
36	จ (Cho Chan)	93.75	93.75	93.75

4. Discussion

In this segment, we will discuss the confirmation of the most prominent letterforms of FT Manifest UD, which are crucial in enhancing legibility in small type sizes. Additionally, we will provide recommendations for refining certain letterforms of FT Manifest UD that are particularly useful for small type sizes.

4.1. The characters Kho Khon /ฅ/, To Tao /ต/, Cho Ching /ฉ/, Cho Chang /ช/, To Patak /ฏ/, Lo Chula /ฬ/, and Ro Rua /ร/

The results of the characters Kho Khon /ฅ/, To Tao /ต/, Cho Ching /ฉ/, Cho Chang /ช/, To Patak /ฏ/, Lo Chula /ฬ/, and Ro Rua /ร/ (Table 9) indicated that the design of the letterforms of FT Manifest UD (as shown in Figure 2) could support legibility in terms of different physical type sizes. This finding confirmed that the key characteristics of the Thai typeface, according to the conceptual framework in this section (top part of Figure 2), can be used to design high-legibility letterforms that correspond to the previous study of Punsongserm (2023); the key features of each letterform in FT Manifest UD include the following:

- Character Kho Khon /ฅ/

  o Wider character width
  o Many spaces within characters, more counter
  o Presence of a massive, serrated line
  o Use of an overturned curve connecting the first loop and the front line

- Character To Tao /ต/

  o Wider character width
  o Many spaces within characters, more counter
  o Use of an upturned curve connecting the first loop and the front line

- Character Cho Ching /ฉ/

  o Second loop that is large enough and protruding from the main body (large second loop and juts out)
  o Curved topline and bent-down (sagged terminal) and does not jut out of the front vertical axis of the first loop

- Character Cho Chang /ช/

  o A minimal loop without a curve connecting the first loop
  o Long diagonal tail that juts out from the main body
  o Use of a curved line at the base (bottom line)

- Character To Patak /ฏ/

  o Diminutive first loop
  o More aperture
  o Use of massive underside wavy lines (serrated lines)
  o Omits a tail and has the coil (second loop) protrude out of the vertical axis of the first loop of the character To Patak /ฏ/

• Character Lo Chula /ฬ/

  ○ Sizeable second loop and tail-end juts out of the main body
  ○ Defining up-down diagonals, to be precise (massive, serrated line)
  ○ Pointed tip for a medium height, medium apex height

• Character Ro Rua /ร/

  ○ Front part of the character that protrudes (juts out) from the stem and first loop
  ○ Use of the straight horizontal upper line extending from the body line.

*Figure 2. Key characteristics of FT Manifest UD, compared with Cordia New and TH Sarabun New
(in case of letterforms ค, ต, ฉ, ซ, ฎ, ฬ, and ร) (source for top part: Punsongserm, 2019a)*
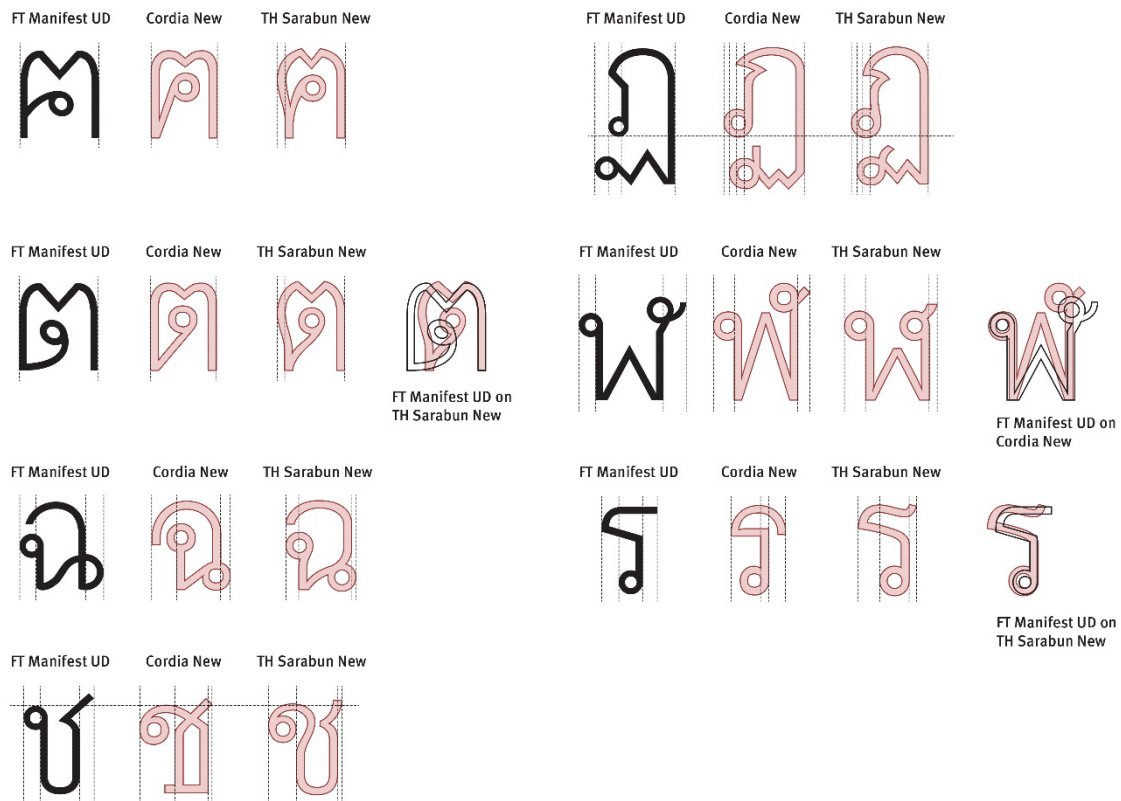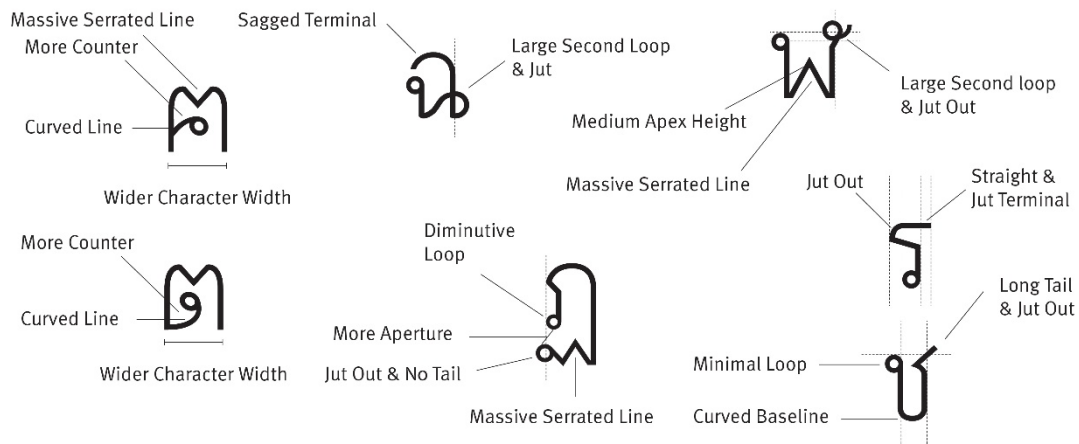
4.2. The characters Kho Khwai /ค/, So So /ซ/, Do Chada /ฎ/, and Tho Thong /ธ/

To improve the legibility of the letterform of the FT Manifest UD for the characters Kho Khwai /ค/, So So /ซ/, Do Chada /ฎ/, To Patak /ฏ/, and Tho Thong /ธ/ to reinforce more effectiveness in small type sizes, we suggest as follows:

- Character Kho Khwai /ค/: The improvement must maintain broader character width, more counter space, and a curved line connecting its first loop to the front line (Figure 4). However, it could improve the part of the diagonal curve line connecting the front line to the first loop, which can be lowered to enhance recognition.

- Character So So /ซ/: The improvement must retain key features of providing a diminutive loop; having a massive, serrated line; and jutting out of the front of the main body, as well as having a curved baseline and a long diagonal tail that juts out of the main body (Figure 4). To enhance legibility, it should increase the length of the character's tail, So So /ซ/, to make it longer than before.

- Character Do Chada /ฎ/: The improvement must retain key characteristics of having a diminutive loop, a large second loop with no tail, and a broader aperture (Figure 4). To improve legibility, the lower part of the character Do Chada /ฎ/ could be adjusted downward to make the aperture wider and make an observable vertex for the lower part, as well as increase the counter space of the character Do Chada /ฎ/, as suggested by Punsongserm et al. (2018b) (see Figure 3).

- Character Tho Thong /ธ/: The improvement must keep the use of a horizontal top line and protrusion of the front part by increasing the protrusion of this front part slightly (Figure 4).

Figure 3. Improving approach for Do Chada /ฎ/ letterform. (source: Punsongserm et al., 2018b)
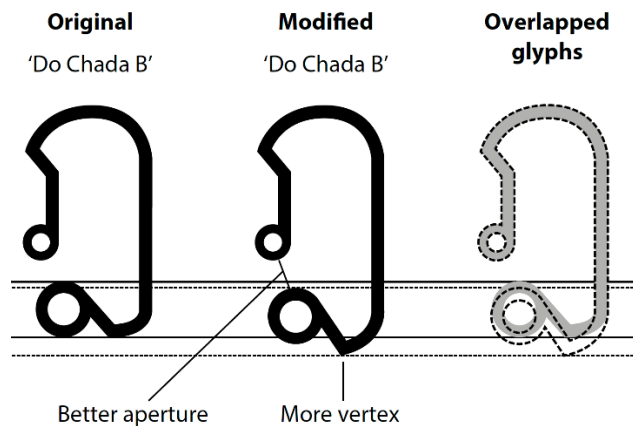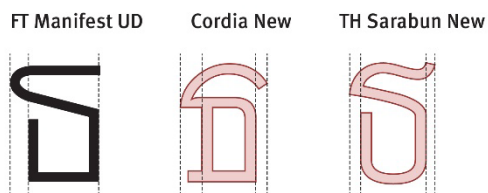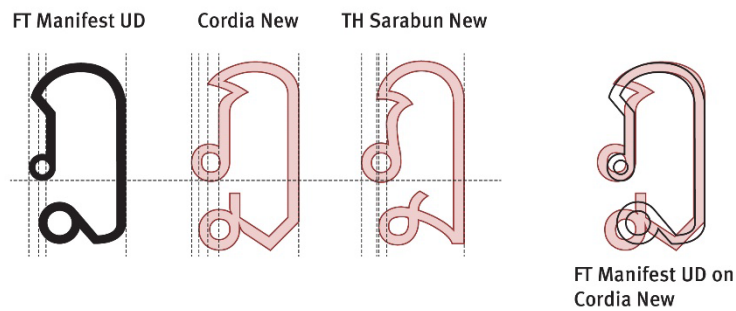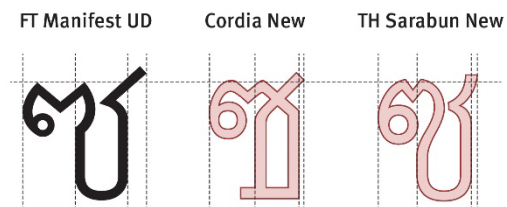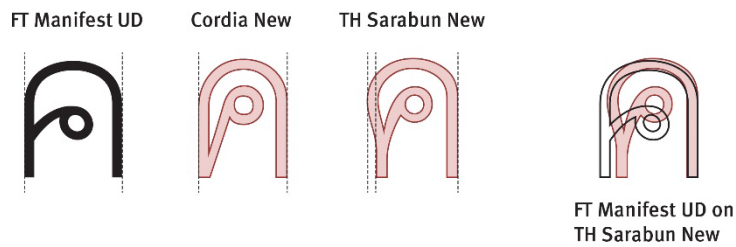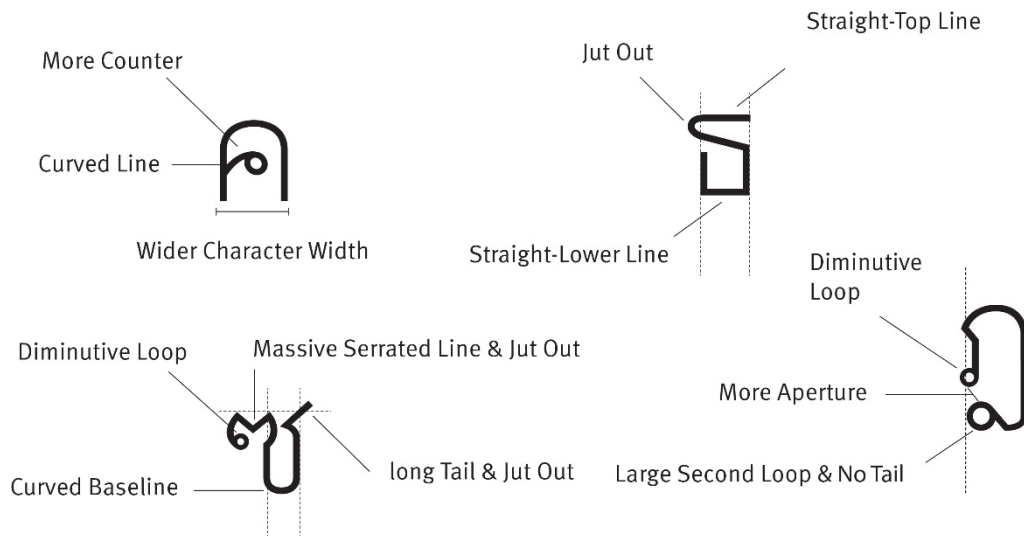
Figure 4. Key characteristics of FT Manifest UD, compared with Cordia New and TH Sarabun New
(in case of letterforms ค, ซ, ฎ, and ฮ). (source for top part: Punsongserm, 2019a)

4.3. The characters Pho Samphao /ภ/, Po Pla /ป/, Fo Fa /ฝ/, Fo Fan /ฟ/, Ho Hip /ห/, and Yo Yak /ย/

The present study suggests that the letterforms improvement for the characters Pho Samphao /ภ/, Po Pla /ป/, Fo Fa /ฝ/, Fo Fan /ฟ/, Ho Hip /ห/, and Yo Yak /ย/ (as shown in Figure 5) to have better legibility. The following suggestions conforming to the previous study (Punsongserm, 2023) may improve clarity and legibility.

- Character Pho Samphao /ภ/: The suggestion is to keep using a simplified nib and slightly increase the character width, including possibly increasing the size of the enlarged loop to ensure the loop has more protrusion to enhance better legibility.

- Character Po Pla /ป/: In this study, we found that the characters Po Pla /ป/ of each typeface provided a higher percentage of correct answers than the other characters tested. The letterform of the letter Po Pla /ป/ has used the same structure as the letter Bo Baimai /บ/, and then added a vertical straight tail (ascender). To maintain legibility, a straight baseline and a wider character width must be retained to enhance visibility. For better legibility, the character width should be slightly broader, including extending the size of the loop slightly.

- Character Fo Fa /ฝ/: The character Fo Fa /ฝ/ applied the same structure as the character Pho Phung /ผ/ and then added a tail (ascender). Although the use of curved front lines for the characters Pho Phung /ผ/ and Fo Fa /ฝ/ provided the benefit of enhancing legibility in blur simulation (fovea vision) and short-exposure (parafovea vision) experiments, according to the results of the Punsongserm (2019a, 2019b) study, the results in this study showed that the effectiveness of characters Pho Phung /ผ/ and Fo Fa /ฝ/ of FT Manifest UD did not differ from Codia New and TH Sarabun New. To improve the legibility of the character Fo Fa /ฝ/ (including character Pho Phung /ผ/), in addition to preserving the key letter features (see Figure 5), the curved frontal line should be adjusted to make the upper aperture wider. This way helps support legibility and visibility to make it easier to identify the characters Fo Fa /ฝ/ and Pho Phung /ผ/ at various small type sizes.

- Character Fo Fan /ฟ/: The character Fo Fan /ฟ/ of the FT Manifest UD was less effective than the character Fo Fan /ฟ/ of Cordia New in the experiment. The effectiveness was not different from the character Fo Fan /ฟ/ of TH Sarabun New. When comparing Cordia New and TH Sarabun New with the FT Manifest UD (see Figure 5), we found that the loops of Cordia New and TH Sarabun New are more prominent in size. It has a higher serrated line (apex) than the serrated line of the FT Manifest UD, with similar character widths. To improve the character Fo Fan /ฟ/ of the FT Manifest UD, its character width may be expanded to more than Cordia New and TH Sarabun New to increase the counter space and enhance visibility.

*Figure 5. Key Characteristics of FT Manifest UD, compared with Cordia New and TH Sarabun New
(in case of letterforms ภ, ป, ผ, พ, ห, and ย). (Source for top part: Punsongserm, 2019a)*
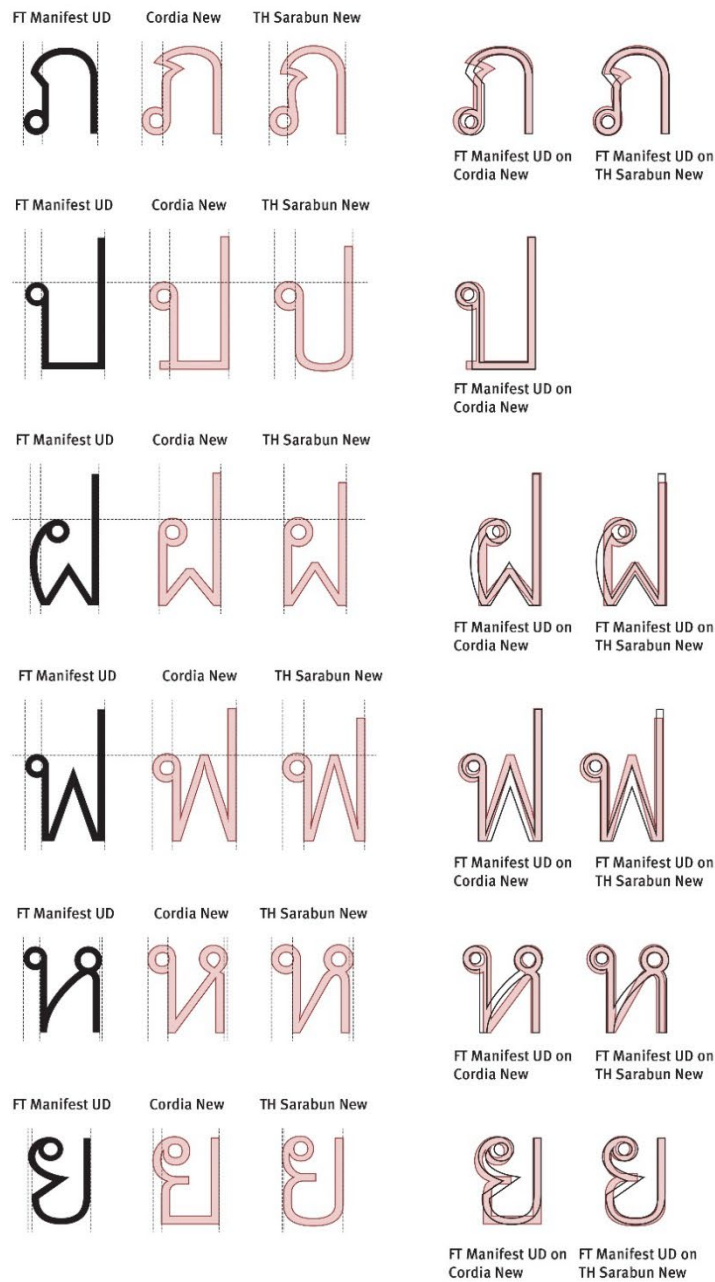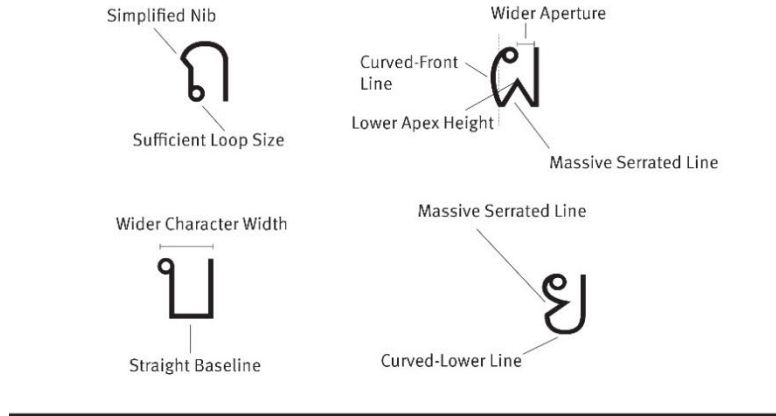
- Character Ho Hip /ห/: The effectiveness of the character Ho Hip /ห/ of the FT Manifest UD was not different from the character Ho Hip /ห/ of Cordia New for the present study. In Figure 5, the character Ho Hip /ห/ of Cordia New and TH Sarabun New is compared with the FT Manifest UD and shows a significant difference. The character Ho Hip /ห/ of FT Manifest UD has a diagonal curvature, which differs from a straight diagonal of the Cordia New and TH Sarabun New. The use of diagonal curves for the character Ho Hip /ห/ of FT Manifest UD derives from the character Tho Thahan /ท/ structure of FT Manifest UD. To maintain this aspect, improving the legibility and visibility of the character Ho Hip /ห/ of the FT Manifest UD may increase the character width and adjust its curl (second loop) to extend (jut) out the vertical axis of the back line to the righthand side more.

- Character Yo Yak /ย/: FT Manifest UD's character Yo Yak /ย/ was inferior in performance to the characters Yo Yak /ย/ of Cordia New and TH Sarabun New. When comparing the character of FT Manifest UD with that of other typefaces, we found that the characters of other typefaces used more horizontal lines protruding within the character than the jagged lines (see Figure 5). The results indicated that using a massive serrated line following the FT Manifest UD approach was ineffective in identifying small type sizes. Also, omitting the presence of the loop of the character Yo Yak /ย/ may not affect the legibility in small print sizes. To improve the legibility of the character Yo Yak /ย/ of the FT Manifest UD, we may apply this horizontal at mid-body style instead of jagged curls similar to the letter feature of Cordia New and TH Sarabun New, including reducing the size of the loop to increase the negative space (counter space) within letterform.

5. Conclusion

In the current study, we conducted a study to evaluate whether the Thai UD typeface (FT Manifest UD) can improve legibility for Thai readers of varying ages and visual acuities. We compared the legibility of the Thai UD typeface with two other familiar text typefaces. Based on the test statistics, the FT Manifest UD (Thai UD typeface) demonstrated better overall effectiveness than the Cordia New and TH Sarabun New typefaces. These results were obtained at a significance level of 0.05 and are consistent with the findings of the previous study (Punsongserm, 2023), in which the effectiveness of the typefaces was measured using the distance threshold method under the same conditions of Thai consonants and visual angles. However, among individuals in graphic design and related fields, the FT Manifest UD outperformed the TH Sarabun New typeface overall, except the Cordia New typeface, which produced a similar effect as the FT Manifest UD. It is worth noting that these results differ from those of the previous study (Punsongserm, 2023), which found that FT Manifest UD had significantly better effectiveness in each group of volunteers when compared to the Cordia New and TH Sarabun New typefaces.

