Assessment of Time Allocated to Pedestrian Crossing: A Contribution for a More Inclusive Lisbon

Avaliação do Tempo Atribuído à Travessia de Peões: Contributo para uma Lisboa Mais Inclusiva

Sílvia BOAVENTURA✉[1], Jorge RODRIGUES[1], Teresa PLANCHA[1], Mariana MARTINS[1], Marta SILVA[1], Vitor Brás da SILVA[1], Luís HORTA[1], Pedro Soares BRANCO[1]

Acta Med Port 2020 Jun;33(6):401-406 ▪ https://doi.org/10.20344/amp.12527

ABSTRACT

Introduction: With progressive ageing of the Portuguese population, it is paramount that the conditions of outdoor accessibility and safety are adapted to this age group. The aim of this study was to assess whether the time allocated to pedestrian crossing in the crosswalks with pedestrian crossing lights between Curry Cabral Hospital and local public transport is enough to allow safe passage of the elderly.

Material and Methods: We evaluated 100 ambulatory care patients from the Physical Medicine and Rehabilitation department. All of them answered a questionnaire, the Activities-Specific Balance Confidence Scale (Portuguese version) and performed a 10-meter walk test. All crosswalks with pedestrian crossing lights between the hospital and local public transport were analyzed, in a total of 26, and the gait speed required to perform a safe crossing was calculated.

Results: Mean age of patients was 75 years and the majority (73%) were female. The study showed that all patients could safely cross 17 (65%) crosswalks. The nine remaining crosswalks (35%) represented an obstacle to our sample.

Discussion: If the required gait speed as currently set in legislation for the disabled was implemented, 99% of the patients would have been able to cross the crosswalks safely.

Conclusion: It is essential to apply the gait speed set in legislation, since non-compliance endangers elderly patients in Curry Cabral Hospital, increasing the likelihood of accidents and the feeling of insecurity on the streets.

Keywords: Accident Prevention; Accidents, Traffic/prevention & control; Aged; Pedestrians; Portugal; Walking

RESUMO

Introdução: Com o envelhecimento progressivo da população portuguesa, é fundamental que as condições de acessibilidade e segurança na via pública estejam adaptadas a este grupo etário. O objectivo deste estudo foi avaliar se o tempo atribuído à travessia de peões nas passadeiras semaforizadas entre o Hospital de Curry Cabral e os transportes públicos locais é suficiente para permitir a travessia dos idosos em segurança.

Material e Métodos: Foram avaliados 100 doentes seguidos em consulta externa no Serviço de Medicina Física e de Reabilitação. Todos responderam a um questionário, à escala de confiança no equilíbrio específica da atividade e executaram o teste de marcha de 10 metros. Foram analisadas todas as passadeiras semaforizadas dos percursos de marcha entre o hospital e os transportes públicos locais, num total de 26 e calculada a velocidade de marcha necessária para realizar a travessia das passadeiras em segurança.

Resultados: A média de idade dos doentes foi de 75 anos, sendo a maioria do género feminino (73%). Concluímos que todos os doentes conseguem atravessar em segurança 17 (65%) passadeiras, representando as restantes nove (35%) um obstáculo para a nossa amostra.

Discussão: Se o valor de velocidade de marcha nas passadeiras estipulado na legislação para os cidadãos com mobilidade condicionada fosse devidamente aplicado, 99% da amostra teria conseguido atravessar as passadeiras em segurança.

Conclusão: É fundamental que o valor de velocidade de marcha nas passadeiras estipulado na legislação seja aplicado, pois o seu incumprimento coloca em risco os utentes idosos do Hospital de Curry Cabral, aumentando a probabilidade de acidentes e o sentimento de insegurança na via pública.