Most results revealed that key characteristics of Thai letterforms for legibility improvement contributed to the legibility of FT Manifest UD's letterforms when used in different small print sizes. However, the present study suggested that improving letter features could provide better legibility in identifying small print sizes for the FT Manifest UD's letterforms, such as developing broader character width and providing more counter space, increasing or decreasing the size of the loop and the length of the tail, and adding the presence of a jutting part, as we presented in the Discussion section.

Other factors besides letter features affect legibility and visibility, such as the size of stroke weight. We found evidence that greater boldness, or visual angles rather than regular boldness,

in medium size for Roman letterforms can enhance legibility in smaller type sizes. In contrast, ultra-letter boldness does not support recognition (Beier & Oderkerk, 2019). In addition, increased letter spacing, letter width, and letter boldness enhance performance in low-vision reading owing to age-related macular degeneration (Beier et al., 2021). There is a need to investigate the effectiveness of thickness and broadness in Thai letterforms, especially in small sizes. This insufficiency is an opportunity for further study.

To expand the scope of studies on the effectiveness of FT Manifest UD related to the degree of visual angles, it is imperative to compare it with the efficacy of Roman-like Thai typefaces, which are other commonly employed fonts in various media. To achieve this, it is recommended that the adapted distance threshold methodology utilized in a prior study by Punsongserm (2023) be employed in conjunction with the method in the present study. This methodological approach can elicit the effectiveness of letterforms through varying visual angles based on physical sizes and distances.

6. Acknowledgments

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Is the City Planned and Built for me?

Citizens' experiences of inclusion, exclusion and (un)equal living conditions in the built environment.

Lilian Müller
Lund University, Department of Design Sciences, Sweden, ORCID 0000-0003-4897-2629,
lilian.muller@certec.lth.se

Emil Erdtman
Lund University, Department of Design Sciences, Sweden, ORCID 0000-0001-5326-5879,
emil.erdtman@certec.lth.se

Per-Olof Hedvall
Lund University, Department of Design Sciences, Sweden, ORCID 0000-0002-0962-2899,
per-olof.hedvall@design.lth.se

Abstract: This paper is based on a study where four go-along interviews with a total of sixteen participants were conducted in three Swedish cities. The purpose of this study was to find out how different aspects and qualities of the built environment affected different persons in terms of experiences of inclusion and exclusion and strategies used to deal with obstacles in the environment.

The study highlights the citizens' experiences and perceptions of the urban built environment, based on their individual conditions for using it, in relation to the planners' and decision-makers' visions, planning practices and construction. The participants were asked about their views on the necessary conditions for them to visit the city and its places and buildings, what barriers they might experience that either made them change routes or avoid the area completely and what kind of environments they experienced as welcoming and inclusive.

The study shows that there is an ongoing multifaceted exclusion of citizens from the built environment. This situation is not in accordance with current building regulations, neither with overall societal goals and ambitions, nor with the international conventions Sweden has undertaken to follow. The study also points to opportunities to change the situation, with the help of knowledge about enablers in the built environment and how Universal Design can become an important planning variable to bring about change.

Keywords: Accessibility, Universal Design, Disability, Urban Planning, Built Environment

1. Introduction

Having access to, and use the built environment has a significant impact on people's lives on many levels. It influences the possibility to get to a job or education, to be able to reach community services, leisure time and cultural activities, and is an essential part of the fundamental right to participate in society (UN, 2006). The access to, and experience of the local environment are also connected to health and wellbeing (Steinfeld & Maisel, 2012).

The perception of the surrounding environment is determined by everyone's individual conditions and experiences. Individual preferences, abilities and conditions colours the picture differently for each of us by our surroundings. What is an attractive urban environment for one person is perceived differently by others. An essential prerequisite for being able to take part in the city's offer at all, for many, is what is referred to in Swedish building regulations as accessibility and usability (Boverket, 2011).

The term 'accessibility' is often used in planning contexts as a matter of people's availability to different destination points or types of service. This approach is used not least in connection with traffic planning (Curl, 2013), (Jamei, Chan, Chau, & Gaisie, 2022). There is a significant difference between this way of using the term, compared to what 'accessibility and usability' aims at in the Swedish building legislation (Boverket, 2018). What is described in the law as *accessibility and usability* refers to people's use of the built environment, regardless of various disabilities. The regulations require planners and developers to ensure that what is built is accessible and usable for everyone in the target group identified as accessibility and usability for 'people with limited mobility or orientation capacity' (Boverket, 2011). When the term is used interchangeably with, for example, access to service, there is a great risk of ambiguity and misunderstandings among planners and decision-makers. Another complication is the difference between what building regulations states as accessible, and the individual perceived accessibility (Egard, 2022), (Hedvall, 2009), (Hedvall, Ståhl, & Iwarsson, 2022). The regulations prescribe minimum levels of accessibility which are not always sufficient to meet the conditions of all individuals.

In practice, using the term accessibility in other contexts, such as 'reachability' or 'access to', leads to ambiguities arising during the planning phase. When these terms are used interchangeably in planning documents, it is unclear whether accessibility in the sense of the law is meant or something else, which can cause unintentionally failing to achieve the meaning of the law during the planning process and exclusion of the appointed target group in the building regulations.

The planning tools used today are often based on standardized images of users' abilities, and previous research has shown the challenge of incorporating accessibility and concepts such as universal design into the planning tools (Koch & Legeby, 2022). Digital tools used in urban planning, are often used in relation to the concept Space Syntax (Hillier & Hanson, 1984), (Van Nes & Yamu, 2021) a method developed to analyse the shape and structure of the city in a social context and its impact on society. In this context, 'accessibility' is used as a way of describing proximity and spatial integration, which is intended to be a useful measure of perceived distance and orientability in the urban environment (Koch, 2022). The different values that are obtained with the help of different tools are the basis for analyses of e.g., how people move in the city, perceive the city in terms of distance, orientability, etc., and are also used as a tool in normative community planning to express desirable behaviours of the people in city life. Also, accessibility aspects in the built environment can be considered in a systemic perspective, of such patterns and effects on a larger scale (Koch, 2022).

In practice, however, there are large differences between this planning practice, and the accessibility and usability for different individuals in the city. The many different conditions of human diversity generate differences in how one chooses to move around in the city, how quickly one moves between point A and point B, how one orients oneself, etc. Aspects such as age, disability, gender, etc. provide different conditions both on a general and individual level. The assumption of an 'average person', and the use of measures and tools related to such beliefs, can risk driving a segregating development (Ericsson, Wojahn, Sandström, & Hedvall, 2020),

(Hamraie, 2017). While the norm is taken for granted as a given, without critical reflection, it also creates insider and outsider groups.

Mobility is in many ways a core issue in the issue of equal urban environments. Being able to move in and through the city presupposes, given the citizens' diverse circumstances, access to flexible means of transport. Public transportation is still not accessible for all in Sweden (Stjernborg, 2021). For some persons with disabilities, there is an option to apply for special travel services, i.e., an especially organised accessible transport. The right to use these transport services is decided by the 290 different Swedish municipalities, and decisions are based on different criteria, i.e., the duration of the disability and the individuals' significant difficulties in using public transport (Svenska Färdtjänstföreningen, 2012). The transports often take place in groups, where possible problems that may arise with different individuals travelling together in smaller cars, such as asthma and allergies, are not considered. According to public statistics, only 286000 persons in Sweden were granted travel service in 2021 (2,7 % of the population), which is the lowest number since the measurements started in 2009 (Trafikanalys, 2022). The number of granted applications is continuously falling, despite a sharp population increase during the same period (SCB, 2022).

It is a far-reaching responsibility to create accessibility and usability for people with disabilities, which Sweden has committed to implementing in connection with the signing of the UN Convention on the Rights of People with Disabilities, CRPD (UN, 2006). The CPRD states in article 9 the responsibilities on accessibility in relation to the built environment (UN, 2006) art.9 p 1a-b,2a-e), which is further developed and explained in General comment no 2 (UN, 2014). The strict application of universal design is expressed as the way forward.

What determines inclusion or exclusion from enjoying one's right to the built environment includes a wide range of different aspects: it can be about the design of the physical environment, access to different forms of service such as accessible public transport, but it is also about norms, attitudes, and the view of people outside the image of the 'average person' (Imrie & Kumar, 1998).

Inaccessible urban environments entail not only the exclusion of users, but also suffering, emotional burden, and costs because of accidents (Bonehill, von Benzon, & Shaw, 2020). According to current Swedish research, the number of injured users of electric wheelchairs or walkers has tripled between the years 2006-2016. Among the most common causes of accidents are curbs, level differences and uneven surfaces (Carlsson & Lundälv, 2022).

Previous and now used methods to capture social values in the built environment have been tried, for example, through sociotope mapping (Ståhle, 2006) and social impact assessment (Vanclay, 2003), (Esteves, Franks, & Vanclay, 2012). The sociotope mapping is a planning tool meant as a representation of users perceived space, by mapping the social and cultural values of places. The users play in this method a central role by participating in the mapping, and the outcome has been considered as valuable for local planners. The method has been used during by several Swedish cities in Sweden, among them City of Gothenburg (Göteborgs stad, 2023). The background to developing the model was recurring conflicts around densification, which led to a need to map places of special ecological, social, or cultural value. It is regarded as a 'bottom-up' process, aimed to handle the contradiction between the citizens' 'life world' and the planners 'system world' (Ståhle, 2006).

The concept of social impact assessment was originally an answer to requirements in National Environmental Policy Act (NEPA) 1969 of the USA (Esteves, Franks, & Vanclay, 2012). In a Swedish

context the concept has been used as an analysis tool and process support with the aim of gaining increased knowledge of a place and identify important social aspects that need to be taken care of in the planning work. It is also used to describe social consequences of various proposals for change. This tool is mainly used by strategic planners with low citizen participation (Boverket, 2023), (Göteborgs stad, 2023).

Strengths of both methods are that social issues are raised early in the process. In the sociotope mapping, the focus is mainly on how different places are used, not by whom. Social impact analyses are a strategic tool for the planners that do not involve the users in the same way, and where it is possible to make active choices about different types of consequences or different groups that are prioritized. As a complement to this type of tools, methods that involve the human diversity and who can use different environments are still missing.

Previous studies on disability and the built environment, have framed users' experiences of social oppression and marginalisation (Imrie & Kumar, 1998) (Imrie, 2012), how the analysis of the relationship between person and environment also should include individual physical, psychological and social dimensions (Lid & Solvang, 2016), (Bonehill, von Benzon, & Shaw, 2020). Citizenship and right-based conceptions of social justice are fundamental for the equal treatment of persons with disabilities as full members of the community, and analyses of access to the built environment need to be framed within this framework (Kitchin & Law, 2001).

2. Aim and research questions

The aim of this study was to shed light on citizens' experiences of inclusion and participation in the city, by identifying environments perceived as good examples or barriers in the built environment from the individual and a UD -perspective, where accessibility and usability are ensured, or not, based on human diversity, equal rights and equity. The study constitutes a concluding part of studies on universal design and the built environment, through all phases of the urban development process.

Participants' experiences of urban design and factors that either contribute to or discourage the use of the city for people with different abilities and conditions, are examined to identify patterns in the urban form and the design of public space and buildings that can influence the perception of an equal or unequal cityscape.

The study concerns citizens' access and accessibility to the city in a broad sense, such as spatial accessibility on a detailed and overall level, mobility modes, orientability and more.

The main research questions are:

- What urban environments are perceived as examples of an inclusive or exclusive built environment, and why?

- What strategies do participants use to avoid or overcome obstacles and barriers in the built environment?

- What are the decisive conditions for the participants to be able to visit and stay in the city?

- How do the participants perceive the opportunity to influence the design of the local environment?

3. Method

In the study, four go-along interviews (Kusenbach, 2003) were conducted. The method was chosen to get a holistic, in-depth understanding of how people relate or do not relate to the spaces in their cities, and what their day-to-day experiences of inhabiting this place are like. The go-along method is considered to be especially suitable for environmental perception, spatial practices and in social areas (Bartlett, Koncul, Lid, George, & Haugen, 2023), (Carpiano, 2008), (Kusenbach, 2003).

In total, sixteen citizens participated, divided on the three cities: Gothenburg, Kalmar, and Lund. The three cities are of various sizes – big city, a middle-sized city and a smaller town in a Swedish context - and are all located in the southern part of Sweden. These locations were selected as all cities took part in the research project behind. The participants were recruited mainly through invitations to different municipal citizen Councils, but all participants were not necessarily members of those councils. The participants of the study were familiar with disability perspectives on the built environment, but also to other relevant concepts such as the aging society.

All walks took place in central parts of the cities, covered 700 - 1500 m and were selected to cover a wide range of services in the city. The participants connection to the various places that were visited along the walks also varied. Some were familiar to the area since childhood, while others were moved in or had weaker connections to the area for other reasons. Thus, the participants experience of the selected areas were based on various kinds of previous encounters with the environment (Seamon, 1979).

All go-along interviews were conducted during autumn/winter 2022/2023, from November to February, which may be of importance considering reduced daylight and low temperature outside. The duration of the walks varied between 45 and 90 minutes. Two of the go-alongs were conducted in the same town, the other two in one city each.

The go-alongs were documented by audio-recording, notes and photos. The recordings were complete in three of the walks. In the fourth, this was not possible since there was a larger number of people who participated. As a complement to the collected data from walkalongs, some municipal planning document related to places/buildings that were visited on the walks, were used in the analysis.

The interviews were semi-structured, and among the questions discussed during the go-alongs were (translated from Swedish):

- What is important for you to feel welcome, safe and included in public buildings and places in this city?

- What types of places do you like to visit, and what places do you avoid, and if so, why? What prevents you from being able or wanting to use a certain building, environment or place?

- What does accessibility to the city's services and services mean to you?

- How does it work best for you to get through the city and between different destination points that are important to you (i.e. workplace, school, shopping, leisure activities)?

The interviews were all analysed thematically on an overall level with an inductive approach, aimed at finding patterns in the participants' answers on their experiences of the environment that were visited. The findings were analysed in a first step after each completed conversation walk. Patterns regarding environments, phenomena, activities, properties of buildings and places

were then analysed on an overall level (Yin, 2011); (Yin, 2018); (Bryman, 2016); (Kvale & Brinkmann, 2014).

4. Results

During the four go-along interviews, the participants have highlighted positive and negative aspects regarding their own opportunities to visit and stay in the city. The various factors that emerged and that affected the participants' access to the city's spaces and offerings are divided into the following areas, which are described in this section:

- Challenging and excluding urban environments

- Inclusive and welcoming environments

- Citizens' influence and participation in local urban planning

- Barriers, obstacles and enablers

- Citizens' suggestions

The different aspects, all related to accessibility in some way, will in the following section be discussed on a detailed level (as barriers and enablers) and on the overall level (as excluding or including environments and the possibility of having an impact on local urban development).

At the end of this section, a summary will follow of barriers and obstacles and what strategies the participants had when facing these barriers; what kind of environments that participants perceived as welcoming and including environments; and finally, some suggestions from the participants.

4.1. Challenging and excluding urban environments

The participants in the study, expressed several challenges in the urban environment, during the go-alongs. In this section, an overview of the most challenging and excluding environments, according to the participants, is presented, divided as follows:

- Topography and distances.

- Uneven ground surfaces, steep side-sloping walkways and level differences.

- Transport and mobility modes, including digital challenges.

- Areas of mixed use.

- Light and noise.

- Categorisations and special solutions

At the end of the section a short summary of the most challenging environments is given.

4.1.1. Topography and distances

Some of the key aspects causing challenges and exclusion on a general level, according to the participants in the go-along interviews, were related to topography and distances.

What a 'walking distance' is differs among individuals. For some, 500 m in a hilly terrain is a barrier-free route; for others, 10 m in a plain terrain can cause challenges. The walking distance can be seen in relation to the appearance of the terrain, but must also be related to the individual's conditions, which can also vary constantly depending on the daily state of health and

fitness. One participant made clear that on some days, 500 m could be a possible distance to move by foot; other days, she would have difficulties with the very short distance of 10 m. Another participant expressed the difficulties of carrying shopping bags for longer distances (more than 25 m).

Long distances from dwellings to different facilities represented clear barriers for several of the participants:

"It's difficult to reach the swim hall nowadays since they (The municipality) decided to locate the new swim hall in a suburb outside the city centre. It works if I can use the car to get there" (IP 1)

Participants expressed the necessity to always plan every detail of a visit to the city beforehand.

"I must think about reducing the distances I need to walk as much as possible, so that I have the energy to do what I have gone into town to do. As I will never get the permission for travel service, I must find a parking lot as close to the entrance as possible" (IP 14)

One participant using a wheelchair had a clear strategy to be able to get to the football arena outside the city centre.

"Outside the city centre there are more walkways and bicycle roads paved with asphalt. I use my electric scooter and have found out the shortest accessible route". (IP 3)

Figure 1: After the reconstruction of the square the area is covered by uneven street stones without contrasts.

4.1.2. Uneven ground surfaces, steep side-sloping walkways and level differences

Uneven ground surfaces and level differences were considered by the participants as frequent barriers in the city centres. Sideways, walkways and squares covered with cobblestones or small uneven street stone was a considerable problem in all three cities. The appearance of such ground surfaces was, in a few cases historical heritage, but more often built in the 2000s. Despite requirements in the building regulations that walkways shall be firm, even and slip- resistant, a significant proportion of newly constructed areas in the city centres were covered with uneven stone paving. Level differences, which also according to building regulations shall be avoided in

the case of new construction and should be remedied afterwards in existing public environments, were frequent also in the city environments.

Some examples from the middle-sized city are showed in Figure 1 and 2. A newly reconstructed square is mainly covered with uneven street stones (Figure 1) and the newly built tram stop is reached only by stairs in the main walking route from the train station to the tram stop (Figure 2).

In the medium-sized city, the layout of the street space with sloping sidewalks, uneven ground coverage and level differences was a major obstacle for wheelchair users as well as walker users or pedestrians with balance problems. An example of a walkway with even and paving, in accordance with building regulations, was found - a shorter street in the centre that was renovated in the 1970s.

Among the rest of the pavements in the old city centre, many had steep side slopes. These were, in some examples, a result of time (with deficient maintenance) or, in other cases, a result of a conscious choice to lead away water from facades. This caused big problems, especially for the users of a walker and a wheelchair (Figure 3). The big risk of injuries was an apparent reason for the participants to avoid these streets, or if necessary, use the private car for direct reach of entrances to facilities they wanted to visit.

4.1.3. Transport and mobility modes

In all go-alongs the importance of good accessibility that well connects all parts of the city, both in terms of geography and facilities.

The necessity of *flexible transport modes* was also clearly identified in all three go-alongs. The difficulties of visiting the city centre using a private car was one reason to avoid visits at all. Some participants, all using different mobility aids, were dependent on strategically placed parking lots to be able to visit the city centre. The location of parking lots, with short distances to entrances of facilities, was decisive for which activities, places, and shops they could visit. Public transport was not an option for any of these participants due to inaccessible vehicles, stations or stops, or long distances between home and bus stops. One participant expressed the need to be a 'parking-expert':

*Figure 2: A new level difference with stairs was created in an earlier flat area,
when constructing the new tram station.*

Figure 3: The walkway has a steep side slope, putting users in danger of falling, especially when using a walker or wheelchair.

Figure 4: The design of the open place do not support the orientation – different transport modes are using areas not separated from each other neither physically nor visually.
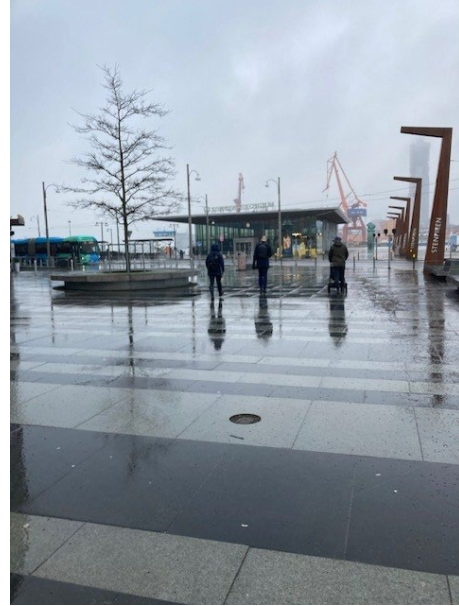
"One must be an expert on where accessible parking is located, and how to interpret the complicated parking rules" (IP 7).

Distances between home and bus stops were also mentioned as an excluding reason to visit the city centre at all. Barriers in the built environment in the city centre were also mentioned as reasons for participants to instead shop in external shopping centres with a higher degree of accessibility.

Digital challenges were also addressed. One participant expressed the difficulties using parking apps, as one reason to avoid going to the city centre by car. Without access to or knowledge of digital solutions, participants also expressed difficulties in buying tickets for public transport, reaching timetables for local transport and more.

Other challenges in using public transport, not caused by inaccessibility itself, was highlighted by several participants. Orientation in travel centres, to know which bus/tram to choose, to understand timetables and ticket rules, problems for persons with asthma or allergies to wait at tram stop when other passengers do not respect the ban to smoke and to pay attention to when trams arrive, were some of these difficulties.

4.1.4. Areas of mixed use

The concept of shared space for mixing traffic types was perceived by the participants as very challenging, especially for people with impaired vision, hearing, or orientation difficulties. In one of the cities, a shared space in front of a travel centre for public transport was visited. The main objection was that such a place is difficult, and even dangerous, as there are few visible or audible warning signals when fast cycle traffic crosses the footpath. The participants also expressed how the place's unclear boundaries and lack of contrasts specially created the difficulties of orientation, and how all the grey colours were perceived as unesthetic (Figure 4). When discussing how the lack of colours and lack of qualities to understand the environment could cause problems for users, one of the participants exclaimed:

"This is unethical aesthetics" (I9)

Figure 5: The wheelchair -symbol was found at doors for goods intake, leading to back entrances.

Fig 6. One example of how ground surfaces have been improved in connection to the city's maintenance work. The uneven street stones are now only decoration on the sides of the walkway.

4.1.5. Light and noise

Well-lit outdoor environments are not only necessary for people to be able to get around safely and orient themselves but are also an essential quality for the experience of safety and security. One participant expressed the lack of lighting in one part of the city centre as being a decisive importance to visit that area or not.

How various difficulties in the sound environment created insecurity was mentioned during one of the interviews. It was, for example, about unsynchronized signal systems between different forms of public transport: when the tram arrives, signals are given, but when the bus arrives there is silence.

The risk of increased noise in the city center, and thus increased health risks, was discussed in relation to new residential environments near railways. The strategy to build new housing blocks close to the railway is related to densification. When crossing a bridge over the railway station in one of the go-alongs, the strength of the railway noise became apparent. In another example the other side of the coin was also discussed in terms of risks – the difficulties to detect when silent electric cars in the streets, especially for a person with reduced hearing.

4.1.6. Categorisations and special solutions

Thought patterns that categorize users became another recurring theme during the conversations. Stair-free options are often marked with a wheelchair-symbol, despite the necessity of alternative routes for many users. The acceptance of special solutions for persons with disabilities is still causing excluding and stigmatizing experiences. Still, wheelchair -users are directed to the back entrances, staff entrances and goods intake, and to specially designated audience locations. Some examples came to the fore during one go-along. To reach the entrance doors of the city's theatre in the small city, one must pass the stairs. No signs are telling persons who cannot walk stairs where to go. However, at the merchandise intake and stage entrance, there is a line at the bottom of the sign telling that this 'entrance' is also for wheelchair users

(Figure 5). There is no bell to use if you want someone to open the door from inside. One participant explained that the only way to get the staff's attention that you would like to visit the theatre and need help to get in, is to remain at the square outside the main entrance, and hope that someone can see you from the windows.

At the cinema in the same city, wheelchair users are placed either in front of the first row, where one must bend the neck the whole film through, or in the passages, which is forbidden due to evacuation rules. In the newly built assembly hall completed in 2016, people with wheelchairs may only sit at the top of the hall, which makes it impossible to be integrated with the accompanying company and challenging to reach the stage in case of interactive performances or conferences.

"We don't go to the cinema or the theatre anymore" (IP 2 and 3).

A strong image of the exclusion of certain citizens largely emerged during the conversation walks. In the big city, it was told about how whole neighbourhoods were impossible to move around in, for persons who had, for different reasons, difficulties with uneven ground cover. In the smaller city, a wide range of facilities were closed to those who cannot use stairs. This applied to the grocery stores in the residential area as well as services in the city centre. *'No, I cannot come in here'* became a common statement about shops, pubs, restaurants, hotels and other service establishments we passed during the walk.

4.2. Inclusive and welcoming environments

In all three cities participants expressed positive experiences from visiting the city. The patterns that emerged when discussing what attractive urban environments meant to each participant, some places or activities in common were:

- Places with views over the city, green areas and water.

- Squares as meeting points.

- Cultural activities.

- Historical buildings and architecture.

- Bridges.

To visit the city centre to be able to watch or take part in city life, in activities but also as an observer, was important to several of the participants. The possibility of moving around, especially for health reasons and the importance of visiting the city centre to avoid being isolated at home was explicitly mentioned.

For some participants, the visit to the city centres was mainly work-related, where accessibility to the actual building where this took place, including the way from the parking lot to the entrance, was most important. Others visited the city centre just in their free time or for fun.

The importance of views, green areas, water and interesting architecture was highlighted in all go-alongs. In one of the cities, the participants appreciated that the municipality created an app where you can report obstacles in the built environment, so that measures can be taken. The initiative to place so-called 'conversation benches' around the cities - benches that, through signage, encourage citizens to talk to each other – was highly appreciated by the participants.

4.3. Influence and participation in local urban planning

Several of the participants, who also were members of municipal councils for the disabled or the elderly, expressed despair when it came to the opportunities to really influence planning and building issues in the municipality.

"We are invited to sit at the table, raise our hands and have opinions. It's a one-way communication" (IP 1)

On the overall level, a lagging commitment of the municipalities to improve accessibility for persons with impairments was perceived by several participants as a significant obstacle.

Some participants, involved in city councils for disabled, aging people or accessibility, talked about the resistance they meet, often among municipal officials:

"The responsibility for actions to remove obstacles was firstly placed on a project employee, now it is completely taken away" (IP 3)

One participant even called the municipality a driver against deteriorating accessibility:

"An outdoor escalator was planned in a housing project, connecting the newly constructed block of apartments to the higher located bridge. This was by the Disability Council regarded as a very important detail in the decision of building permits. Later another unit in the city administration told the construction company to take it away to save costs" (IP 14)

In other cases, physical barriers to buildings prevented participants from participating and influencing. A participant talked about how he, being a member of the municipal disability council, was given the opportunity to discuss drawings for a new arena with the responsible architect. According to drawings, there were no integrated accessible audience seats in the arena, despite recommendations in the building regulations.

"I had to wait at the square while the architect brought the drawings outside as there were steps to the entrance of the architect's office. In the square, I examined the drawings, and we had a discussion" (IP 3).

The necessity that responsible planners and decision-makers are looking up to link the small individual detailed accessibility measures to an overall whole-city perspective was highlighted as an essential aspect by several participants.

"A holistic view is missing; accessibility is not only in the details but important on the overall city level" (IP 8)

"Measures for increased accessibility are sometimes not connected – they have not thought the whole way through" (IP 3)

Some also talked about how accessibility measures sometimes came about 'by accident', for example, level differences between walkways and streets that was taken away because of big Sports event. Other examples were how measures was taken slow, only in connection with replacements of lines and pipes in the street (Figure 6).

Every success in terms of impact becomes important, and testifies to a participant's understanding and perseverance:

"Nowadays, the city has a policy to improve the ground surface gradually, in connection with the replacement of lines and pipes in the street. Changes are slow; you must constantly push for action" (IP 3)

"How we fought to keep the Pharmacy in town, and we succeeded" (IP 15)

4.4. Barriers, obstacles and enablers

Benches were one of the most mentioned enablers during the go-alongs. Participants of various ages and with various impairments mentioned benches as a decisive aspect for the possibility of spending a day in the city centre. One participant expressed the paradox when the municipality want the citizens to exercise for better health, without realising that without public benches many people could not go out for walks at all.

"There are never enough benches. And many of those that exist are worn. When you come to town, you want to take a breath and have some peace and quiet. You need to be able to rest. Sometimes they put benches in the 'wrong' places - where the municipality themselves think they should be and not where many people want to sit" (I 1).

Access to public toilets was highlighted as another critical issue. Finding them, having access to and managing payments systems were all aspects connected to public toilets. For some of the participants, it was a decisive factor in being able to make a visit to the city centre.

Flexible mobility systems, including accessible public transportation and the possibility to use your own car, including finding parking lots with alternatives to digital payment, were of special importance for those who live outside the city centre.

4.5. Citizens' suggestions

In the various cities, different suggestions for improvements came from the participants during the walks. A general desire was addressed to planners and decision-makers to 'think the whole way through'. Being able to use the city is not determined by fixing any individual street crossings or entrances. Accessibility measures must be linked at the city level. You arrive, move between destination points, and get to, in and out of buildings and places, participate in activities e t c. A sense of inclusion is closely related to the possibility of being able to freely choose which theatre or restaurant you want to go to, to be able to choose a route when moving around within the city, not to be forced to make long detours to find specific special solutions or to spend all energy and ability to get to and from a destination instead of being able to save this for the activity you wanted to participate in.

There were many requests for improved accessibility related to what has been described above. Among other concrete proposals that emerged from the participants were:

- Change the design of the city carefully so that people do not lose their sense of home and orientation.

- Protect the range of services in the centre through increased accessibility and premises rents that counteract empty premises.

- Make it easier for all visitors through clearer signage and directions. In particular, the lack of signage for cyclists needs to be addressed.

- Avoid special solutions as far as possible. In residential areas, all tenants should be allowed to use door-opening systems that are installed as residential adaptations.

- Allow flexible mobility systems. Public transport is not available to everyone, and alternatives must be available.

- Flexible payment systems are needed both for paying for tickets in public transport, when parking with your own car, and in shops.

- Avoid so-called shared spaces, which are difficult for many to find their way around and create risks of accidents.

- Assistants to people with disabilities should be guaranteed free parking and admission to cultural events when working.

5. Discussion

The findings show that there is an ongoing exclusion of persons with disabilities from the built environment. In addition, this exclusion of people with disabilities also affects the possibilities to influence plans and construction processes. In the study, examples emerged of important aspects that functioned as enablers for various participants. The deficient dialogue with citizens also limits the acquisition of knowledge about such needs and solutions, seen from a human diversity perspective.

5.1. An ongoing multifaceted exclusion

The findings show how a multifaceted exclusion of persons with disabilities are going on. This confirms previous research (Imrie & Kumar, 1998); (Kitchin & Law, 2001); (Bonehill, von Benzon, & Shaw, 2020). The various stories told by participants of the go-alongs, bring out a picture of the many different forms this exclusion is rooted in. It also shows how the exclusion, with varying strength, is rooted in factors along a sliding scale: from troublesome obstacles in the environment such as squares paved with cobblestones, to the total exclusion that takes place when there are no alternatives to stairs to an entrance. Or when a person in a wheelchair wants to go to the cinema, and the only available space are placed in the escape route, where no one is allowed to stay. Or when a person with restricted mobility, who cannot use public transport, not are allowed neither to park a car close to the entrance nor use special transport, nor use a parking place for persons with reduced mobility, due to rigid rules (Trafikanalys, 2022); (SCB, 2022). The many forms in which the exclusion takes its form further demonstrate the importance of including many dimensions in the analysis of the relationship between a person and the environment (Lid & Solvang, 2016). Several of the examples shown in the findings, highlight the necessity to consider accessibility and usability also in a systems perspective and on different scales (Koch, 2022).

The findings also show how Swedish laws and regulations on accessibility in the built environment are systematically disregarded (Egard, 2022); (Stjernborg, 2021). Newly laid out squares and streets are paved with cobblestones or uneven stones, without thought and with no respect neither for the law or the user. Stairs are placed in public places where there were no level differences before. Walkways are kept with steep sliding slopes, regardless of the obvious risk of injuries. Shops and other services in the city centres continue their businesses without remedying what, according to the regulations, are regarded as easily remedied obstacles (Egard, 2022).

Many of these deviations are related to deficiencies in the physical environment. In addition to that, many challenges were related to contradictory or non-existent signage and difficulties with

orientation in dense built-up areas with no view of the surroundings. Other factors that exclude, such as negative attitudes, categorisations, and special solutions, also appeared, and the digital and economic exclusion. Several challenges were of the kind that should be easy to avoid or easy to fix.

High curbs and poor maintenance of streets and walkways create dangerous obstacles and cause injuries to people with poor balance, impaired vision, walking difficulties, users of wheelchairs or walkers, etc. (Carlsson & Lundälv, 2022). Mixed areas such as 'shared spaces' have since long been documented as very difficult solutions for many people (Imrie, 2012). Nevertheless, such places are still being built.

Existing methods for capturing social values in the built environment, such as sociotope mapping (Ståhle, 2006), (Göteborgs stad, 2023); social impact assessment (Vanclay, 2003), (Esteves, Franks, & Vanclay, 2012) or tools like space syntax (Hillier & Hanson, 1984), (Van Nes & Yamu, 2021) could be further developed to better capture also issues such as accessibility, usability and universal design.

The challenges brought to the fore in this study also show how planning tools and practices need to be supplemented with a human diversity perspective. To move forward, a step that can bring about change is to implement Universal Design throughout the planning and construction process in order to prevent and counteract excluding environments. By moving away from the assumption of an 'average' person, UD can be the key to provide more different and flexible solutions that better match people's different conditions (Steinfeld & Maisel, 2012).

5.2. The necessary enablers

The findings highlight several details in the built environment that can, for many persons, be addressed as 'necessary enablers'. From previous research we know that some of such decisive enablers are public toilets and benches (Kitchin & Law, 2001), (Koch & Legeby, 2022). In addition to that, participants highlighted how their possibilities to move around in the city were dependent on:

- Parking lots, both disabled parking and regular parking lots, for all those persons with restricted mobility who do not have permission from their municipality to park their car on a disabled parking.

- Handrails along slopes or other challenging environments.

- Lighting in public places.

- Clear signage and orientation boards.

5.3. Citizens' impact on the design of the built environment

Formal methods for citizen dialogue in connection with planning processes, general invitations to dialogue meetings are often made, where it can be assumed that citizens have access to the right digital information channels, opportunities to attend meetings independently, and that the venue and arrangement are physically, informatively, and communicatively accessible. This risk to limit which citizens can participate. The form and design of the arrangement governs the extent to which those present can express their opinion. In the end, the opinions received are sorted, whereby the responsible planners decide which opinions are to be incorporated into the proposal, and which should be left without action (Boverket, 2018).

The study shows how citizens and groups who experience obstacles and exclusion in the city have knowledge and ideas about possible improvements. The chosen method was helpful to address such discussions in environments that the participants were familiar with (Kusenbach, 2003). How the strong commitment to influence their city for the better was met by decision-makers, was experienced by the participants in the study in different ways, from cautious optimism to almost resignation. Several of the participants were members of local councils such as elderly councils or disability councils. Nor did they express that they could influence to a greater extent. In relation to Arnstein's ladder of participation, the lowest level, non-participation, and the bottom rung of symbolic participation are reached at most (Arnstein, 1969).

The findings suggest that established methods and models for citizen collaboration can be reviewed. When property owners, sometimes the municipality itself, do not even meet the current minimum legal requirements for accessibility and usability in the built environment, citizens who can contribute with knowledge and suggestions for solutions, are an important resource.

6. Conclusions

The negative special treatment of persons with disabilities from the built environment are in this study documented on a sliding scale from obstacles in the physical environment (sometimes easy to remove) to complete exclusion from public places, local services and more. The disregard of applicable laws and regulations (Boverket, 2011); (Boverket, 2018) continues systematically. This creates new obstacles in the built environment, while the work to remove existing obstacles stops or are delayed. To counter discrimination and segregation, there is an urgent need to rethink the planning processes, to leave room for human diversity and to move away from notions of an 'average' person or the normate template (Ericsson, Wojahn, Sandström, & Hedvall, 2020); (Hamraie, 2017).

The participants contributed to the identification of important enablers, highlighting especially the need for flexible mobility policies that take human diversity into account. The identification of enablers also made visible how the lack of holistic perspective in urban planning in itself contributed to creating obstacles and excluding users. The participants' experiences highlighted important issues such as equal conditions and prerequisites for mobility and residence in the urban space. It also points at the gap between what the building regulation states as accessible and the individual perceived accessibility (Egard, 2022); (Hedvall, 2009); (Hedvall, Ståhl, & Iwarsson, 2022).

The pointing out of the necessary enablers is important knowledge to achieve accessibility also in an overall, entire-city-perspective. The concept and practice of Universal Design is a key to pursuing such a development.

The possibilities to influence the design of the built environment were, according to the participants, very limited, despite participation in diverse municipal councils. Considering the findings in this study, there may be reasons for the municipalities to review forms of cooperation and dialogue with their citizens. To reach the minimum level of accessibility and usability, as stated in laws and regulations, is a modest goal. To avoid the exclusion of certain citizens and to achieve a more inclusive built environment presupposes a significantly deeper understanding of human variations and needs, where a close dialogue and collaboration with citizens and organizations for people with disabilities is necessary. How the UN Convention on rights for persons with disabilities (UN, 2006), (UN, 2014), is to be incorporated into practical action in

planning and construction, which in the Swedish context is a municipal responsibility, is another important aspect that needs attention for change to take place.

This study was a qualitative exploratory study, and the conclusions are not generalisable to the three case studies nor to Sweden in general.

There is a need for more research on the health effects and the social costs of exclusion that are highlighted in this study. By making such effects visible, the motivation to bring about change can increase among more actors.

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Health accessibility

Quality of life and physical, psychological and social health in the migrant population

Cristina Belén Sampedro Palacios
University of Jaén, Spain, ORCID 0000-0003-0595-7699, cbsamped@ujaen.es

Yolanda María de la Fuente Robles
University of Jaén, Spain, ORCID 0000-0002-2643-0100, ymfuente@ujaen.es

Jesús Hernández Galán
ONCE Foundation for Cooperation and Social Inclusion of People with Disabilities, Spain, ORCID 0000-0002-7939-1213, jhernandez@fundaciononce.es

Virginia Fuentes Gutiérrez
University of Jaén, Spain, ORCID 0000-0001-6876-067X, vfuentes@ujaen.es

Abstract: Health and migration are vital parts of the development cycle. Health should be understood not only as a state of physical and psychological well-being, but also of social well-being. Social determinants play a major role in health and, therefore, also in physical and cognitive accessibility. The aim of this study is to link both realities (migration and health), in order to study the variables of quality of life and physical, psychological and social health in the migrant population. There are three main objectives: 1) To understand the perceptions of quality of life and physical, psychological and social health of the migrant population; 2) To identify and describe pathologies and disabilities among migrants; and 3) To determine if there is accessibility to the health system (treatments and control). A quantitative methodology comprising descriptive and correlational analysis was employed. The main tool was a descriptive questionnaire, supported by three scales (The Quality of Life and Health Scale [WHOQOL-BREF]; Depression, Anxiety and Stress Scale [DASS-21]; and Multidimensional Scale of Perceived Social Support [EMAS]) previously validated and proposed by international organizations, such as the World Health Organization. The main results were that levels of quality of life, psychological health and social support are moderate in the migrant population. In addition, 47.3% of the migrant population has a health pathology, with only 29% having access to health resources. The main conclusion is that the presence of pathologies and the lack of disease control among the migrant population is a sign of the need to review the actions implemented by government institutions, such as the Common European Asylum System. In addition, there is a need to make health resources accessible to the entire population regardless of social class.

1. Introduction

It is said that the ability to move, or mobility, is one of the most fascinating humans behaviours. Migration is an indispensable part of human evolution, survival and diversity. Since time immemorial, humans have moved to other places in search of better food, better climatic

conditions and even better defensive terrain. Human mobility, therefore, is one of the main driving forces of the development of societies and their inhabitants, both in the past and in the present (Peña and Ausín, 2015; Lotero-Echeverri and Pérez- Rodríguez, 2019; Nagurney and Daniele, 2021). There are many reasons for initiating a migratory process, such as economic, employment or health reasons. Moreover, there is no time or place in history that has not been involved in events that encourage the mobility of its citizens, such as wars or armed conflicts. Therefore, migratory flows are a constant reality at the international level (Abu-Warda, 2007; García, 2017).

In addition to migration, health is one of the factors that determines the development of people's lives, as well as the evolution of societies. Historically, health issues have slowed down or accelerated social evolution. In Spain, some examples of the slowing down of growth and development are, among others, the Spanish flu pandemic that occurred during the First World War, the smallpox epidemics and the current COVID-19 pandemic (Tió, 2022). An example of acceleration of social evolution in Spain is provided by technological development and its application to the creation of smart and accessible cities (Villar, 2007; Piñones-Rivera, 2021). Combining aspects of health and migration, armed conflicts are one of the main catalysts of the migratory process. In all cases, wars have a negative impact on people's health (Mellese, 2022). Moreover, they often have after-effects, i.e., they can lead to death or the acquisition of a disability that accompanies people during their subsequent migration.

A good example of this is the case of Nujee Mustafa, who fled the Syrian civil war by travelling 5,600 km in a wheelchair with the help of her sister. She reached Germany, where she was able to receive the necessary health care (Rojas, 2022). Another example is the situations experienced by people with disabilities in the current war in Ukraine. These people require specialised humanitarian aid measures to be provided effectively by third-sector institutions, such as the help being given by the ONCE Foundation towards the reception and sheltering of blind and disabled people, in order to address the problem of double vulnerability (ONCE Foundation and ILUNION, 2023).

These situations are reflected in the data provided by various government agencies. According to the Office of the United Nations High Commissioner for Refugees (UNHCR), there were an estimated 89.3 million forcibly displaced people in the world at the end of 2021, increasing by 0.6 million in the space of a year from 20.7 million refugees in 2020 to 21.3 million by the end of 2021 (UNHCR, 2022). Factors such as persecution, conflict, violence, climate change, economic mistreatment and limited access to basic resources all contribute to continually increasing human displacement. Likewise, the International Organization for Migration's World Migration Report 2022 (2022) shows that 281 million people are international migrants, which means that 3.6% of the world's population is residing in a country other than their country of origin.

In addition, figures from the World Health Organization (2022) state that 1.3 billion worldwide people suffer from disability. This means that 16% of the world's population suffers from some type of disability. Inaccessibility to health services or resources has been identified as one of the main difficulties suffered by these people. In turn, health inequalities lead to vulnerability and social exclusion. Migration and disability are two factors that combine to drive double vulnerability and increase the risk of social exclusion (Díaz, Huete, Huete and Jiménez, 2008).

According to the World Health Organization (1959), health is defined as a state of complete physical and social well-being, and not merely the absence of disease. This definition, for the first time, transcends the idea that health is only related to physical well-being. The WHO also identifies the achievement of the highest attainable standard of health as one of the fundamental

rights of every human being, regardless of race, religion, political ideology, economic or social conditions. This is why, when defining health, it is essential to take into account the three dimensions involved (physical, psychological and social), while also bearing in mind that the social aspect can be disabling.

These data make it possible to recognise migration as a social determinant of health. Social inequalities are often referred to as a determinant of health without specifically identifying what these social inequalities are. It is therefore important to acknowledge migration as a social determinant of health in and of itself due to: (I) The vulnerability experienced in the migration process, followed by potential social exclusion (Brunnet, Lobo, Silbeira, Kristensen and Derivois, 2020); (II) Language and cultural barriers (and knowledge of migrants' rights and duties), which promote inaccessibility of the resources of the Welfare State; (III) The process of assimilation and adaptation to the environment and the new culture that all migrants have to go through (Bollini and Siem, 1995; Sanz and Valenzuela, 2016); and (IV) The lack of support networks seen in most cases (Almeida, Molmar, Kawachi and Subramanian, 2009).

Vulnerability, as an element of migration, is a reality that must be taken into account (Comelles and Bernal, 2007; Mendola and Pera, 2021; Rodríguez, 2022). Vulnerability leads to a deterioration in people's mental and physical health, and therefore has a negative effect on the search for and establishment of social support (Bhugra, 2004). It could be said that vulnerability is both a cause and effect in the migration process, and it even favours the development of pathologies and disabilities (Díaz, Huete, Huete and Jiménez, 2008; Sampedro, Cano, De la Fuente and Fuentes, 2021). Moreover, this situation implies a disruption in the healthcare accessibility chain, as per the DALCO criteria (Spanish Association for Standardization, 2017), where, according to the criteria, all individual, regardless of their abilities or disabilities, should have equitable access to environments, products and services available in the community. In this case, the elements that make up the healthcare system are not accessible to the migrant population, as barriers prevent compliance with appropriate location and communication criteria in most cases. In summary, migration as a social determinant has a negative effect on people's health due to vulnerability and the factors already mentioned, such as acculturation, assimilation and differentiation of the new culture, wich also create barriers to health accesibility. Life habits may gradually worsen, exerting negative effects on health (Bollini and Siem, 1995; Fajardo, Patiño and Patiño, 2008; Urzúa, Boudon and Caqueo-Urízar, 2017).

Given that there is a clear link between migration and health/disability, study of the health and disabilities of migrants is essential in order to provide a theoretical framework that can serve as a basis for the design of social policies, as well as to ensure access to the health system for the migrant population (World Health Organisation, 1959). However, the health of migrants is an unexplored phenomenon (Burgos and Parvic, 2011; Truscan, 2013), especially in relation to disability and universal accessibility. Authors such as Piñones-Rivera and Concha and Gómez (2021) have addressed the issue of health and migration as a determinant of health, taking into account the structural vulnerability that migration implies, the importance of providing a theoretical basis, as well as the need for well-designed social policies. However, disabilities and pathologies directly linked to migration continue to be overlooked, although some authors have focused on identifying and studying some of the pathologies suffered by migrants, such as Ulysses syndrome, chronic stress, depression, etc. (Loizate, 2006; Moreno, Engel and Polo, 2007). In short, the vast majority of the theoretical background focuses on the study of mental health in migrants (Rodríguez and Hervias, 2022), leaving physical health, quality of life and disability in the migrant population unexplored, in its link health accessibility.