Palavras-chave: Acidentes de Trânsito/prevenção e controlo; Idoso; Marcha; Pedestres; Portugal; Prevenção de Acidentes

INTRODUCTION

With the Portuguese ageing population (an increase in the elderly population has been found in the Lisbon region from 15.4% in 2001 to 18.2% in 2011)[1] it is imperative to ensure age-appropriate accessibility and safety conditions when walking in the street. Some physical and psychological capacities tend to decrease with ageing. Reflexes, visual, hearing, reasoning, perception, attention, concentration and mobility abilities become progressively more limited.[2] Ageing leads to a decrease in the ability to foresee and anticipate risks and to increase reaction time, which is often disregarded by drivers. According to PORDATA (Contemporary Portugal database), the number of pedestrian collisions has decreased considerably in the Lisbon Metropolitan Area in recent years (3,963 in 1996 to 2,005 in 2006), even though there are still almost as many pedestrian collisions in this region as in the whole of Northern Portugal (2,005 in the Lisbon Metropolitan Area and 2,124 in Northern Portugal), with the elderly being one of the most-at-risk populations.[4] The average pedestrian walking speed varies between countries. According to the Highway Capacity Manual (HCM 2010), the average pedestrian walking speed ranges between 1.0 m/s and 1.2 m/s.[5] According to the

1. Unidade Funcional Músculo-esquelética. Serviço de Medicina Física e de Reabilitação. Hospital de Curry Cabral. Centro Hospitalar Universitário de Lisboa Central. Lisboa. Portugal.

✉ Autor correspondente: Sílvia Boaventura. silviaboaventurab@gmail.com

Recebido: 08 de julho de 2019 - Aceite: 30 de outubro de 2019 | Copyright © Ordem dos Médicos 2020

Portuguese legislation aimed at mobility impaired people (DL 163/2006), the amount of green time should allow pedestrians to cross at a speed of 0.4 m/s, although this has proved difficult to apply in practice. Promoting pedestrian movement of the elderly in the city is beneficial to health and stimulates social interaction.[6] All factors that impair this activity lead to a reduced autonomy and quality of life. This study was aimed at assessing whether green time allocated to pedestrians through signalised crosswalks between the *Hospital de Curry Cabral* (HCC) and local public transports allowed safe crossing to elderly patients attending the Physical Medicine and Rehabilitation (PM&R) outpatient clinic.

MATERIAL AND METHODS

Participants

A group of 100 patients attending the PM&R outpatient clinic at the *HCC – Centro Hospitalar Universitário de Lisboa Central (CHULC)* was included in the study and an informed consent was obtained from all the participants. Portuguese patients aged 65 and older, living in the Lisbon Metropolitan Area and attending the PM&R outpatient clinic at the HCC, with the ability to walk independently with or without a walking aid and to cover a 10-metre uninterrupted walk were included in the study. The patients presenting with heart disorders and/or acute or chronic lung disorders were excluded from the study.

Procedures

Questionnaire: the participants were asked to complete a multiple-choice questionnaire including identification, personal background, usual medication, mobility in the community and perception of accessibility and safety conditions at crosswalks. Respondents were also assessed with the *escala de confiança no equilíbrio específica da actividade* (CEEA scale), a validated version for Portugal of the ABC Scale (Activities-Specific Balance Confidence Scale).[7]

Testing: patient's walking speed was assessed by use of the 10-metre walk test performed at the hospital, outside the outpatient clinic, on a 14-metre even gravel ground painted path (including a two-metre acceleration and two-metre deceleration area). Participants were asked to perform the 10-metre walk test under two different conditions: 1) usual gait speed - patients were asked to walk at their usual, comfortable speed; 2) maximum gait speed - patients were asked to safely walk as fast as possible. Each participant has performed one test under each condition.

Signalised crosswalks

All signalised crosswalks on the walking routes of patients attending the HCC PM&R outpatient clinic to use the different public transportation options were analysed. The three different hospital entrance gates were considered: (i) through *Rua da Beneficência* gate, (ii) through the gate in front of Zurique Hotel and (iii) through the gate in front of Holiday Inn Hotel. The routes between these three gates and public transports, on nine different walking routes, were analysed, namely:

- Access through *Rua da Beneficência* gate: connection to the subway (*Praça de Espanha* station); connection to the bus at *Praça de Espanha*; connection to the bus at *Avenida de Berna* (three different routes);

- Access through the gate in front of Zurique Hotel: connection to the train (*Entrecampos* station); connection to the subway (*Campo Pequeno* station); connection to the bus at *Avenida da República* (three different routes);

- Access through the gate in front of Holiday Inn Hotel: connection to the subway (*Campo Pequeno* station), connection to the bus at *Avenida da República*; connection to the bus at *Avenida de Berna* (three different routes).