Previous studies show that the health/disability of migrants is practically ignored. Migrants with disabilities are acknowledged in regulations and the actions of some European countries, but they are invisible in the data (Díaz, De la Fuente and Muñoz, 2019). This points to the need for scientific study of the migration phenomenon in relation to other variables in addition to mental health or sexual and reproductive health (Llanes-Díaz, Bojórquez-Chapela and Orgers-Ortiz, 2023; Ortíz, Díaz-Grajales, López-Paz, Zamudio-Espinosa and Espinosa-Mosquera, 2023), as has been done so far (Wickramage, Vearey, Zwi, Robinson and Knipper, 2018). The lack of scientific study of the phenomenon makes migrants more prone to human rights violations and consequently a lack of access to health systems (Morawa, 2003).

As has already been stated, scientific research is the missing piece with respect to ensuring the health rights of the migrant population. However, there are actions that serve as an example of good practice, such as the agreement between the European Parliament and the ONCE Foundation. Its objective is to improve the quality of life of 80 million people with disabilities in Europe. Special attention is paid to people with needs caused by humanitarian and health crises. The vast majority of these crises are caused by war and migratory processes, and actions are aimed at mitigating the negative effects of migration on people with disabilities (Mulas, 2022).

Therefore, the main objectives of this research are: (I) To describe the existence of pathologies and/or disabilities in migrants; (II) To identify the level of access to healthcare and control or lack thereof over their health; and (III) To understand the perceptions of migrants regarding their quality of life, psychological and social health. The ultimate goal is to provide relevant information about the right to health and health services of migrants with disabilities, thereby contributing to the scientific literature on migration and quality of life, as well as physical, psychological and social health, through specifically addressing the issue of disability in migrants.

2. Methodology

In this section, the research methodology is presented, divided into five subsections where the following is described: I) Study Population; II) Research Instruments; III) Procedure; IV) Ethical Considerations; V) Analysis Plan

2.1. Study Population

The sample of this study is composed of 131 migrants aged between 18 and 70 years old and currently residing in Spain. The main characteristics and distribution of the study population are as follows: 50 women (37.2%) and 81 men (61.8%) of various origins distributed in Europe (7.6%), South America (24.4%), Africa (60.3%), Asia and Eurasia (7.6%). The reasons for migration included war or persecution (37.4%), health reasons (22.9%) and other reasons (economic, work, family, studies, etc.) (39.7%).

Participants were selected for the study using non-probability and convenience sampling since the entire population of migrants is too large to be fully considered and evaluated (Salkind, 1999).

2.2. Instruments

The Google Forms tool was used to create the study instrument. More specifically, it was used to create a descriptive questionnaire divided into four sections. The first section deals with health variables. It consists of three main questions (Q1: Situation of disability, illness and health; Q2: Type of health problem; Q3: Access or lack thereof to healthcare). For the remaining three

sections, three scales previously validated and cross-culturally translated by their corresponding authors were used.

The Quality of Life and Health Scale (WHOQOL-BREF). Proposed and created by the World Health Organization (2004) to explore self-perceived quality of life, the Spanish (original research language) version of this scale has been validated by Torres, Quezada and Ducci (2008). It is a generic instrument consisting of 26 items and four dimensions: physical health, psychological health, social relationships and environment. The higher the score in each domain, the better the quality of life profile of the person assessed. The response scale ranges from 1 to 5, as follows: 1) Very bad/Very good; 2) Not at all/Extremely; 3) Not at all/Totally; 4) Very dissatisfied/Very satisfied; and 5) Never/Always.

The Depression, Anxiety and Stress Scale (DASS-21). Created by Antony, Bieling, Cox, Enns, and Swinson in 1998 and validated in Spanish by Ruiz, García-Martín, Suárez-Falcón and Odriozola-González (2017), this scale is composed of 21 items divided into three subscales: Depression, Anxiety and Stress. The higher the overall score, the more severe the symptomatology. The response scale ranges from 0 to 3, as follows: 0) It has not happened to me; 1) It has happened to me a little or some of the time; 2) It has happened to me a lot or a large part of the time; and 3) It has happened to me a lot or most of the time.

The Multidimensional Scale of Perceived Social Support (EMAS) was proposed and designed by Zimet, Dahlem, Zimet and Farley (1988) and validated in Spanish by Ruiz, Saiz, Montero and Navarro (2017). It consists of 12 items that measure perceived social support from three sources (dimensions): family, friends and significant others. The response format is Likert-type, with options ranging from 1 to 7 as follows: 1) Strongly disagree; 2) Strongly disagree; 3) Somewhat disagree; 4) Neither agree nor disagree; 5) Somewhat agree; 6) Strongly disagree; and 7) Strongly agree. The higher the score obtained, the greater the perceived social support.

2.3. Procedure

The online questionnaires were designed and structured based on the aforementioned instruments, and administered through the Google Forms tool. However, some of the questionnaires were administered in paper format and then included in the online tool. All responses were stored in an Excel spreadsheet, which facilitated subsequent statistical analysis using IBM SPSS Statistics v22 (2013).

For study implementation, contact was made with the directors and technicians of the main institutions receiving migrant populations, along with adult education centres and hostels, in order to obtain the necessary permits to access the facilities and make contact with the target sample. In order to obtain the permits, favourable ethical reports had to be presented, as well as an explanation of the objectives of the study and the fieldwork process. In most cases, permissions were obtained to gain access to the centres and to be able to offer migrants the possibility of participating in the study. Also, the snowballing technique had to be used as a way to increase the number of participants. The questionnaire was administered between October and mid-December 2022, in person and online, with a duration of between 20 and 30 minutes per respondent.

Once the data were obtained, the necessary statistical tests were applied. The final phase was to interpret the meaning of the results and produce the conclusions of the study.

2.4. Ethical Considerations

To ensure appropriate application of the fieldwork, the ethical protocols for social research with humans of the university in which the study was carried out were followed: 1) Generation of a research report; 2) Provision of information and an informed consent document for the participant; and 3) Presentation of a letter of presentation for the institutions to the Ethics Committee. The Committee's opinion was favourable, and they thus gave permission for the research to begin. The study was subject to the American Psychological Association (2017).

2.5. Analysis Plan

Quantitative data analysis was performed using IBM SPSS Statistics v22 (2013) software, including descriptive statistical analysis of the scores on the different scales used. For this purpose, various normality tests were applied to the quantitative variables to determine whether parametric or non-parametric tests should be applied. The Kolmogorov–Smirnov test (IBM Corporation, 2013) was used to assess normality. Since the number of respondents was greater than 50, a bilateral correlational analysis between variables was then carried out. To determine whether was a positive linear relationship and/or a negative linear relationship. When the distribution of both variables was normal, Pearson's correlation was used; otherwise, Spearman's correlation was used.

Once the tests had been carried out, we selected the relevant data to be included in the results section of the study, such as the main results and the results of descriptive and correlation analyses. Finally, to conclude the analysis phase, the results were interpreted, giving rise to the conclusions of the study.

3. Results

The results are organised around two themes: (I) Descriptive analysis of the variables of health, quality of life, and psychological and social health in migrants; and (II) Interactions between variables previously studied. The results showed that, in terms of gender, there were no significant differences between the answers given by men and women.

3.1. Descriptive analysis of quality of life, psychological and social variables in relation to health

To comprehensively understand and address the findings, this section categorizes the discoveries into: I) Health Status in Migrants, and II) Migrants' Perception of their Quality of Life, Psychological Health, and Social Health.

3.1.1. Health status of migrants

The results corresponding to block 1 (Health) of the descriptive questionnaire pertain to the existence of pathologies or disabilities. In addition, the aim of this block was to determine the types of pathologies suffered by the people surveyed and whether they recognised or ignored the ailments. Finally, block 1 tried to find out whether the respondents have control over their health and access to the health system. Three questions addressed these issues: Q1) Do you have any illness, disability or health problem? Q2) What pathology, illness or disability do you identify with? and Q3) Do you have treatment or access to the necessary resources to treat/manage your

health? The questions sometimes served as filter questions. Table 1 shows the frequencies and percentages of the responses to the questions.

The results regarding the health status of migrants showed that 12% of people do not identify themselves as having any disease, disability or health problem. These results show a discordance between the results of Q1 (Do you have any illness, disability or health problem?) and those of Q2 (What is the health problem or disability you have?). Despite the fact that 65.6% of the respondents said that they do not suffer from any illness, health problem or disability, some admitted that they identify with one of the listed pathologies (chronic pathologies and disability [36.6%], acute pathologies [6.1%] and psychological pathologies [4.6%]). This shows that, from the outset, many of the people surveyed had a distorted perception of their own health.

In total, 47.3% of the migrant population had some type of illness, health problem or disability. Among these, chronic pathologies and disabilities were the most common (36.6%).

Table 1. Results of questions Q1, Q2 and Q3 pertaining to the health status of migrants. Own elaboration. Sampedro, De la Fuente, Hernández y Fuentes, 2023

Variable	Category	N	%
Q1.	YES	45	34,3
	NO	86	65,6
Q2.	Chronic Pathologies and Disability	48	36,3
	Acute Pathologies	8	6,1
	Psychological Pathologies	6	4,6
	No Pathologies	69	52,7
Q3.	NO	93	71
	YES	38	29

Finally, the data showed that only 29% of the people surveyed have access to the health system or are in control of their health. This compares with 71% of people who stated that they do not currently have access to the treatments or resources necessary to control their health. In total, 18.3% of migrants with pathologies or disabilities reported being deprived of the necessary resources for the treatment of their health conditions. This is either due to a lack of access to the health system or to a lack of economic or technical resources. Therefore, the results indicate restricted accessibility to health services, especially for migrants with disabilities or other health problems. These people often face significant barriers in obtaining the necessary health care.

3.1.2. Perception of migrants regarding their quality of life, psychological health and social health

The results corresponding to blocks 2, 3 and 4 of the descriptive questionnaires relate to migrants' perceptions of their quality of life, psychological health and social health. Table 2 shows the data for the variables studied, including their dimensions, the mean (total) scores and the scores used as a reference for interpreting the data.

The results regarding the perceived quality of life (WHOQOL-BREF) of the migrants showed that they perceived quality of life as moderate or average. In other words, they do not identify it as good or bad, but rather as normal. These inferences are based on the mean score of each dimension: physical (20.80), psychological (21.08), social relations (9.57) and environment (23.66). These average scores reflect moderate or normal perceptions, with the exception of the dimension of social relations where the mean indicates a poor perception of quality of life. This may be due to the scarcity of support networks due to the migratory situation.

Therefore, the results show that, in order to improve the quality of life of migrants, it is important to take into account the dimension of social relations, which is a key element to improve both perceived and actual quality of life.

The results for psychological health (DASS-21) were divided into three dimensions: depression had a moderate average value (6.24), as did anxiety (5.67) and stressful situations (7.43). Thus, the levels of depression, anxiety and stress were not high among the migrant population. Traits associated with the three emotional states were identified. The presence of depression, stress and anxiety episodes represents evidence of the need to improve migratory conditions (Antony, Bieling, Cox, Enns, and Swinson, 1998).

Table 2. Variables and dimensions quality of life, physical, psychological and social health. Own elaboration. Sampedro, De la Fuente, Hernández y Fuentes, 2023

Variable/Scale	Dimension	Median	Score
Quality of life (WHOQOL-BREF)	Physics	20,80	(1)
	Psychological	21,08	(1)
	Social Relations	9,57	(1)
	Environment	23,66	(1)
Psychological (DASS-21)	Depression	6,24	(2)
	Anxiety	5,70	(3)
	Stress	7,43	(4)
Social (EMAS)	Family	22,55	(5)
	Friends	21,76	(5)
	Significant Others	22,82	(5)

(1) The average score is 30 points: 30 or more, good; 29 or less, moderate; 0–10, bad
(2) 5–6, mild; 7–10 moderate; 11–13 severe; 14 or more, extremely severe;
(3) 4, mild; 5–7 moderate; 8–9, severe; 10 or more, extremely severe
(4) 8–9, mild; 10–12, moderate; 13–16, severe; 17 or more, extremely severe
(5) The average score is 28 points: 28 or more, good; 27 or less, moderate; 0–10, bad.

The results regarding perceived social support were divided into three dimensions: the first is the support received from family, the second refers to the support given by friends and the third is the support given by significant others. The three dimensions all had moderate or average scores

(family, 22.55; friends, 21.76; significant others, 22.82). This means that the level of social support perceived by the surveyed migrants was low due to reasons such as distance from family, the non-existence or scarcity of friendships as a result of migration and the difficulty of establishing interpersonal relationships with other people who may have a special meaning in their lives.

Ultimately, good social health depends on the establishment of support networks. Migrants encounter a deficiency in this area of health because they lose their support networks when they arrive in the host country. They have to create new networks despite difficulties and cultural barriers. In addition, the results regarding quality of life coincide with the notion that social relations contribute to a good quality of life and good health.

3.2. Interactions between the variables studied (health, quality of life, psychological and social health)

The second block of data shows the correlations established between the variables studied. The aim was to identify whether the main correlations of the different determinants of health (physical, psychological and social) were positive or negative. Establishing the interrelations of the variables allows the identification of areas where scientific study and political action are required to meet the needs of the migrant population in terms of access to health.

In order to determine the correlations, non-parametric statistical tests were carried out. The correlations between variables were classified as perfect (r=1), very high (r=0.8–0.99), high (r=0.6–0.79), moderate (r=0.4–0.59), low (r=0.2–0.39), very low (r=0.1–0.19) or null (r=0). The results were grouped according to the type of correlation and trend.

A very high correlation was found between anxiety and stress. Thus, the presence of a state of anxiety implies the presence of a state of stress. Also, there was a very high correlation between physical health, psychological health and environmental outcomes. This indicates that deterioration in one domain of health (physical, psychological or social) leads to worsening in the others. There must always be a balance between the three dimensions in order to be able to speak of an optimal state of health.

There were strong interactions between depression, stress and anxiety. This implies that the presence of one of these issues leads to the others appearing more easily. In other words, depression is more likely to appear in people who suffer from stress and anxiety. These results indicate the need for treatment to improve the psychological state of the migrant population, especially at the beginning of the migration process.

Regarding inverse or negative correlations, these were mainly seen between the psychological dimensions of quality of life. The better the physical health, the less likely depression, anxiety and stress were to be present. This means that it is necessary to promote physical health as a key to improving psychological health among the migrant population.

The rest of the interactions between variables were considered of minor importance to the objectives of the study. There was minimal interrelation between psychological health and social networking. However, it is essential to maintain a minimum level in the social health dimension in order to maintain the balance mentioned above.

Finally, the results showed that it is important to understand the interactions between quality of life, psychological and social health outcomes in order to determine which are the main dimensions of health and quality of life, and thus to make effective interventions.

4. Discussion

To date, research on the health of migrants has been scarce or even ignored. However, there are some authors who focus on the determinants of health, including migration. This makes it possible to identify various factors relating to the health status of migrants and sheds light on the double vulnerability situation relating to migration and disability.

One of the most relevant results of this study was that more than half of the migrants surveyed (61.8% of the men and 37.2% of the women) claimed not to suffer from any illness or health problem. However, later on, they identified themselves as having some of the proposed pathologies; 47.3% of the migrants surveyed had a pathology or disability. This issue has already been highlighted in previous studies explaining that there are cultural factors and prejudices that prevent migrants from talking about their health problems. Hankivsky (2012) talks about how systemic inequalities arise through the overlapping of social categories (gender, social class, ethnicity, etc.), particularly between men and women in health studies in which the total number of pathologies affecting the migrant population was not fully elucidated (Carballo, Cottler and Smith, 2008). This can be considered as a limitation, taking into account the gender perspective.

In term of results to the pathology and disability, there are few precedents in the literature. However, there are studies that attempted to compile European regulations that take into account migrants with disabilities (Anonymous). In addition, there is a benchmark study that presents qualitative and quantitative data on migration and disability in Spain. As in this study, it tries to make the phenomenon of migrants with disabilities visible, including in terms of their health (Díaz et al., 2008). Likewise, the results of our study revealed that 71% of the migrant population surveyed have no control over or access to the health system. This fact is affirmed by previous research that highlights the factors associated with migrants' lack of access to the health system. For example, Hernández- Vásquez, Vargas-Fernández, Rojas-Roque and Bendezu-Quispe (2020) state that there are factors associated with migrants' non-utilisation of health services. These factors include language, cultural and gender barriers, etc., associated with the transcultural theory of care (Leininger, 2022). In addition, there are clear differences in access to health services between the migrant population and the autochthonous population. This makes it impossible for the migrant population to be cognisant of their right to health on an equal basis with the rest of the population (Cabises Tunstall, Pickett, and Gideon, 2012). However, there are not studies linking the inaccessibility to healthcare products and services for the migrant population with DALCO criteria (Spanish Association for Standardization, 2007). This study identifies, for the first time, the need to break down health barriers to compliance with the accessibility chain in relation to migrants. In order to discuss healthcare accessibility, it is essential to break down barriers that hinder access to healthcare system, that in this case, these barriers are social and cultural.

Similarly, our results on migrants' perceptions of their quality of life (normal or moderate) are supported by previous literature highlighting the different determinants of quality of life (physical health, psychological, environment and social relations). León-Pérez, Patterson and Coelho, (2022) stated that the legal status of migrants is a social determinant of quality of life and health (Davies, Basten and Frattini, 2009; Razum, Karrasch and Spallech, 2016). Therefore, the migration process affects migrants' quality of life and their self-perceptions. Despite this fact, migrants are indeed satisfied with the social conditions around them compared to the native population (Bălţătescu, 2007).

Finally, our results on psychological and social health were the closest to those of previous studies. There is a tendency to study the mental (depression, anxiety and stress) and social health of the migrant population as opposed to their physical health or access to healthcare. We found studies such as that of Acarturk, Cetinkaya, Senay, Gulen, Aker and Hinton (2018), which states that the predictors of the mental health of migrants are related to the vulnerability that they experience during and after the migration process (Brunnet et al, 2020). Regarding our results for social health, the data showed that the migrant population had low perceived social support. This implies a worsening quality of life. These results are supported by studies such as that of Buchcik, Borutta, Nickel, Knesebeck and Westenhöfer (2021), who established a direct interrelation between the social relations and quality of life in migrants. Likewise, various studies show the need to study the social variable in relation to the health and quality of life of migrants (Henríquez, Urzúa and López-López, 2022), as well as the need for more studies of migration and disability as a form of social diversity (Martín-Cano et al., 2020).

5. Conclusions

The main conclusions that can be drawn from this study are as follows: the presence of chronic pathologies, disability and other illnesses is a constant within the immigrant population. Therefore, administrative action and third-sector (specialised) institutions are required to maintain the interventions that are currently being applied to immigrants with disabilities. Furthermore, it is necessary to implement new actions and social policies that promote prevention of the development of pathologies in migrants, especially those caused by migration as a social determinant of health.

Secondly, it is concluded that the quality of life, psychological health and social support of migrants are moderate. Therefore, it is necessary to further study the conditions accompanying migration in order to obtain a good scientific basis for the construction of international measures for the protection of migrants, including their health. This will ensure health accessibility as a first step in the recognition of the right to barrier-free health.

Thirdly, it is concluded that migrants encounter various barriers to accessing the health system. Moreover, even when they can access the health system, they encounter cultural, linguistic, cognitive, limitations and barriers among others. It is therefore necessary to restructure and redesign healthcare protocols so that they are accessible to the entire population in accordance with a human rights approach and the DALCO criteria (Spanish Association for Standardization, 2007). To guarantee universal and equal access to healthcare for all citizens, a special emphasis should be placed on populations with more than one characteristic promoting vulnerability, such as migrants with disabilities or chronic pathologies. This requires more research on the accessibility of health care for migrants and the breaking down of barriers that hider access to the care system, which in this case are social and cultural barriers.

Finally, it is important to emphasise that this study aimed to promote the right to universal accessible health. The factors affecting the health of migrants originate. The factors affecting the health of migrants originate from the inaccessibility of healthcare for some of the most vulnerable people. Therefore, health accessibility begins with the breaking down of existing barriers within a health system that prevent the maintenance of a good state of physical, mental and social health for some groups. To achieve this, the transformation of a traditional society into a society that is accessible and designed for all people is required, focusing on two main aspects: on the one hand, there is a need to rethink the measures adopted by the Common European Asylum System, to convert them into more humane measures; a good start would be to integrate the

Sustainable Development Goals (2015) in all measures taken by governments and health systems. On the other hand, it is the responsibility of institutions to ensure human rights and protect the most vulnerable people; society should be accessible to and designed for all people.

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The impacts of mental health and psychological well-being on architecture students' performance during distance learning.

Lessons learnt from the COVID-19 lockdown in Jordan

Deyala Tarawneh
Architecture Department, University of Jordan, Jordan,
 ORCID 0000-0002-5364-0189, d.altarawneh@ju.edu.jo

Haneen A. Al Sawalqa
Architecture Department, University of Jordan, Jordan,
ORCID 0000-0003-4580-7572, h.alsawalqah@ju.edu.jo

Maysoleen Al-Adayleh
Department of Architecture, Università degli Studi G. d'Annunzio Chieti e Pescara, Italy,
ORCID 0000-0001-7502-3950, maysoleen@gmail.com

Saleem M. Dahabreh
Architecture Department, University of Jordan, Jordan,
ORCID 0000-0002-1659-2085, saleem.dahabreh@ju.edu.jo

Hasan Isawi
Architecture Department, University of Jordan, Jordan,
ORCID 0000-0002-8666-0231, h.isawi@ju.edu.jo

Abstract: Amidst the global COVID-19 pandemic, strict lockdown measures were implemented worldwide to safeguard lives and limit widespread infections. Accordingly, distance learning methods were implemented at educational institutions. This paper critically examines the adaptation of distance learning methods for university students during this crisis, arguing that insufficient attention was given to mental health and mental and emotional well-being. The situation's urgency led to overlooking psychological factors that subsequently impacted students' learning outcomes and academic performance, especially when compared to traditional learning experiences.

This paper focuses on architecture students at the University of Jordan, aiming to reveal to what extent the implementation of distance learning during the COVID-19 lockdown affected their mental health and psychological well-being, thus affecting their overall performance. Using a mixed-method approach, the paper included real-time class observation, reflection exercises conducted during the lockdown, and a survey distributed to architecture undergraduates. The survey aimed to increase our understanding of the intricate connections between mental health, psychological well-being, and the dynamics of online educational environments, thus providing insights for future online learning scenarios.

The paper's findings exposed overlooked dimensions during the rapid transition to online learning. The emphasis on technical aspects such as infrastructure, devices, and software side-tracked the end-users importance and performance within the educational process. Concepts like 'toxic positivity,' intensified by increased social media usage during the lockdown, gained prominence. By examining the impact on architecture students in Jordan, this paper underscores

key findings, identifies critical issues, and advocates for a more comprehensive approach to distance learning.

Keywords: Mental health, psychological well-being, COVID-19, distance learning, toxic positivity, Jordan.

1. Introduction

During COVID-19, Jordan enforced a total lockdown as an essential measure to mitigate the pandemic's spread and safeguard lives. In response to this situation and to guarantee the ongoing provision of education across various academic levels, there was a nationwide shift to online teaching. Considerable efforts were invested in bolstering the technical infrastructure crucial for sustaining the educational process. Concurrently, initiatives aimed at enhancing educational service providers' skills, including academic and administrative staff, have been rigorously pursued. Amidst these commendable endeavours, students' mental health and psychological well-being, and their potential impact on learning outcomes and academic performance, have regrettably received less attention and a lower placement in officials' priority lists.

While an extensive body of literature thoroughly explores the impact of mental health on student performance (Rapuano 2019; Baloran 2020; Blankenberger and Williams 2020; Darling-Hammond et al. 2020). A limited amount of research has focused on the effects of the lockdown on the mental health of students; moreover, the unique circumstances presented by the COVID-19 pandemic, along with the unprecedented shift to distance learning, compelled this paper to investigate if and how mental health and psychological well-being were taken into account during the transition from traditional (in-person) to non-traditional (online) learning environments for university students.

During the lockdown, the insistence on maintaining a positive outlook regardless of the severity of one's circumstances, otherwise known as 'Toxic Positivity', a concept that potentially hinders the natural expression of emotions and impedes effective emotional coping, imposed an additional burden on university students to elevate their performance in unrealistic measures, often resulting in adverse outcomes such as anxiety and burnout, which this paper also highlights as a potential threat.

By examining the outcomes of a survey distributed to a sample of 84 students from the Architecture Department at the University of Jordan during the online teaching period, which commenced with the initiation of the COVID-19 national lockdown in mid-March for six weeks which later shifted into a strictly-enforced curfew, this paper aims to assess and appraise the level of awareness concerning mental health and psychological well-being among the participants; to shed light on any emerging coping mechanisms that may be observed; and lastly, to pinpoint potential strategies for affording heightened consideration to mental health and psychological well-being in the anticipated permanent shift toward online instruction.

2. Literature review

The impacts of daily stress and workload on sleep patterns, physical activity, emotional state, sociability, mental well-being, and academic performance of students have been explored in numerous literature discussions. However, discussions highlighting the concerns about the mental health of people impacted by COVID-19 have not been adequately addressed (Chaturvedi

et al. 2021; Dodd et al. 2021). Much research has been published addressing what has been technically done to cope with the COVID-19 lockdown. For instance, post the suspension of face-to-face classes due to COVID-19 in Hong Kong, Moorhouse (2020) describes in detail the adaptations made to one of his courses using a combination of asynchronous and synchronous modes of instruction. With the former, annotated material with tutor voice-over was uploaded to the learning management system, group tasks were changed into individual tasks, and additional instructions and notes were provided for clarity—conversely, the latter involved video conferencing software to deliver real-time live sessions. Interestingly, and similar to the study case, Moorhouse found that few students joined the online video calls; students rarely talked and used the chat features instead. Moreover, office hours and communication with students beyond class time were achieved through an instant messaging platform. Additional practices for implementing remote learning during the pandemic in order to reduce setbacks during school closures in other contexts, such as the United States, also highlighted problematic dimensions similar to the referenced research study. Such challenges encompass insufficient resources within educational institutions to facilitate conducive learning environments for students, as well as a widespread lack of internet access in many households. Evidently, students showed signs of anxiety, such as difficulty concentrating or falling asleep. Moreover, studies show that other students are at risk of developing more severe reactions, such as severe depression and suicidal behaviours (Morgan 2020).

Examining the situation from an alternative perspective, teachers' related challenges also emerged worldwide. In Germany, for example, König, Jäger Biela and Glutsch (2020) analysed the extent to which teachers maintained social contact with students and mastered core teaching challenges. Moreover, their study also identified critical factors influencing the adaptation to online teaching, including school computer technology, teacher competence such as technological pedagogical knowledge, and proficiency in digital teaching and learning. These factors were deemed fundamental for the successful transition to online teaching, both during the immediate response to COVID-19 and for long-term sustainability. Other teacher-related challenges emerging in the COVID-19 pandemic era and adding to its uncertainty and mirroring aspects of the study case include (1) availability of practical online connection and support; (2) educator professional development for online learning; (3) conversion of traditional face-to-face courses into successful online courses, and; (4) the recognition of student teachers' practical experience (Van Nuland et al. 2020).

Furthermore, Teachers faced significant challenges adapting to online teaching and maintaining certain levels of interaction and communication with students. A primary contributing factor to these challenges lies in the pervasive uncertainty surrounding the definitive end of university closures and the resumption of regular pre-COVID-19 campus activities. Teachers are further strained by concerns about potential job losses stemming from the economic ramifications of the COVID-19 lockdown. In addition, the expectation to maintain consistent performance and productivity levels while prioritising well-being and care imposes an impractical demand. Teachers are also expected to become more tentative about students' emotions, special needs, and circumstances, all while grappling with the acquisition of new tools and coping mechanisms and fulfilling administrative responsibilities. (Flores and Swennen 2020; Leacock and Warrican 2020; la Velle et al. 2020).

Apart from the technical issues related to remote learning and student academic performance, recent research demonstrates solid reliability between COVID-19 and dysfunctional anxiety (Irawan et al. 2020; Villani et al. 2021). Associations have also been identified between the proliferation of the pandemic and various adverse outcomes, including impairment, reliance on

alcohol/drugs for coping, negative religious coping, extreme hopelessness, and suicidal ideation (Lee 2020). More recently, the utilisation of tools, including smartphones, has been identified to measure and assess such impacts (Wang et al. 2017). From the academic perspective, Corbera et al. (2020) emphasised that the abrupt transition to home-work, the transition to online teaching and mentoring, and the adjustment of research activities during COVID-19 had a significant toll on academia. They argued that in academia, in order to counter the negative effects of such a transition, should adopt an "ethics of care", which is a more human-centric approach in academia, where the well-being of individuals is prioritised, and an ethics of care becomes integral to the academic ethos, especially in times of unprecedented challenges like the COVID-19 pandemic. This fosters a culture of care, refocuses on what is essential, and redefines excellence in teaching and research, resulting in a more respectful and sustainable academic environment both during and after the pandemic. Instances of modifications implemented to shift originally designed face-to-face courses to online delivery, along with the challenges encountered during the process, have been widely documented. For instance, strategies to respond to the emotional toll of the pandemic and online teaching encompass several key measures. These include cultivating a positive and cheerful disposition among teachers to foster both mental and physical well-being, checking on students regularly, and adopting an approach that refrains from undue emphasis on perfection. Additionally, teachers have found practical strategies such as utilising recording methods to be practical (Bos et al. 2016).

3. Methodology

The research utilised a mixed-method approach situated within the qualitative paradigm. It adopts a descriptive and analytical narrative approach grounded in documents, surveys, literature, and reflections. The core findings were primarily drawn from an online survey administered during the lockdown period, targeting university students within the study context. The study encompassed 84 undergraduate students affiliated with the Department of Architecture at the University of Jordan, aged between 18 and 22. The sample composition comprised approximately 26% male and 74% female participants residing in various locations across Jordan and abroad. Notably, nearly 88% hailed from the capital, Amman, while the remaining 12% represented other cities in Jordan and overseas. As per the study's timeline and duration, the study was conducted from March 2020 to May 2020; the research coincided with the lockdown period, during which universities were entirely closed, and education transitioned to online platforms across all disciplines and institutions. Post-lockdown, online teaching persisted in compliance with government defence laws and subsequent regulations from the Ministry of Higher Education, continuing up to the remaining of the academic year, and following, new regulations were launched to endorse more hybrid systems for universities to adapt both online and in-person formats. The Ministry of Higher Education in Jordan also focuses on issued guidelines for the integration of online learning in 2021; the guidelines focused on restructuring the academic programs and reviewing their components and contents to align with the requirements of online learning in addition to reviewing the plan for each course within every program to ensure alignment with the adopted learning modality (Ministry of Higher Education 2021).

The online survey, conducted via Google Forms and accompanied by a consent form, adapted questions from the Royal Institute of British Architects (RIBA) survey on the impact of the pandemic on architecture students. The RIBA survey, which examined 398 architecture students, reveals that these young adults are grappling with significant stress and harbour concerns about

their future careers. The findings underscore the extent of the challenges faced, with 58% of students experiencing mental health struggles and nearly half expressing apprehension about their job prospects (RIBA 2021).

Additional insights were gleaned from similar studies (Shih et al. 2003; Darius et al. 2021)and tailored to the study's context. The questionnaire was compiled of 80 items in all, divided into three sections, each concerning a different dimension—the first section included the demographic information for the participants. The second section focused on living space qualities and online learning. The third section was concerned with the mental health and well-being of the students. The questionnaire was anonymous to ensure the confidentiality and reliability of the data.

The data underwent SPSS analysis, with researchers employing descriptive statistics to illuminate respondent characteristics.

In addition to the survey results, real-time observation was complemented by reflective sessions with students during classes. Specifically, at the conclusion of each lecture, a designated period of 5 minutes (referred to as a "safe space") was allocated. During this time, the recording was turned off, and instructors initiated open dialogues with the students. Instances arose where students, upon unmuting their microphones, expressed frustration due to ambient noise hindering their participation. In response, encouragement was provided, emphasising the collective nature of the learning experience. Students were prompted to express challenges encountered in online learning, fostering a collaborative discussion. The observation process also involved the research team exchanging notes through a focus group format, incorporating input from the instructors.

4. Results

The pervasive effects of the COVID-19 pandemic have deeply influenced various facets of students' lives, notably impacting both collective and individual physical and mental health. Given these challenges, a heightened emphasis on students' mental health is deemed essential.

Online learning introduces complexities, with experts underscoring the potential challenges in the mental, emotional, and academic realms. The ramifications of the COVID-19 pandemic present substantial hurdles for architecture students. Analysing these consequences fosters the development of informed solutions and future learning scenarios, which have been proposed in different academic institutions similar to Jordan, where the Ministry of Higher Education issued decisions aimed at enhancing the process of distance education and blended learning.

At the outset, participants provided information on gender, age, living arrangements, and current situations. Predominantly, the respondents were female (n=62, 73.8%) compared to (n=22, 26.2%) males, with most falling within the 21-23 age group (n=40, 47.6%). The majority resided in Amman (n=74, 88.1%), and a significant portion lived with their families (n=75, 89.3%) rather than alone (n=7, 8.3%), as detailed in Table 1.

Through the student's responses and reflections on the survey, the research investigated the factors/challenges in education that contribute to poor mental health and how students are affected by them. In general, during the online learning period, students faced four common issues which this paper argues had the biggest impact on their mental health and wellbeing as follows.

Table 1: Socio-demographic characteristics of participants. Source: Authors, 2020.

Variable	Frequency (n)	Percent (%)
Gender		
Male	22	26.2
Female	62	73.8
Age		
18-20	12	14.3
21-23	40	47.6
23-25	25	29.8
26 or above	7	8.3
Living in Amman		
No	10	11.9
Yes	74	88.1
Accommodation		
With parents	76	90.5
Grandma house	5	5.9
Hospital	1	1.2
Out of Jordan	2	2.4
Year of Study		
01-feb	26	30
03-abr	36	42
5	17	20
Online Learning		
Yes	80	96
No	4	4
Currently staying with		
Family	75	89.3
Alone	7	8.3
Friend	1	1.2
Other	1	1.2

4.1. Accessibility issues

Accessibility issues were concerned with technical infrastructure, including internet connections, devices, technology and programs, were highly significant. As shown in table 2.

Technological barriers in the online learning environment have an impact on the online learning adaptation process. As revealed from the results, it could be seen that poor technical infrastructure is a significant obstacle in online learning.

According to a study by Zolghadri and Mallahi (2013), and similar to the study findings, the most relevant themes connected to infrastructure hurdles to e-learning were low-speed internet networks, communication challenges, and difficulty accessing the Internet.

Table 2: Accessibility Issues. Source: Authors, 2020.

Variable	Frequency (n)	Percent (%)
a. Digital tools		
The used digital tools		
Laptop	41	49.1
Portable tablet	13	1.6
Mobile phone	36	43.3
PC	5	6
Time spent on digital tools/Number of lectures per week		
1 - 2	32	38.1
3 - 4	35	41.7
More than 5	17	20.2
The level of online effectivity		
Extremely low	16	19
Low	25	29.7
Moderate	26	31
High	12	14.3
Extremely high	2	2.3
b. Internet connections		
Availability of internet connection		
Intermittent connection	34	41
Constant connection	50	59
Online classes attendance		
No	4	4.8
Yes	80	95.2
Full lecture attendance		
Yes	66	78.6
No	18	21.4
c. Used software's/ programs (most effective platform)		
Used online meeting apps		
Zoom	22	26.1
Microsoft teams	12	14.2
Facebook	12	14.2
Nothing	17	20.3
Other	7	8.3
Level of app's effectivity (Does it suit the architectural teaching requirements?)		
Extremely low	38	45.2
Low	19	22.6
Moderate	24	28.5
High	3	3.5
Extremely high	0	0

According to a study by Zolghadri and Mallahi (2013), and similar to the study findings, the most relevant themes connected to infrastructure hurdles to e-learning were low-speed internet networks, communication challenges, and difficulty accessing the Internet.

The online learning infrastructure consists of a variety of tools and equipment, including: internet connection, devices (pcs and laptops devices, portable tablets and mobile phones), in addition to technologies and programs. If all of these factors were sufficiently effective, online learning may be successfully implemented.

4.1.1. Internet connection

According to the survey results, many students were not provided with the high bandwidth or the robust internet connection that online courses require and thus failed to catch up with their online classrooms. The survey showed that about 95% of the respondents attended online classes. However, 66% of the students had internet connections problems, and 39% of the students could not complete the lectures due to the weak internet connection, which required extra effort from the student to follow up on the lessons they missed.

4.1.2. Devices

The main tools used in the online classrooms were pcs and laptops devices, in addition to portable tablets and mobile phones. About 32% of students reported that they did not own computers and shared the available devices with their family members. This leads them to seek help in learning resources for technical assistance.

4.1.3. Technologies and programs (Computer Literacy)

Architecture students need special tools and programs due to the specific nature of the field, and in-person feedbacks are constantly needed especially in design subjects. In the online classroom, the video conferencing applications did not support this type of learning.

About 51% of the students complained that the services offered by these videoconferencing applications such as Zoom, Facebook, and Microsoft teams, were not efficient with architecture modules. As a result, 21% of the students recommended cancelling the online teaching or improving the used programs and technologies to satisfy the online teaching process.

4.2. Academic performance issues

Academic performance issues were concerned with the readiness and qualification of instructors, level of communication skills, excellence and experience, learning process and used methods. As mentioned earlier, the nature of architecture modules is a mix of theoretical and practical subjects which requires much practical work, group meetings and face-to-face interactions with others, as shown in Table 3.

During the study period, all subjects were given online, which led to a much more challenging and less effective learning process, that in return negatively affected the students' performance. The survey revealed that students were not well-prepared and had adaptability struggles with online learning. Students were used to traditional teaching methods, so they could not adapt to the new situation. 44% of the students said that the online classes were of low efficiency in contrast with the physical classroom, which can be referred to many factors:

Table 3: Academic performance issues. Source: Authors, 2020.

Variable	Frequency (n)	Percent (%)
Use of digital learning tools is responsible for student's low academic performance		
Yes	65	78
No	18	22
The tasks, exams required by e-learning led to confusion and poor performance		
Yes	59	69.7
No	20	20.2
Used teaching methods		
Classic (recorded lectures and presentations)	72	85.7
Modern (suits the current situation)	12	14.2
The modules that were more effective in online teaching during the lockdown period (ranking the modules according to their effectiveness)		
Architectural theoretical modules	43	51.2
Architectural practical modules	20	23.8
General theoretical modules	36	42.8
General practical modules	18	21.4
Instructors Readiness		
Well-prepared (improved teaching methods)	48	57.1
Not prepared/ not organized	11	13.1
Don't interact with students	25	29.7
Taking any design online classes during the lockdown period		
No	15	17.9
Yes	69	82.1

a. Using recorded lectures: although recorded lectures offered the flexibility of replying them at any time desired, the missing interaction whether between students themselves or between students and instructors, made understanding practical subjects more challenging. And while theoretical topics such as history of architecture, housing issues, architecture and psychology, architectural criticism, were easier to comprehend, practical subjects had the most problems. About 52% of the responses pointed that the online classes, especially the practical subjects, were ineffective due to their different teaching methods such as design studios, technical drawings, freehand, building constructions, and graduation projects.

b. Instructors Readiness: Although universities moved to online classes, most instructors still used the same curricula and learning outcomes meant for face-to-face teaching. Student's reflection revealed that some instructors were unprepared and struggled with unfamiliar teaching methods, forcing them to resort to trial-and-error approaches. The experience of the instructors with online education was minimal, so they could not cope with the students in a seamless way that fits with distance learning. This affected the level of communication skills excellence between students and instructors. In other words, not having well-planned teaching strategies and methods that fit the new situation of education made the communication process more complicated. Moreover, 34% of responses noted that more

time is needed for the online classes than physical classes. And almost half of the responses showed that there was not enough interaction while having recorded lessons, reading pdf files or copied books, and PowerPoint slides. Some instructors did not follow up with students as they used to in the physical classroom.

c. The study revealed that the students of the first and second year were the most affected by online learning because most of the modules during the first and second year are given manually, not computerised; for example, basic design, freehand sketching, architectural drawings and building constructions. Therefore, having feedback on manual drawings through the computer screen was very difficult and inefficient. The third-year students become less affected than the fourth-year students and the fifth-year students were the least affected because they almost finished the required modules and only have the graduation project.

4.3. Social issues

Social issues were concerned with social interaction, privacy/level of confidence with online classrooms, and home environment, as shown in Table 4.

The survey results showed that social issues such as: student confidence with online classrooms, privacy, and family corporation widely affected the online learning process.

a. Student confidence with online classrooms: Students' comfort with online classrooms was notably affected by the use of cameras during lectures, proving to be an uneasy and challenging adjustment for many. The survey responses indicated that a significant 69% of students, particularly females, opted not to activate their cameras. Among those who did use the camera (constituting 77% of the respondents), a substantial portion expressed discomfort for various reasons. Some students cited a lack of trust in online platforms and concerns about privacy breaches within their homes, fearing the inadvertent appearance of family members during the sessions. Additionally, others hesitated to use the camera due to feeling unprepared or unequipped for its use.

b. Privacy: Architectural students encountered a significant challenge related to the insufficiency of privacy during their online learning experiences. Given the unique study requirements of architecture, which involve the use of drawing tables and tools, students found their homes to be inadequate compared to the dedicated physical classrooms in the university. The survey findings underscored that the online learning environment at home did not provide a satisfactory level of privacy for students during their lessons. A substantial 84.5% of the respondents expressed that the deficiency in privacy had a detrimental impact on the overall quality of their lives.

c. Family corporation: during the lockdown and online learning, the family environment played a significant role in providing support and a healthy environment for students. Considering that this is a sudden and unfamiliar situation, students faced difficulties with their families. 90% of the responses spent the lockdown with their families. However, there was a lack of cooperation between parents and students during their online education. 79% of the students were forced to interrupt their lectures because of family's daily activity and requirements. That causes distraction, lack of focus and leads them to spend extra time following up with the missing lessons.

Table 4: Social issues. Source: Authors, 2020

Variable	Frequency (n)	Percent (%)
Social interaction		
Interacting with instructors		
Low	35	42
Moderate	30	44
High	11	13
Face-to-face interaction contributes significantly to boosting students' academic achievement		
Yes	74	90
No	10	10
Using camera		
No	58	69.0
Yes	26	31.0
Feeling comfortable when opening the camera during online class		
No	65	77.4
Yes	19	22.6
Feeling of privacy (positive or negative impact)		
No	28	33.3
Yes, Positive	30	35.7
Yes, Negative	26	30.9
Reason of feeling unsecure		
The situation was unfamiliar	10	11.9
The lectures were recorded	7	8
The sudden problems with Internet connections	24	28.5
Lack of motivation	43	40.4
Family Corporation		
Have an obstacle with family		
Yes	40	44
No	44	56
Obstructed by family everyday life activities during online classes		
No	18	21.4
Yes	66	78.6

4.4. Spatial issues

Spatial issues were concerned with the living space qualities and equipment available that aid the online learning process, as shown in Table 5.

The survey results showed that the living space qualities and the available equipment were not adequate for students to study. Having a private place encouraged the student to improve their skills and offer flexibility to learn new skills and work efficiently. Most of the participants spend the lockdown period in their original living place (n=76, 90.5%) with their family. They shared the

same room with brothers and sisters, which prevented them from getting their own space to do their work compared with the students with a private room. About half of the participants did not have a private room (n=43, 51.2%) and shared their room with 1 to 2 more people.

To sum up, living space design did not support online learning as the physical learning rooms. More than half of the participants lacked privacy, impacting their learning quality (n=55, 65.5%). This impact negatively affected 58.4% compared to 7.1% that were positively affected. Furthermore, the lack of enough space to get the privacy they need in the living place caused a distraction for the students; simultaneously, being alone in front of the computer screen for a long time every day with no interactions harmed students' mental health.

Table 5: Spatial issues. Source: Authors, 2020.

Variable	Frequency (n)	Percent (%)
Private room during lockdown		
No	43	51.2
Yes	41	48.8
If NO, Number of people you share your room with		
0	36	42.9
01-feb	40	53.6
03-abr	3	3.6
If student does not have a private room, does privacy concern have an impact on learning?		
No	28	33.3
Yes	56	66.7
The design of student's lockdown space supports online learning		
Yes	34	40.5
No	50	59.5
The negative impact of having a lockdown space that doesn't support online learning		
Very low	8	9.5
Low	13	15.5
Medium	30	35.7
High	18	21.4
Very high	3	3.6
A proper desk is available during online classes		
No	48	57.1
Yes	36	42.9
Dressing up for online classes		
Yes, only the upper part	32	38.1
No	35	41.7
Yes, fully dressed	17	20.2

5. Discussion

The study investigated the influence of online learning on the mental health of architecture students, revealing four major issues throughout this time. First, accessibility difficulties involving technological infrastructure arose as a key concern. Technical obstacles, particularly low-speed internet networks and issues accessing the internet, hampered successful online learning. The lack of reliable internet connections, shared equipment, and inefficient video conferencing apps were cited as important inhibitions, highlighting the need for improved online learning infrastructure.

Second, academic performance difficulties were identified, emphasising the need for teacher preparedness, improving online communication skills, and the provision of flexible learning techniques. The switch to online classrooms revealed gaps in instructor preparation and a challenge with different teaching styles. Students reported a preference for in-person interactions and hands-on work, noting the inefficiency of recorded lectures and the necessity for professors to modify teaching methodologies to meet the online setting. According to the study, students in the first and second years were more negatively affected, particularly those participating in manual modules, while the impact decreased for third and fourth-year students.

Third, social concerns appeared as a major component influencing students' online learning experiences. Concerns regarding privacy, trust in online classes, and family collaboration were prevalent. The reluctance to utilise cameras during lectures, which was linked to privacy concerns and discomfort, had a detrimental influence on student involvement. The absence of quiet locations and family disruptions during online lectures exacerbated distraction and created a less favourable study environment.