All the signalised crosswalks are shown in Figures 1, 2 and 3 with numbers and the different walking routes with arrows.

Figure 1 – Access through the *Rua da Beneficência* gate
Map data: Google, DigitalGlobe.

The length of each crosswalk was measured by using a tape measure and green times were recorded. All green times were based on at least four assessments obtained at different days, different times of the day, including one assessment on a Saturday. The walking speed required to safely cross each crosswalk was based on these data.

Data analysis

Data were analysed by use of Microsoft Excel software and a descriptive analysis of the study participants and the characteristics of the signalised crosswalks was carried out.

RESULTS

Patient characteristics

A group of 100 patients [mean age 75, mostly female (73%] has been assessed and their characteristics are shown in Table 1. Twenty-nine patients used a walking aid: walking stick (7), one crutch (17) or two crutches (5). The CEEA scale is aimed at assessing the confidence level in performing 16 daily living activities, leading to a final score ranging between 0 (minimum) and 1,600 (maximum). A score of 700 has been considered as cut-off for high risk of falling and a score of 800 as cut-off for normal mobility.[8] A 934 mean score has been found in our group of patients; however, a score >700 (high risk of falling) has been found in 31% of the patients in our group. A 0.81 m/s usual average gait speed and 0.95 m/s average maximum gait speed. A <0.4 m/s gait speed has been only found in two out of the 100 patients under a usual walking pattern and in only one patient in maximum walking speed. With the questionnaire

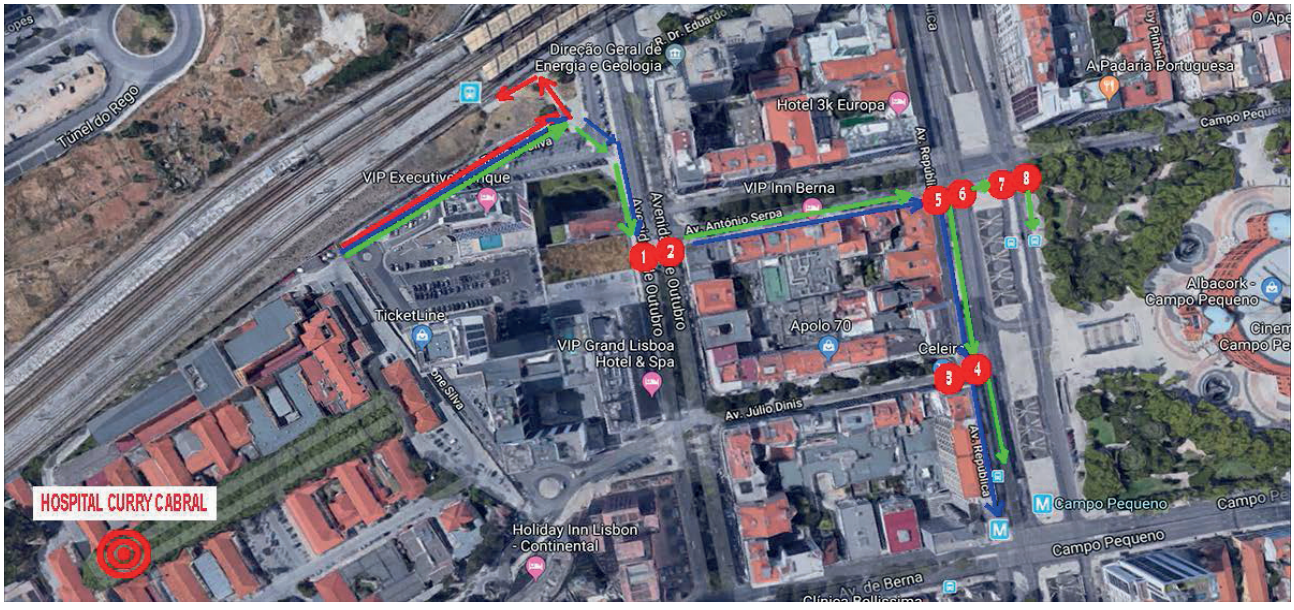

Figure 2 – Access through the gate in front of Zurique Hotel
Map data: Google, DigitalGlobe.