In conclusion, the study discovered that the living environment design had a substantial impact on the quality of online learning. The majority of participants had limited privacy, with more than half sharing rooms with others. This impaired their capacity to concentrate and had a detrimental influence on their mental well-being. The study emphasised the need for enhanced online learning infrastructure and instructor readiness, and attention to social factors to enhance the overall well-being of architecture students during periods of online learning.

6. Conclusions

This study examined the effects of distance learning on architecture students at the University of Jordan, with an emphasis on their mental health and overall well-being. The paper utilizing survey as a research method, which included structured and open-ended questions, found issues that prevented students from meeting intended learning objectives, resulting in inferior academic accomplishment as compared to traditional teaching methods.

The findings revealed that, while online education environments are beneficial for certain students, they may not always benefit their mental health due to a number of factors. Mainly, the unique nature of architectural courses, along with the abrupt shift from physical to online sessions, led in heightened stress, worry, depression, and concentration. As a recommended option, converting each course's curriculum to an online base course improves the learning experience for both students and teachers. The study highlighted the psychological repercussions stemming from the unanticipated switch to online learning, emphasizing the need for a well-planned teaching approach that includes training for both students and instructors. Training

sessions on various applications and software stand recommended to improve the teaching process and foster a more effective learning environment.

Notably, this study drew attention to the essential need of providing adequate internet bandwidth where vast areas across the primarily rural regions across Jordan does not have sufficient reliable broadband and cellular service to ensure the connectivity needed for both students and teachers. Fast and reliable internet remains critical for the sustainability of online learning especially in rural, particularly in remote and underserved areas across Jordan, to ensure seamless connectivity for students and teachers.

The challenges identified in this research underscored that for a successful transition to online teaching necessitates, not only adequate technology and infrastructure but also a comprehensive understanding of the required technology by academics. For example, the study found that academics are often unfamiliar with the technology required to conduct online courses or develop webinars and resource material for student learning unless it falls in their particular area of expertise. Thus, the results advocated for a nuanced approach, suggesting that blended courses, combining online and in-class elements, could offer a more effective solution, particularly for design studio courses.

In conclusion, this paper examined the various challenges students faced in during transition from face to face to online learning. The paper highlights the importance of considering the negative psychological and emotional consequences of online learning in addition to the need for addressing technology requirements. While technology .is important for distance learning, it is equally important to address students' psychological, emotional, and mental challenges. Findings emphasize the need to recognize the limitations of the virtual environment, acknowledge the human dimension in education, and develop strategies to minimize adverse effects that occur on student well-being and academic achievement.

It is crucial to note that the study's findings may not be universally applicable, given its specific context within Jordan and the University of Jordan. The sudden shift to online learning, while essential during the pandemic, had profound effects on students' mental health and well-being. As the study concludes, the impact of COVID-19 on students' mental and physical health calls for attention and support, echoing the sentiment of encouraging those struggling to seek help as needed.

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Universal Accessibility in regular bus lines in Spain

Cristina Dueñas Díaz-Tendero
University of Jaén, Spain, ORCID 0000-0002-3793-0514, cristina.duenasdiaztendero@gmail.com

Ángeles Verdejo Espinosa
University of Jaén, Spain, ORCID 0000-0002-7998-553X, mverdejo@ujaen.es

Yolanda María de la Fuente Robles
University of Jaén, Spain, ORCID 0000-0002-2643-0100, ymfuente@ujaen.es

Abstract: Transport infrastructures are fundamental elements to achieving social cohesion, territorial development and the productive growth of society, but they must be accessible, sustainable, resilient and of high quality. There are several plans at the local and European levels that address strategies and directives to achieve inclusive public transport that adheres to the parameters of sustainability and accessibility. Therefore, in this work we have conducted a study and analysis of the situation of intercity regular bus public transport in Spain. In addition to carrying out an exhaustive bibliographic review on the importance and interest of public transport and accessibility, we also reviewed companies in the sector in order to reinforce our research. A survey of different groups of people, with and without disabilities, was performed to provide a broad and diverse view of the problems and advantages of public bus transport. The advances and challenges of using this means of transport for the mobility of people and its importance to improving society have been analysed. This research seeks to extract an in-depth analysis - through a review of the literature and surveys of 82 people - of the accessibility chain in regular bus lines in Spain, and to offer proposals and recommendations that can help the main stakeholders in the sector to offer accessible, inclusive and quality transport.

Keywords: Universal Accessibility; Intercity buses; Regulatory; Accessibility Chain; Challenges.

1. Introduction

According to INE data recently published in a report on passenger transport (Passenger Transport Statistics. Provisional data (INE, 2022), more than 399.4 million passengers used public transport in Spain in May, 37.7% more than in the same month of 2021. When we focus on interurban transport, the figures reveal that 111.5 million travellers used this option in May this year, an increase of 43.6% compared to the same month in 2021.

Table 1 shows the data for the different modes of interurban transport and the number of passengers in each mode. As we can see, the intercity bus is the mode of collective transport most used by passengers, surpassing rail, air and sea transport.

In addition, it is important to note that the interurban bus is the means of transport that is most present in all municipalities; in fact, in many small rural towns, this is the only public transport option available to residents. It is also a very economical means of transport.

Table 1. Intercity transport. INE (May, 2022)

Intercity Transport	Number of Passengers transported (thousands)	Rate (%) Annual	Rate (%) of the year-to-date average
Suburban bus	42425	39.5	41.2
Medium-distance bus	15407	51.9	53.2
Long-distance bus	933	100.9	144.5
Total bus	58765	43.3	45.1
Suburban railroad	43034	35.6	38.7
Medium-distance rail	2644	71.2	82.8
Long-distance rail	2728	108.6	155.0
AVE Railway	1902	124.6	173.6
Rest of the long-distance railway	826	79.3	121.7
Total railway	48406	40.0	43.9
Peninsular air	1332	160.0	218.2
Peninsular air-rest of territory	1769	134.7	212.5
Inter-island air	465	35.4	65.7
Air (inland) total	3566	121.6	180.0
Maritime (coastal)	809	66-5	99.9
TOTAL	111547	43.6	46.9

* Suburban includes all rail operators, and only RENFE for medium distance and long distance.

The Observatory of Universal Accessibility of Interurban Transport 2012 captured this idea perfectly: "This means of transport is the lowest common denominator of mobility in Spain" (ONCE, 2013).

Having described the current situation of this means of transport, let us now consider the following question: if the intercity bus is so common in our municipalities, and is in many of them the only means of connection with other towns, can it be used by everyone? That is to say, can all citizens benefit from this means of transport?

To answer in the affirmative, Universal Accessibility and the Principles of Universal Design or Design for All must be present. According to LIONDAU (LIONDAU, 2003), Universal Accessibility is "the condition that environments, products and services must meet in order to be understandable, usable and practicable for all people". (Head of State, 2003).

Universal Design, or Design for All, aims to design products or services that can be used by the greatest number of people. The principles that govern this methodology are:

- Equivalent use.

- Flexible use.

- Simple and intuitive to use.

- Perceptible information.

- Tolerant of error.

- Low physical effort.

- Size and space for access and use.

At this point, it should be noted that Accessibility is a right that is included in Art. 9, Accessibility, of the International Convention on the Rights of Persons with Disabilities:

> *"To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas. These measures, which shall include the identification and elimination of obstacles and barriers to accessibility, shall apply to, inter alia:*

> *a) Buildings, roads, transportation and other indoor and outdoor facilities, including schools, housing, medical facilities and workplaces;*

> *b) Information, communications and other services, including electronic and emergency services.* (UN, 2006)*"

The European Union's Strategy for the Rights of Persons with Disabilities 2021-2030 (Union of Equality: Strategy for the Rights of Persons with Disabilities 2021-2030) reflects upon the importance of accessibility when accessing services and products on equal terms:

> *"Accessibility to the built and virtual environments, to information and communication technologies (ICT), goods and services, including transport and infrastructure, is an enabler of rights and a prerequisite for the full participation of persons with disabilities on an equal basis with others. (European Commission, 2021, p. 6)"*

Transport is also mentioned: "Passenger rights guarantee the right to non-discrimination in access to transport and to receive assistance free of charge for passengers with disabilities and reduced mobility travelling by air, rail, maritime means of transport, or bus and coach." (European Commission, 2021) Specifically, the goal is to guarantee non-discrimination in access to transportation and free travel assistance for people with disabilities and reduced mobility.

At this point, linking the ideas of Universal Accessibility and transport, we can define accessible transport as that which enables the right to mobility for all people, i.e., the ease of movement from one place to another, in an autonomous, safe and dignified manner, both in urban and interurban travel, in the different modes of transport.

If we focus on regular intercity buses, can we say that Universal Accessibility exists? Unfortunately, we can affirm that very little progress has been made in this field, but we will

discuss it in greater depth over the course of this document. This is largely the result of the low level of adaptation due to the existence of an atomized market, i.e., small companies. Moreover, the current regulations do not contribute much to achieving this, as we will see in the following section.

In order to achieve Universal Accessibility in interurban public bus transport, there must first be a commitment on the part of government agencies and private intercity bus companies to provide this service in a meaningful way that goes beyond just nice-sounding words on a page. Also necessary is the idea that accessibility benefits us all and therefore, when it does not exist, it leads to discrimination and the exclusion of groups.

1.1. State of art

We can compare this project to those previously carried out on the same topic, such as:

- Comprehensive Study on Accessibility to Public Transport in Spain conducted in 2018.

- Accessibility, Safety and Design for All in Transportation published in 2016.

- Observatory of Universal Accessibility in Interurban Transport in Spain 2012

- Universal Accessibility of Modes of Transport in Spain: Current Problems, Main Advances and Future Challenges, which was published in 2012.

- The Accessibility of Bus Transportation: Diagnosis and Solutions. Study conducted in 2006.

The first, the degree of accessibility of the different means of public transport in Spain is analysed, with the aim of obtaining a diagnosis that can be used in public policies in this area and in a National Accessibility Plan. The section on interurban buses deals with the technical specifications for the concession of long-distance interurban routes for the regular transport of passengers for general use and other obligations required of the contractor, from which information is obtained on the fleet of accessible interurban buses in Spain and a brief summary of the companies that manage them and their actions on accessibility and for people with disabilities (Díaz Velázquez, 2018). *"Specifically, of the 1148 vehicles, 46.25% had measures in place to facilitate access to transport for the people with disabilities or reduced mobility (Díaz Velázquez, E., García, C., 2018, p. 204-205)"*.

In the second, the information collected focuses on accessibility, safety in road vehicles for people with reduced mobility especially at the level of road transport regulations and legislation. Specifically on intercity buses only what they are is explained (Dols Ruiz, 2018).

The third shows how, especially in rural areas, interurban transport is essential for the mobility of many people and accessibility is fundamental to achieve quality mobility for all. However, intercity buses do not have may accessibility measures in place. Furthermore, the Observatory specifies what an intercity bus journey is like, i.e. the accessibility chain. Finally a series of recommendations are given based on design for all, regulations, good practices, training, research and innovation. In this Observatory, research work is carried out to diagnose the state of accessibility in interurban transport in 11 towns and cities and the link between them (ONCE, 2013).

The fourth section reviews the current situation and main initiatives for universal accessibility in all passenger transport in Spain, as well as the current regulations and the challenges for the future. As far as intercity buses are concerned, it is shown that this is the means of transport that

has evolved the least in terms of universal accessibility and some noteworthy initiatives in regions of Spain are presented (Juncá Ubierna, 2012).

The fifth document is the only one that focuses exclusively on bus transport (interurban and urban) and is closer to the present project. At the beginning of the document, the legal framework is presented, then the business context of this sector, followed by the needs and problems linked to the lack of accessibility and its relation with people with disabilities, and finally the objective and proposals. The general objective is that everyone can make use of these means of transport as long as universal accessibility requirements are taken into account. And among the proposals, greater involvement of the Administrations, how the business sphere intervenes and the participation of associations of people with disabilities, as well as training, compliance with legislation, commitment to innovation, comprehensive accessibility programmes in bus companies and improving attitudes and behaviour in favour of accessibility (Vega Pindado, 2006).

Regarding the similarities and differences between the five previous document and this project, none of them focuses exclusively on intercity buses, the only one is the last one where this subject plays a very important role. In the Observatory, research is carried out as in this study, but the difference lies in the fact that the data collection is different, as we carried out a survey and a review of the companies in the sector. And in the fifth, there is a difference, which is the survey.

We would like to thank you for publishing these studies, documents and research, which helped us in the preparation of this research work.

1.2. Structure

In the first part of the article, an introduction to interurban transport in Spain is given, statistical data is collected and the main indicators for the study are obtained. It is found that the bus is one of the main means of interurban transport. A first analysis is made of the accessibility situation in this type of transport, taking into account the parameters of accessible design for all persons, regulations and current legislation (the part of regulations and legislation is shown in the project in its extended version). The second part of the manuscript investigates the accessibility chain and DALCO[1] criteria. The survey was conducted among 82 people residing in Spain. Finally, a survey of people with and without disabilities is carried out to obtain results on important issues in the field of accessibility in interurban transport. Finally, the conclusions of the research and bibliographical references are presented.

2. Methodology

Several methodologies were combined during the preparation of this work. On the one hand, we conducted a bibliographic review of regulations, manuals, books, research papers and web pages relevant to the subject at hand. We also contacted companies in the sector and the General Directorate of Land Transport's Sub-Directorate General of Management, Analysis and Innovation in Land Transport to ascertain the current situation in the sector (this part is shown in the project in its extended version).

Moreover, in order to enhance the document, be as realistic as possible and capture the everyday situations of many people when travelling by this means of transport, we administered a survey

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[1] DALCO Criteria: They are a series of requirements related to the actions of 4 wide groups (AENOR, 2007): Ambulation, Apprehension, Location and Communication. These actions must be satisfied in order to guarantee the global accessibility to environments, products, and services

to gather the impressions, experiences and opinions of 82 people living in Spain, 48 of them with disabilities and 34 without.

2.1. Accessible mobility

Today, private vehicle transportation leads any ranking of transportation use. This trend should change towards a greater use of collective public transport, due to, among other reasons, sustainability and the fight against climate change. It has been proven that public transport is more efficient and less polluting than private transport.

Mobility is a right we all have, as stated in Art. 13 of the Universal Declaration of Human Rights: "1. Everyone has the right to freedom of movement and residence within the territory of a State." (UNITED NATIONS, 1948).

Mobility is an essential element to enable social and economic growth, so it makes sense that everyone be able to partake in this action. Interurban mobility plays a major role here, since every day millions of people travel from their homes to other municipalities or regions to engage in their private, professional and social lives.

Let us take a closer look at the term that appears in the title of this section: accessible mobility. According to the definition given in the book Universal Accessibility and Design for All. Architecture and Urbanism:

> *"It consists of the systematic application of the principles of Universal Accessibility to all those areas of the external environment that allow for the development, use and enjoyment of the same in conditions of safety, comfort, efficiency, personal autonomy, sustainability and ease of use. In this context, transportation is a key element, as it provides the backbone of the mosaic of accessible mobility. (Fundación ONCE, 2011)"*

Given this definition, we want to reinforce the idea that accessibility and mobility must go hand in hand, that there can be no mobility only for the majority that results in isolation and discrimination of a minority, such as people with disabilities and the elderly. This is why transport is so important, especially public transport, which must exhibit all the accessibility requirements in the five fundamental parts of mobility expressed in the book Universal Accessibility and Design for All. Architecture and Urban Planning: "Fixed infrastructures or installations. Rolling stock or vehicles. Frontier or links between both. Information, communication, guidance systems. Management and provision of services." (Fundación ONCE, 2011) . However, this is not always the case, as we will see below.

Accessible public transport promotes mobility, but also parts of the lives of citizens, such as the option to work, leisure, travel due to health issues, tourism, personal relationships, and it greatly helps groups such as people with disabilities and the elderly. CERMI already reflected this idea in its 2002 study, in which it conducted a survey of associations.

> *"The ability to use the means of transportation available to the public is particularly important for a normal life and full participation in society. Some 35.6 percent of the people referred to in the questionnaires have experienced discrimination in accessing public transportation, and not only as a result of physical barriers (inadequate infrastructure and fleets), but also due to attitudinal problems and communication barriers. People with physical and*

sensory disabilities are the most affected by this type of discrimination
(García, 2003)”

Collective accessible mobility can be one of the tools to eliminate exclusion. In the article on GIS Approach Applied to Tourist Bus Route Design on Lanzarote Island highlights how the accessibility of public buses can improve leisure and tourism opportunities for people who live in rural areas:

“The new tourist bus lines proposed here have several advantages for rural populations. They would improve accessibility to leisure facilities for residents in terms of decreased travel time. Those populations would also have two options to travel: at peak time or off-peak time. Most tourism workers would save a lot of travel time in accessing their place of work at one of the tourist centers on the Island. This suggests that time-based exclusion would be improved because this new services provides an incentive to mobility for rural residents (Rendeiro Martín-Cejas, 2021)”.

2.2. Accessibility chain and DALCO criteria

We can define the accessibility chain as "the set of elements that, as part of the user's process of interacting with the environment, allows the realization of the activities anticipated in it". (AENOR, 2007).

If we extrapolate this to intercity bus transportation, we can say that the accessibility chain must not be broken at any step from the time a user takes the initiative to travel until they reach their destination. It is of no use if the origin and destination are accessible but the journey is not because there are barriers that prevent users from doing so. When we talk about a trip, we refer to the service that allows us to go from one municipality to another.

Before delving into the accessibility chain, it is necessary to explain what the four DALCO criteria are and why they are so important. They are explained in detail in the standard UNE 170001-1:2007. Universal Accessibility. Part 1: DALCO criteria to facilitate accessibility to the environment.

- The first of these is Ambulation (“deambulación” in Spanish), meaning the action of moving from one place to another. Mobility can be both horizontal and vertical and rely on the individual's own means, technical aids or the use of means of transportation.

- The second is Apprehension, the action of taking or grasping something. It refers to the ability to manipulate, grasp, twist, press, reach and grasp. It must also consider manual, auditory and visual scopes.

- The third criterion is Localization, the action of locating. In other words, it refers to the ease with which the precise place where something or someone is located can be determined

- The last one is Communication, the exchange of information necessary to carry out an activity. This criterion takes into account interactive communication (visual, tactile or acoustic), panels, graphic and written signs, luminous, acoustic and tactile signs. (AENOR, 2007, p.6-14).

We will next study the Accessibility Chain bearing in mind the four criteria explained above in order to provide a quality service for everyone. Schematically, the links are those shown in Graph 1.

Graph 1. Accessibility chain. Compiled by authors
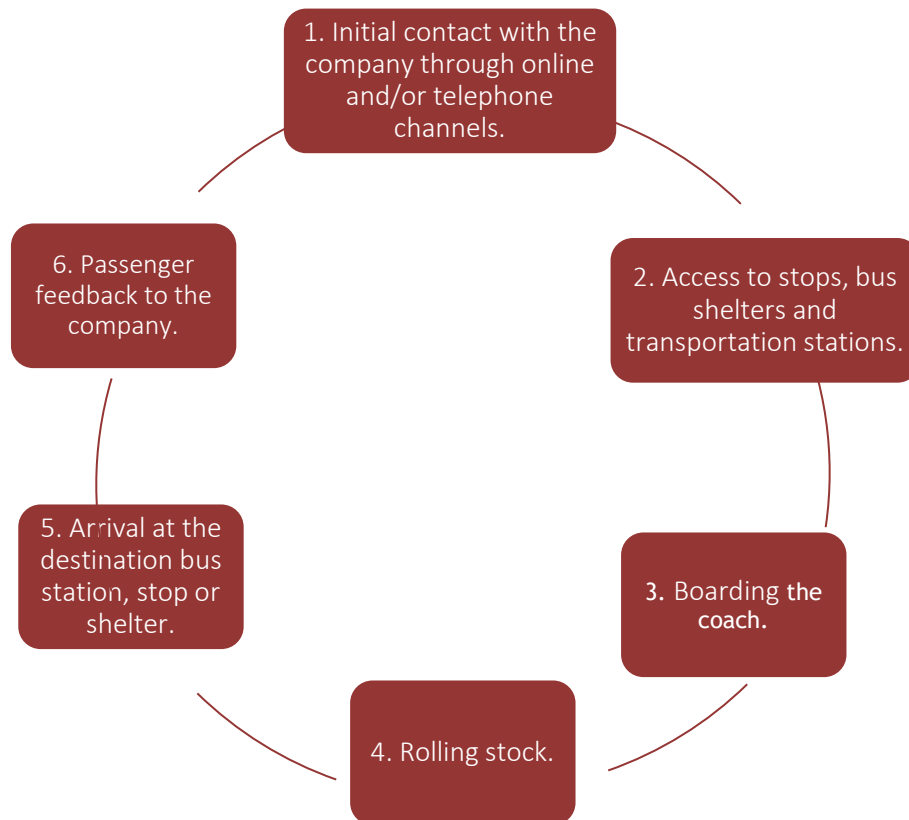
.An example of where the transport accessibility chain can be implemented is in the tourism accessibility chain, as transport is an essential element in the sector. Bus stops are part of a link in the tourism accessibility chain. If the chains are broken, it is definitely not possible to complete journeys, to go to destinations…in short, to enjoy tourism on equal terms.

In the research carried out in the tourist areas of Maspalomas Gran Canaria on the accessibility conditions for people with physical disabilities, it was revealed that there was a deficient walkability, causing the accessibility chain to be broken. Furthermore, it was conclude that it is necessary to undertake accessibility actions in order to reinforce the competitiveness of tourism products (Santana Santana, 2020).

However, although this research focused on people with physical disabilities, it is important to emphasise the goal of achieving universal accessibility for all people.

2.2.1. Initial contact with the Company through online and/or telephone channels

Nowadays, many people decide to purchase tickets in advance of the trip. To do so, they access websites or phone the company providing the service. In addition, information about lines and schedules and other relevant company information can be found using these methods.

Websites must be accessible so that everyone can access them to find answers to their questions and make purchases. To do so, they must be compatible with the assistive products used by many people with disabilities.

Websites must offer personalized solutions that address the needs of customers and that promote interaction with them. For example, a hearing-impaired person has the right to be able to communicate, and the company has to offer a service with a live sign language interpreter on

the website. The information published on the website should seek to be understood by customers. Pictograms provide one solution, and videos must be subtitled and interpreted in sign language.

Another way to contact companies is through official telephone numbers, which, as mentioned above, must also take into account accessibility. This option is not chosen by the hearing impaired, so tele-interpretation would be more appropriate and should be offered by companies.

Regardless of the medium chosen, customer service personnel should provide a quality interaction during this initial contact, a quality that should be present throughout the rest of the accessibility chain. Companies must train their personnel in accessibility and disability issues.

Normally, PRMs (People with reduced mobility) must give 48 hours' notice to the company providing the service that they wish to travel with them, so that the company can make the necessary adaptations to the vehicle. From our point of view, this should change, since people with reduced mobility should not be required to inform travel providers of their desire to travel in buses, which should offer accessibility conditions from the very beginning, ideally on every route. We realize the complications this entails for the transportation sector due to space and investment concerns, but it is the only solution that guarantees equal access to everyone.

2.2.2. Access to bus stops, bus shelters and transport stations

In these facilities, accessibility must be taken into account as a multi-dimensional facet that involves all the services provided there. In addition, the four DALCO criteria must be taken into account. Accessible PRM parking spaces should be located as close as feasible to these places in order to allow this group to access these locations as autonomously as possible, and thus begin or end their bus journey. Bus stops and shelters are the only waiting areas in many towns in Spain. They are also common in the neighbourhoods of large cities. Due to adverse weather conditions, there must be a roof to provide protection in these situations.

Moving on to accessibility, the points to consider include the following:

- There should be no barriers to access these spaces.

- Pavement properly maintained, with non-slip surface and no uneven tiles or holes, tactile paving with a different texture and colour.

- Accessible standing seats with armrests and backrests. In addition, they must have sufficient space for wheelchair users.

- Information panels in easy-to-read and Braille format. One resource currently used is QR codes, which are quite accessible but require users to have access to a cell phone and an internet connection.

Bus stations must also facilitate both horizontal and vertical circulation, which can be achieved by implementing these measures:

- Horizontal movement.

  - Accessible access.

  - Accessible signage.

  - The main door must be accessible, and if it is not, an alternative accessible route must be provided that is properly signposted and does not require a great effort from the person

who needs it. They must also provide access to the same services that are available to those entering via the front door.

o Bridging the difference in level between the sidewalk and the access to the building in a way that is accessible and promotes autonomy without undue effort.

o Passageways must be wide enough for a wheelchair user to manoeuvre (diameter of 1.50 m) without obstacles.

o In addition, it must be possible to operate doors without problems. Automatic doors can be a good resource, but they must be properly marked.

o Inside the station, there should be no obstacles that make movement impossible. Signage can help people determine their current location. Proper lighting and contrast will be necessary for people with low vision, and paving that guides users to the different areas is recommended. In addition, the pavement should be slip resistant.

o Normally in these buildings, the arrival or departure of buses, timetables, etc., are announced by public address system, so it is necessary to install hearing loops for people who use hearing aids. The information that is conveyed orally should also be displayed in writing, which is why the size, colour and text on the screens must be taken into account.

• Vertical movement.

o The best option is an elevator for comfort and safety.

Three key areas of high passenger flow within stations are bathrooms, waiting areas and customer service, which should all have the necessary accessibility features.

2.3. Boarding the coach

Users should be able to board buses as autonomously as possible. Due to their height, PRMs generally have considerable difficulty climbing stairs, so coaches should be equipped with a safe platform lift to enable boarding.

If, however, passengers can use the stairs, they should not be overly steep, and the size of the treads and risers should be such that they can be climbed comfortably, and feature non-slip flooring. We recommend the use of a bar or a support to assist with this climb.

Figure 1. Lifting platform. Mobility Car Solutions. (Mobility Car Solultions, 2023)

2.4. Rolling stock

We use the term rolling stock to refer to the vehicle, i.e. the coach. This means of transport has a great disadvantage in that there is little space available in its interior, which makes adaptations complicated, but not impossible.

The inside of the vehicle should provide the greatest possible freedom of movement without the need for assistance. To this end:

- There should be no steps, with the entire interior at the same level.

- There should be areas for anchoring wheelchairs with adequate and safe restraint systems.

- Free space is needed for wheelchair users.

- Some seats must allow transfer from the wheelchair to the seat by folding down the armrests.

- The space between rows of seats should be wide enough for passengers to sit without any problem.

- There should always be at least one seat reserved for PRM near the driver and the front, or accessible, door. This seat should be wider than the rest, with a support point and properly marked with the ISA.

- Colour contrast can be used to mark the seats and distinguish them from the others on the coach.

- Seats numbers should be in high relief or Braille format.

Information and documents provided to travellers, such as complaint forms, should be available in formats accessible to everyone. Drivers should engage with people with disabilities, the elderly, pregnant women, and children in a manner that is as respectful as with other travellers but takes into account the needs of each group.

As Pilar Vega comments in the book "The Accessibility of Bus Transport. Diagnosis and Solutions" (Vega Pindado, 2006), companies should realize that in order to offer a quality service, accessibility must be present and the staff should be trained in this area and in disability as well:

Another problem we encounter is that many times drivers do not wait for passengers to settle in before resuming the trip, which can cause riders to lose their balance and fall. Coaches should be equipped with an area in the trunk in which to stow the support products needed by people with disabilities who wish to travel in this means of transport with the necessary safety measures. And they should not be charged for this service.

> "Public transport managers understand the importance of service quality to improve passenger appeal, and thus business profits. However, accessibility is not always viewed as a fundamental element in improving quality. Most companies understand this concept, but only partially. They strive to renew their fleets and make them accessible, but they do not understand that the rolling stock must be renewed alongside renewed guidelines and behaviour towards the user, and especially towards the target of these technical improvements: people with disabilities. (Vega Pindado, The accessibility of bus transport: Diagnosis and solutions., 2006)"

Figure 2. 100% inclusive bus. Autocares Víctor Bayo. (Bayo, 2023)

Finally, we should like to focus on guide dogs, which have to be with their owners at all times, meaning they should be allowed to board the bus and have a place next to their owners.

In Spain, one example of a 100% inclusive bus is provided by the company Autocares Bayo for tourist trips and excursions. Although it lies outside the field of concern of this paper, as it is not a regular bus line, we would like to provide this example of how a company has achieved a milestone that could point the way for companies operating regular lines.

2.5. Arrival at the destination station, bus stop or bus shelter

As was the case at the departure bus station, shelter or stop, these same elements should satisfy the same accessibility criteria upon arrival.

2.6. Passenger feedback to the company

Trips do not always end the way we would like them to, which is why we must have the option to file claims in cases of lost objects, delays, improper service, and so on; or, on the contrary, to thank the company the service received. In any case, accessibility must be a feature of every document (complaint/gratitude forms) or channel used for these purposes (online and/or telephone); for example, by providing forms in Braille and easy-to-read text in a suitable font size and colour, with sign language interpretation as needed, and digital accessibility.

We have reached the end of the accessibility chain. We have taken the same journey through its various links that many people make throughout their lives, but that many others cannot due to a lack of accessibility. At this point, we would like to reflect on the reflections of Pilar Vega Pindado in her book La accesibilidad del transporte en autobús. Diagnóstico y soluciones:

> *"However, sometimes the systems do not work, or the transport chain cannot be completed due to circumstances such as deficiencies in public address systems or ticket vending machines, flooded or unsanitary restrooms, defective ramps or broken elevators in the terminal. Therefore, once the link in the transportation chain where a problem exists has been identified, it is necessary to solve it in order to make the service universally accessible. (Vega Pindado, 2006)"*

In other words, maintenance should always be considered to ensure that every mechanism and space is in perfect condition, and if they break down or malfunction, repairs should be carried out in the shortest possible time, since many people depend on them to make the trip.

Before concluding this section, we would like to highlight the figure of the "travel assistant", which is very common in air and rail transport, but less so in intercity scheduled bus transport. We believe that it is a key element in the service provided to groups such as people with disabilities, the elderly, pregnant women and children, which we already discussed earlier. The presence of such a figure would greatly help to improve the quality of the service.

3. Results

The survey was conducted through http://www.google.es/intl/es/forms/about/ and titled "Universal Accessibility in Regular Intercity Bus Lines".

When the survey was administered, the first step was to send it to associations and groups of people with disabilities, whom we believed might be interested in the subject given the lack of accessibility in their everyday routine, but we also wanted to learn the perspectives and opinions of people without disabilities, since accessibility benefits us all.

It is true that we are often unaware of the lack of accessibility, or, on the contrary, of its presence because we do not need it at that moment, but that situation can change at any time, which is why transportation, like all other services, should be accessible from the start.

The survey was based on the following questions, and in some cases the respondents were allowed to choose more than one answer.

The answers to the sixth question indicate that this survey was mainly administered to individuals with physical and visual disabilities, as shown in Graph 1.

The ninth question reveals that the option selected the most by people with and without disabilities is the private vehicle.

Table 2. Survey. Compiled by authors (June, 2021)

Question number	Question	Answers
1	Name (you can write "anonymous" if you prefer not to give your name).	Name
2	Gender	• Female. • Male. • Non-binary.
3	Age	
4	Place of residence: country and location.	Place
5	Do you have a disability?	• Yes • No

Question number	Question	Answers
6	Type of disability. (You can choose several answers)	• Physical. Hearing. • Visual. • Intellectual. • Mental. • Acquired brain damage. • Autism or Asperger's. • I do not have a disability. • Other.
7	Do you belong to any association or group of people with disabilities?	• Yes. • No.
8	If you answered yes, can you tell us which one?	Response
9	What means of transport do you use on a regular	Response
10	Have you encountered barriers when riding or attempting to ride a bus? If so, can you tell us what they were?	Response
11	From your point of view, are intercity buses accessible?	• Yes. • No. • I don't know.
12	If you answered no to the previous question, what changes would you include to make them accessible?	Response
13	From your point of view, are the bus shelters, bus stops and bus stations in your area accessible?	• Yes. • No. • I don't know.
14	If not, what changes would you include to make them accessible?	Response
15	If you needed to go to the bathroom while at a bus station, was it adapted for people with disabilities?	• Yes. • No. • I have never used the bathroom in a bus station.
16	If not, what changes would you include to make it usable for everyone?	Response

Question number	Question	Answers
17	What type of accessibility is most present on intercity buses? (Multiple answers are possible).	• Physical accessibility. • Sensory accessibility. • Cognitive accessibility. • All of them. • None of them.
18	Tell us an example	Response
19	Do you think that the staff of intercity buses (drivers, customer service) are trained in accessibility and disability issues?	• Yes. • No. • I don't know.
20	Do you think that providing assistance to disabled passengers, elderly people, children and pregnant women is essential?	• Yes. • No. • I don't know.
21	If your local bus was accessible, would it lead to a better quality of life? (You can choose several answers).	• Yes, I would be more independent. • Yes, I could get a job outside my town or city. • Yes, I could go to theatres, cinemas, sporting events, leisure activities. • No.
22	Do you have any comments?	Response
23	Provide your email if you would like to receive the results of this survey.	Response

From the tenth question, we note the following reflections from people with disabilities:

- To a great extent, they comment on design aspects, such as defective ramps or elevators, high steps, seat belts that do not work, seats, wheelchair restraints.

- Unpleasant attitude from drivers, who do not provide assistance or do not know how the lifts work. Drivers do not wait for passengers to settle in before going again, with the ensuing high risk of falling. If the driver goes too fast, people in wheelchairs can tip over.

- Inconvenient to have to give several days' notice that you wish to travel.

- Barriers due to orientation and knowing one's location, for example: knowing which bus to take, if the bus number or platform has changed inside the station, etc.

- Non-accessible vending machines, platforms and apps.

- Lack of sign language communication options.

- Need for panels with travel information.

- Autonomy is impossible for the visually impaired.

- There is no information in accessible formats.

- There are some people who have had positive experiences when traveling by this means of transport, especially after moving to a different province or region.

Most of the people without disabilities reported encountering no barriers

For the eleventh question, one of the most important, we obtain the Graphs 2 and 3:

In the twelfth question, the respondents sent us proposals for changes that they would include to make buses accessible; specifically, people with disabilities commented that:

"All the bus fleet adapted"; "Option of validating the ticket through the middle door and not having to go to where the driver is"; "Information panel in sign language and subtitled"; "Guidance system and bus identification"; "Not having to provide notice before traveling".

And people without disabilities: "Improve universal accessibility"; "Only on high-demand buses".

With the next question, the number thirteen, we analyse the accessibility of bus shelters, stops and stations, yielding graphs 4 and 5. The "No" answer continues to be the majority, but in this case the percentages are closer.
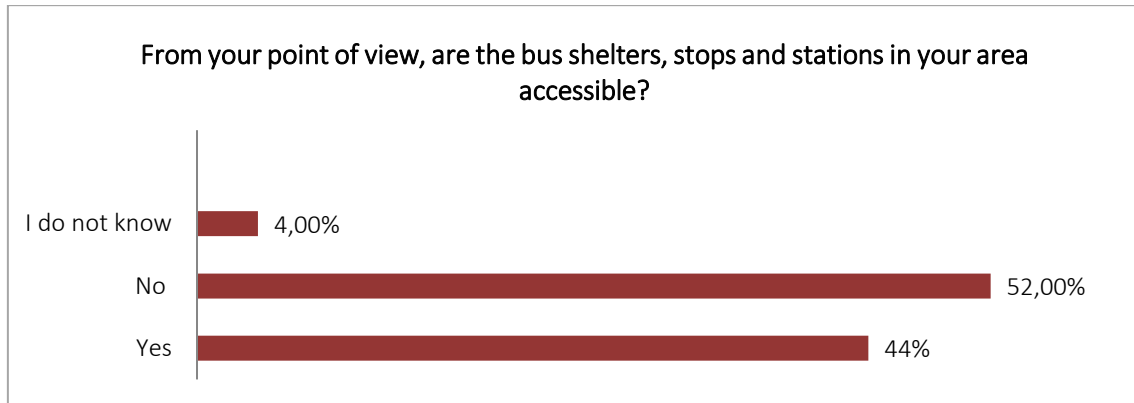
Graph 2. Eleventh question. Responses from people with disabilities. Compiled by authors.


From your point of view, are intercity buses accessible?

- I do not know — 4,00%
- No — 78,00%
- Yes — 18%
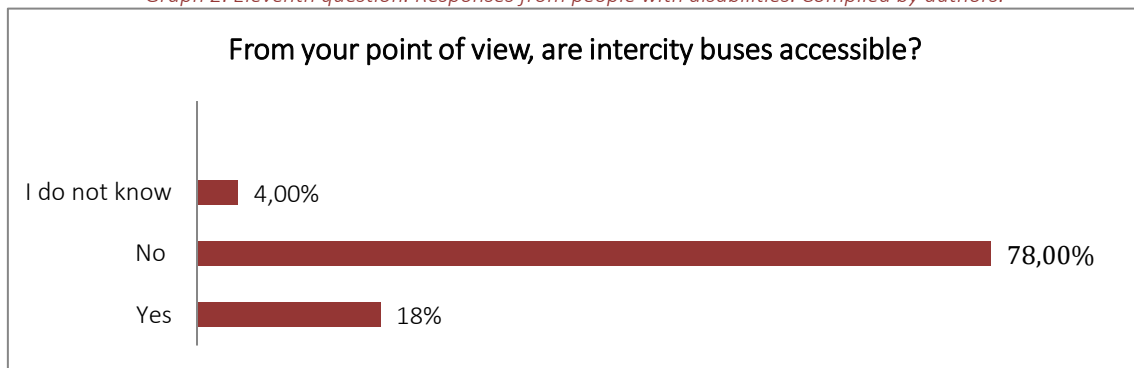
Graph 3. Eleventh question. Responses from people without disabilities. Compiled by authors.

From your point of view, are intercity buses accessible?

- I do not know — 19,00%
- No — 56,00%
- Yes — 25%
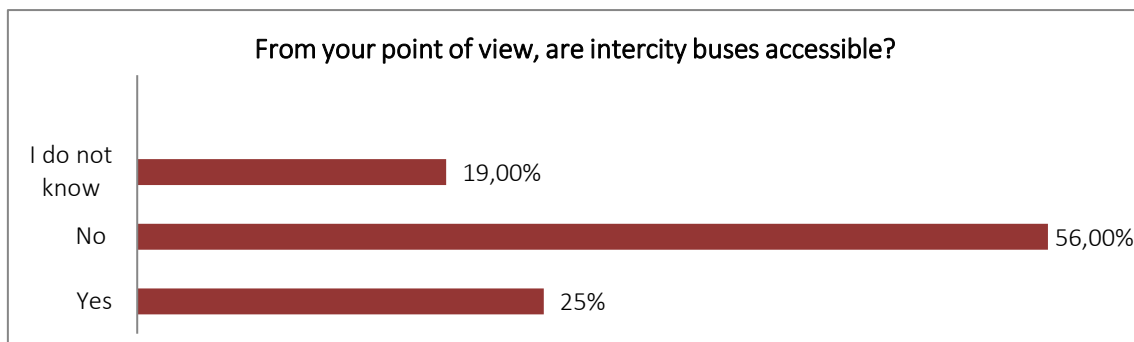
Graph 4. Thirteenth question. Answers from people with disabilities. Compiled by authors.

Graph 5. Thirteenth question. Answers from people without disabilities. Compiled by authors.
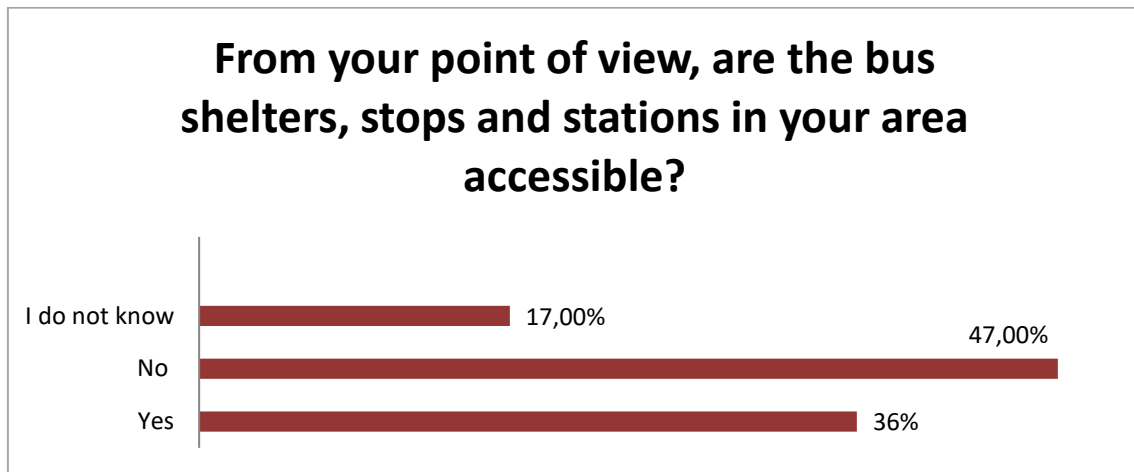
The fourteenth question asked about proposals for actions to achieve accessibility in bus shelters, stops and stations. With regard to the responses from people with disabilities, we highlight the following comments: "Some are being renovated and made accessible"; "Information in Braille"; "Accessible information panels"; "Fixing them, something so simple"; "Seating at various heights".

And people without disabilities: "Remove the parking spaces right in front of the stop"; "Lack of accessibility for the blind"; "Not enough lighting when getting off at the platform in front of the stop".

In the next question, the number fifteen, we focus on the accessibility of bathrooms in the stations, another link in the accessibility chain. The resulting graphs are 6 and 7. The results allow us to conclude that the bathrooms are the most advanced area in terms of accessibility of the three areas we have dealt with: rolling stock, bus stations/shelters/stops and bathrooms.

In the sixteenth question, the respondents offered solutions and ideas for implementing accessibility in the restrooms.

We begin with the people with disabilities, who sent us the following comments: "I often find the adapted bathrooms in bus stations quite dirty, with the grab bars placed in appropriate places or even without them, with the automatic lights going off unexpectedly and leaving you in the dark"; "Sometimes it is better to go to an adapted bathroom in a public place or a nearby cafeteria outside the station"; "An adapted toilet in each station"; "Many times they are used for storage";

"I would add some inclusive changing tables in some stations, or toilets with folding bars, toilet at a good height or that can go up and down"
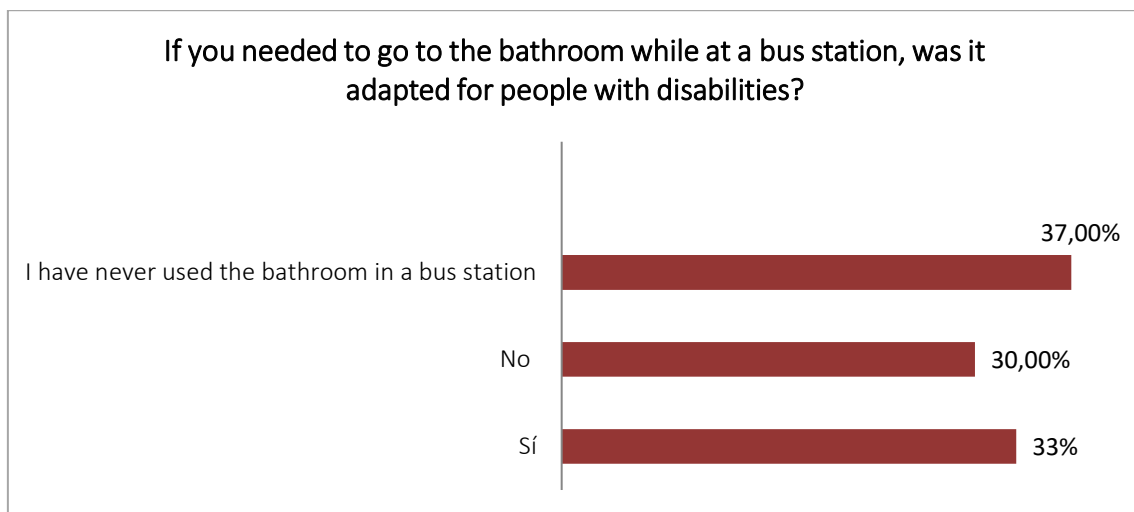
People without disabilities commented that: "Not necessary to ask for the key"; "Place them in an area closer to the platforms and in a visible position"; "Not available".

In the seventeenth question, we asked directly about the type(s) of accessibility most present in the buses. The answers are shown in graphs 8 and 9.
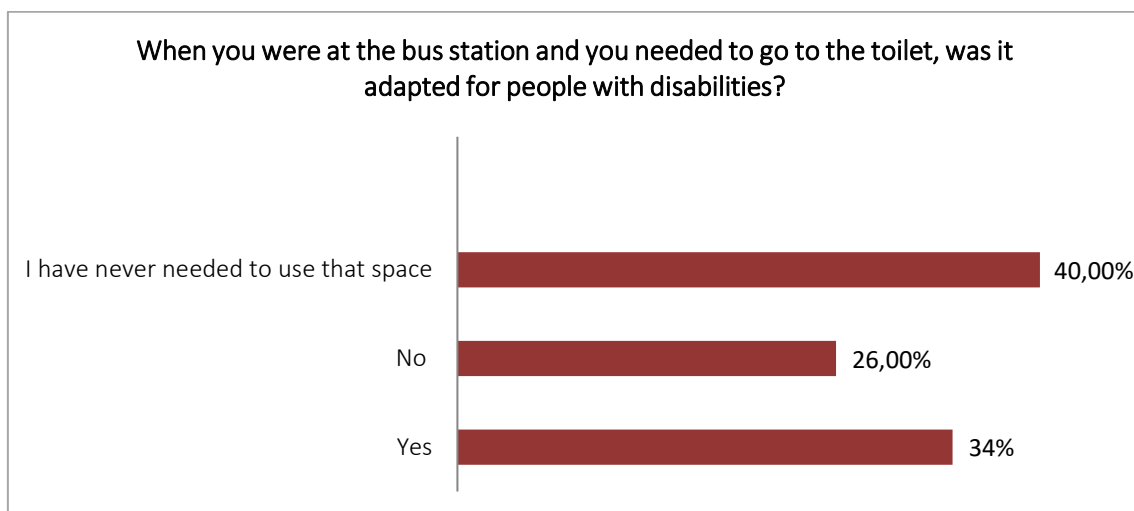
Both graphs follow the trend of prioritizing physical accessibility over cognitive accessibility (largely forgotten). However, we found a quite remarkable disparity in the percentage associated with the answer "None", as people with disabilities are more critical and describe a more complicated situation, while people with disabilities have a less strong opinion. Perhaps, it is because the first group suffers more severely the consequences of the lack of accessibility, and they are indirectly indicating that there is no Universal Accessibility.

This question is very important to our analysis of the current situation, since what many passengers perceive and suffer from is a lack of accessibility in this type of transport, meaning there is still a long way to go.
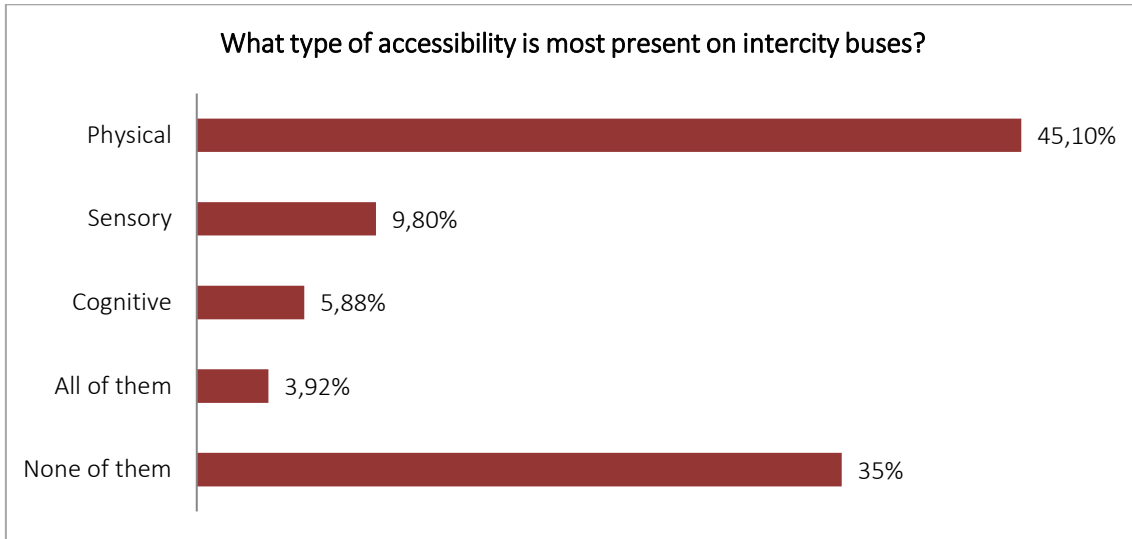
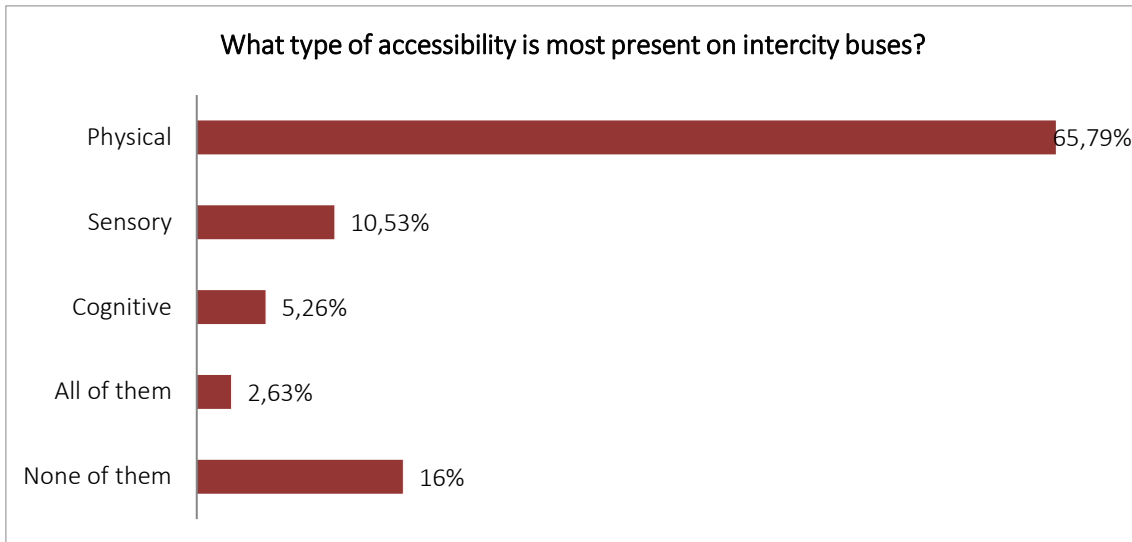*Graph 6. Fifteenth question. Answers from people with disabilities. Compiled by authors.*

If you needed to go to the bathroom while at a bus station, was it adapted for people with disabilities?

I have never used the bathroom in a bus station	37,00%
No	30,00%
Sí	33%

Graph 7. Fifteenth question. Answers from people without disabilities. Compiled by authors.

When you were at the bus station and you needed to go to the toilet, was it adapted for people with disabilities?

I have never needed to use that space	40,00%
No	26,00%
Yes	34%

Graph 8. Seventeenth question. Answers from people with disabilities. Compiled by authors.

What type of accessibility is most present on intercity buses?

- Physical — 45,10%
- Sensory — 9,80%
- Cognitive — 5,88%
- All of them — 3,92%
- None of them — 35%

Graph 9. Seventeenth question. Answers from people without disabilities. Compiled by authors.

What type of accessibility is most present on intercity buses?

- Physical — 65,79%
- Sensory — 10,53%
- Cognitive — 5,26%
- All of them — 2,63%
- None of them — 16%

In the nineteenth question, we focus on whether or not personnel in the sector have received training on disability accessibility, a key point to offer a quality service that is often ignored. The resulting graphs are 10 and 11. In both groups, the percentages are very high. We believe this is due to the respondents' own experiences in terms of the inadequate service received, and to a lack of knowledge in terms of whether or not the personnel have received this training and are not putting it to use, or if the training is not adequate.

In the twentieth question, we asked their opinion of the "personal assistance" service for certain groups and the response was overwhelming, as shown in graphs 12 and 13.

As previously mentioned in the accessibility chain section, this service must be urgently implemented, as it is crucial for many people to decide whether or not to travel by this means of transport. This service should not be viewed as providing assistance, which entails a lack of autonomy in people; it is quite the opposite, what this service provides is the necessary support to carry out an activity as essential as traveling.

Graph 10. Nineteenth question. Answers from people with disabilities. Compiled by authors.
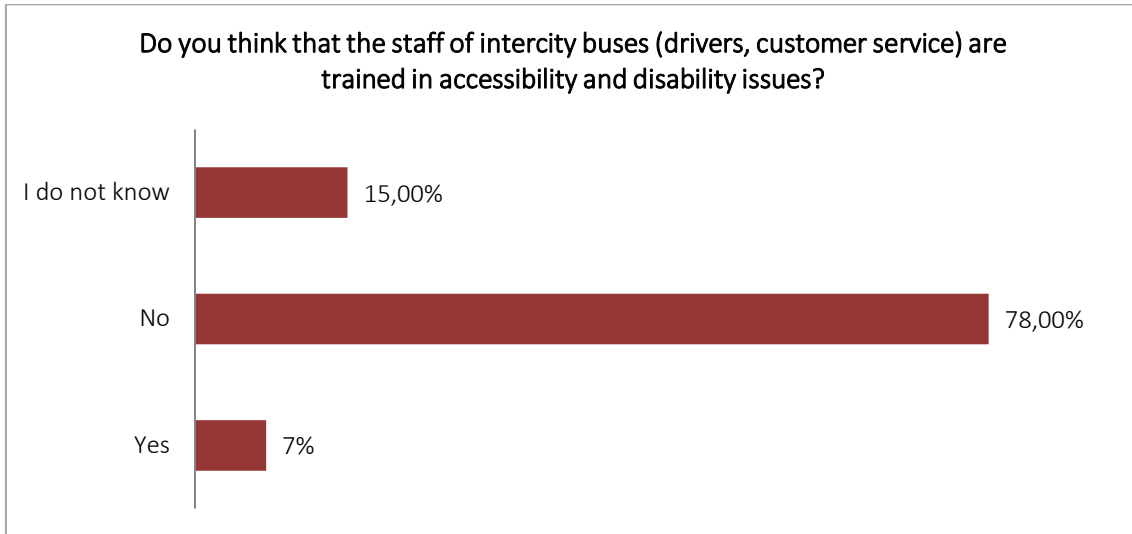
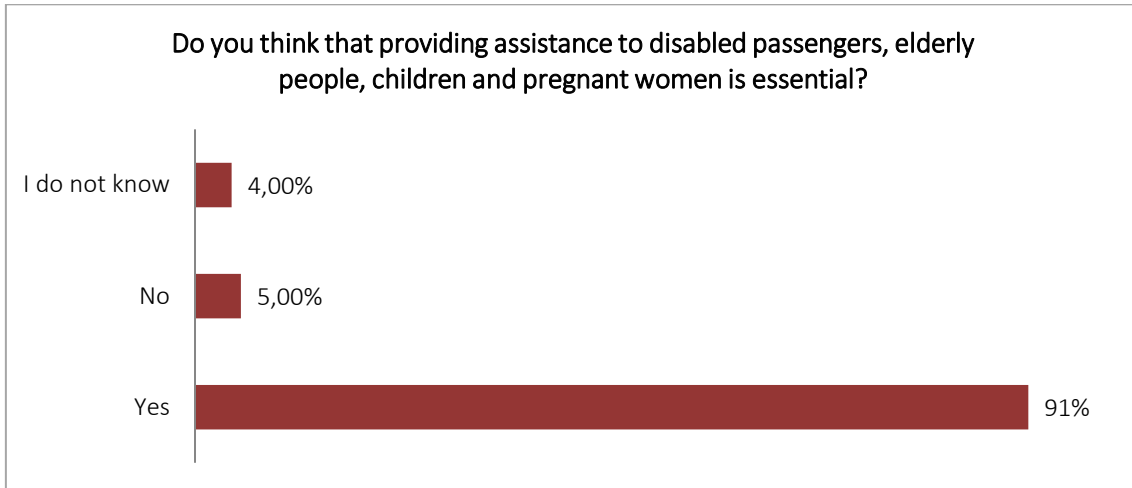*Graph 11. Nineteenth question. Answers from people without disabilities. Compiled by authors.*
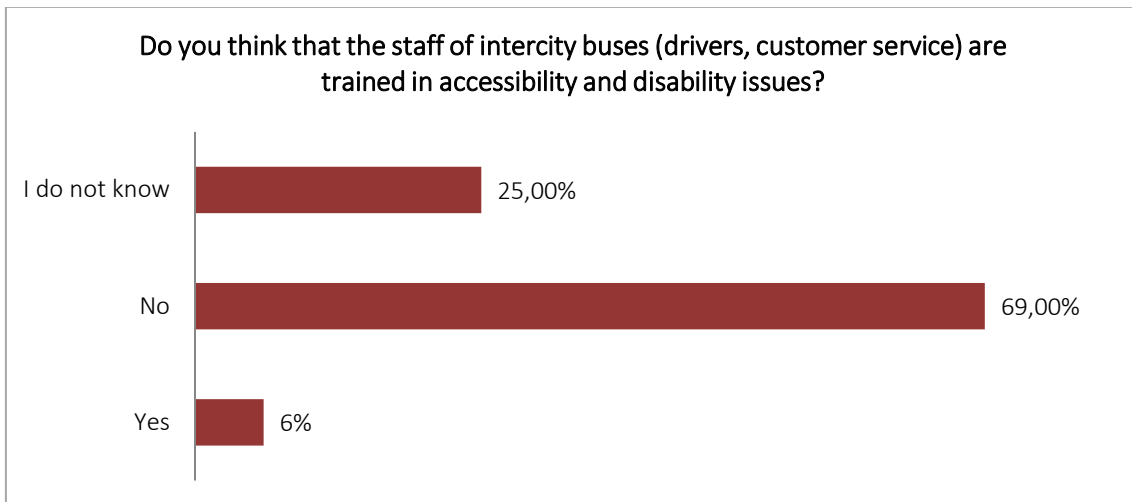
Support should be understood as rights and be defined as part of the needs that each person or group has, whether it involves a pregnant woman, an elderly person or a person with a visual impairment.
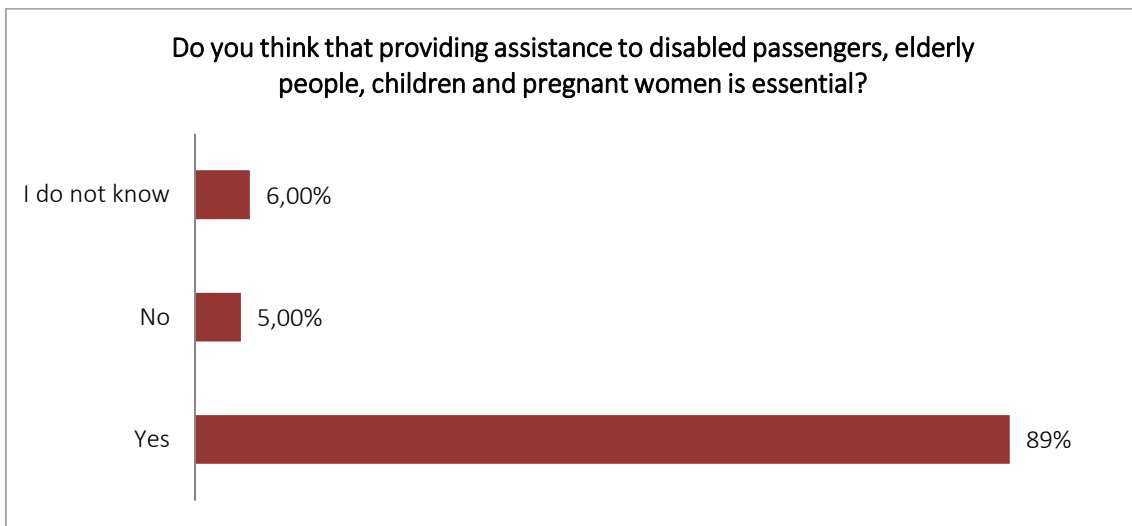
In the twenty-first question, we wanted to focus on the positive aspects that this means of transport and, ultimately, mobility can bring us. The responses and their percentages are shown in graphs 14 and 15. These percentages highlight the importance of autonomy for all people, regardless of their disability.

In the penultimate question, the number twenty-two, we asked for their thoughts, and we were taken aback by the answers. We highlight the following, which will help all of us to have a broader and more critical view of this problem and that will stir our conscience when we read them.
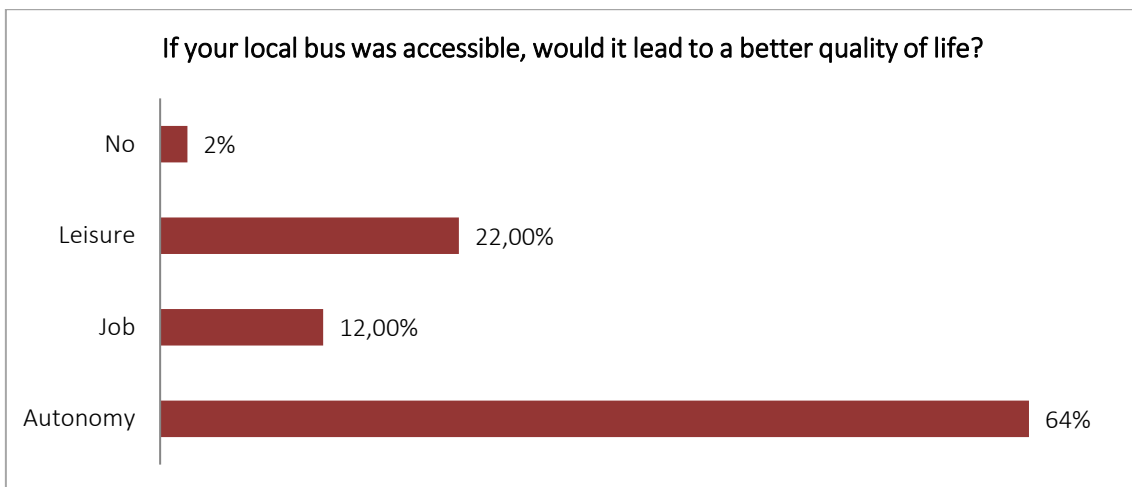
Graph 12. 20th question. Answers from people with disabilities. Compiled by authors.
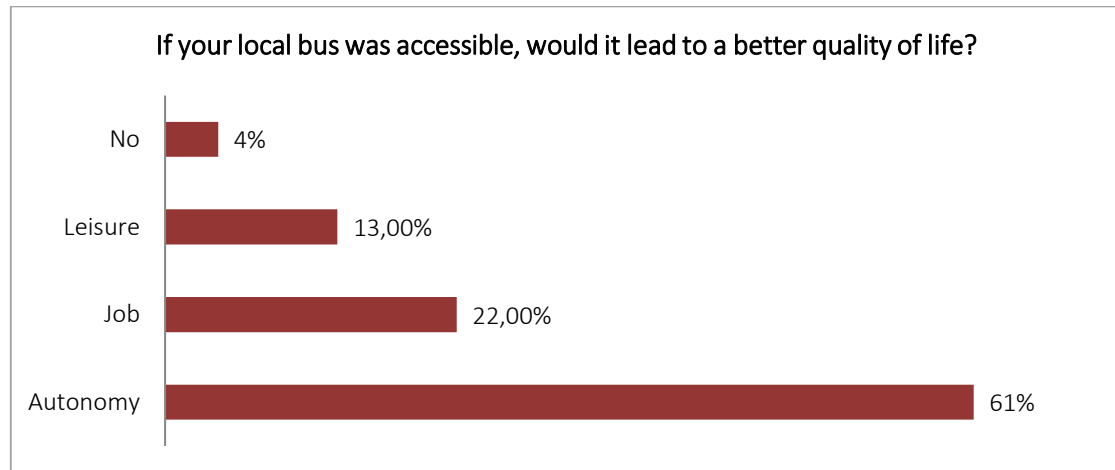

Do you think that providing assistance to disabled passengers, elderly people, children and pregnant women is essential?

- I do not know — 4,00%
- No — 5,00%
- Yes — 91%

Graph 13. 20th question. Answers from people without disabilities. Compiled by authors.

Do you think that providing assistance to disabled passengers, elderly people, children and pregnant women is essential?

- I do not know — 6,00%
- No — 5,00%
- Yes — 89%

Graph 14. Twenty-first question. Answers from people with disabilities. Compiled by authors.

If your local bus was accessible, would it lead to a better quality of life?

- No — 2%
- Leisure — 22,00%
- Job — 12,00%
- Autonomy — 64%

Graph 15. Twenty-first question. Answers from people without disabilities. Compiled by authors.

If your local bus was accessible, would it lead to a better quality of life?

- No — 4%
- Leisure — 13,00%
- Job — 22,00%
- Autonomy — 61%

On the one hand, among the group of people with disabilities, we highlight the following:

- "Universal Accessibility should not be limited to groups with disabilities; rather, it should always be present in every facet of any type of plan, since it is part of every area of life and is beneficial for the whole of society; if something is accessible, it can be used without help from third parties".

- "There is a lot of talk about the integration of people with disabilities, but there is no investment in the accessibility of public transport to achieve said integration."

- "Much remains to be done."

- "Fewer problems, more opportunities for participation."

- "More accessibility in everyday life for all people."

- "We must raise awareness mainly among the officials who have a role in adopting inclusion and accessibility measures in all areas; to give them the political will."

For people with disabilities, we highlight these two reflections:

- "With accessibility we all win, people with and without disabilities. If we increased the frequency and quality of public transport services, we would use them more and save money. With a good public transport service, private transport would not be so necessary and the environmental impact would be lower."

- "Some bus companies (such as AUCORSA in Cordoba) are working on staff awareness and adaptation, both of buses and bus stops, but there is still a long way to go. The important thing is to be aware that accessibility is not only physical, but cognitive, visual and auditory as well."

4. Discussion

Having presented the results of the survey, we now proceed to analyse and interpret them. To do so, we will answer three questions about this means of transport:

- Can it be used by everyone?

- Can all citizens benefit from this mode of transportation?

- Can Universal Accessibility be said to exist?

The data indicate that the answer to all three questions is a resounding no. The respondents generally pointed to the presence of multiple barriers and obstacles that should be urgently considered by government agencies and companies in the sector. Unfortunately, the current situation of this means of transport is that it is not a service that is prepared for the needs of all. Although significant advances have been made, which we acknowledge, they are still far removed from the ultimate goal of Universal Accessibility.

We realize that in order to have a more accurate picture of accessibility in this means of transport and to include a variety of opinions, reflections and experiences, it would have been better to have obtained a larger number of responses and to have reached more groups in order to obtain more pluralistic results. But our resources were limited and we wanted to offer an initial approach to the problems involved in this subject that other people can use as a foundation to undertake more exhaustive research in the near future.

5. Conclusions

At this point, and having reviewed the subject in depth, we conclude that there is still a long way to go to make this means of transport accessible and usable by all citizens.

There are groups that cannot access it, even though it is a public service. This could be defined as discrimination against them. As we have explained in several sections, transport is a right, and so is accessibility, so no one can be deprived of it because of their disability, age, physical condition or personal situation.

It is true that progress has been made, as mentioned above, especially in actions focused on physical accessibility. However, there is a great deficiency in the remaining components that make up Universal Accessibility. In addition, until these actions are implemented on every bus, we will not be able to declare this mode of transport accessible.

Why is the same effort not being made to address visual, cognitive and auditory impairments as with physical impairments? We believe that the main reason is a lack of knowledge of what actions to take, but there are experts and the affected individuals themselves (citizen participation) who can help in this process of transforming a conventional bus to an accessible one.

We would also like to emphasize that without the involvement of every agent, company, citizen and government agency, the great challenge posed by the bus sector will not be met. Therefore, it is necessary to invest economically in implementing all the necessary accessibility measures, and to realize that if this is not done, a quality service will not be provided. When we talk about investments, we are not only referring to rolling stock, but also to bus shelters, stops, stations, staff training, offering the possibility of travel assistance; in short, all the links in the Accessibility Chain that make up this service.

The survey revealed very important ideas that will surely make us all reflect upon and acknowledge the needs of those who do encounter barriers. The result of this will be a more empathetic and supportive society, which will lead to public services for everyone.

We have to consider that any of us at some point may be in a situation of dependency, and we would need our environment to adapt to us, not the other way around. With this work we wanted to emphasize this idea that people should not have to change anything in their personal situation to access essential services, such as transportation. If this service is not adapted to the diversity of citizens, there is clearly something wrong and it must be solved quickly.

We would like to close this research project with the following sentence: "To include is not to let in, but to welcome", by Ana García Sánchez.

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