Figure 3 – Access through the gate in front of Holiday Inn Hotel
Map data: Google, DigitalGlobe.

Table 1 – Descriptive statistics of our group of patients (n = 100)

Descriptive statistics	
Age (mean ± SD)	75 ± 6.32
Gender (female/male), % (n)	73% (73) / 27% (27)
Walking aid, % (n)	29% (29)
Eyewear, % (n)	90% (90)
Number of chronic conditions (mean ± SD)	3 ± 1.73
No. of medications (mean ± SD)	4 ± 1.53
CEEA scale (mean ± SD)	934 ± 378.9
Usual gait speed (m/s) (mean ± SD)	0.81 ± 5.22
Maximum gait speed (m/s) (mean ± SD)	0.95 ± 4.64

SD: standard deviation

on mobility within the community and perceived accessibility and safety conditions at signalised crosswalks, we have found that 74% of the patients usually leave home five or more times a week, 19% between three and four times a week and 7% between one and two times a week. Most patients (88%) have described the need to cross signalised crosswalks in their routes within the metropolitan area of Lisbon, while 31 (35%) out of these have considered that the time allowed for crossings was not appropriate for a safety crossing; nevertheless, only seven of these patients have described that this discouraged them from walking on the street. As regards transports used by the patients to come to the hospital, 26% usually use their own transport (driven by the own patients or by someone else), 65% use a public transport (41 by bus, four by subway, six by train, nine by taxi and five by a combination of two transports),

Table 2 – Signalised crosswalks

Locations	Traffic light monitoring: Signalised crosswalk	Distance (m)	Speed (m/s) (mean ± SD)
Access through the Rua da Beneficência gate (1)			
Av. Combatentes 1st crosswalk	1	16.95	2.17 ± 0.38
Av. Combatentes 2nd crosswalk	2 A	10.70	0.19 ± 0.09
Av. Combatentes 2nd crosswalk	2 B	7.05	0.13 ± 0.09
Av. Combatentes 2nd crosswalk	2 C	11.20	0.20 ± 0.09
Av. Bordalo Pinheiro 1st crosswalk	3	7.80	1.02 ± 0.09
Av. Bordalo Pinheiro 2nd crosswalk	4	8.40	0.14 ± 0.02
Rua da Beneficência	5	9.85	0.29 ± 0.05
Av. de Berna (*Beneficência*)	6 A	9.35	0.29 ± 0.02
Av. de Berna (*Beneficência*)	6 B	12.30	0.32 ± 0.02
Av. de Berna (Side plate)	7	5.00	0.07 ± 0.01
Access through the gate in front of Zurique Hotel (2)			
Av. 5 de Outubro (*António Serpa*) 1st crosswalk	1	6.10	0.57 ± 0.04
Av. 5 de Outubro (*António Serpa*) 2nd crosswalk	2	7.75	0.16 ± 0.01
Av. Júlio Dinis (*Av. da República*)	3	3.65	0.06 ± 0.01
Av. da República (access to side plate)	4	3.00	0.11 ± 0.04
Av. da República (*António Serpa*)	5	3.00	0.09 ± 0.21
Av. da República (*António Serpa*)	6	10.90	0.35 ± 0.21
Av. da República (*António Serpa*)	7	4.05	0.13 ± 0.21
Av. da República (*António Serpa*)	8	6.50	0.21 ± 0.21
Access through the gate in front of the Holiday Inn Hotel (3)			
Av. 5 de Outubro (*Júlio Dinis*) 1st crosswalk	1	6.65	0.61 ± 0.06
Av. 5 de Outubro (*Júlio Dinis*) 2nd crosswalk	2	7.30	0.86 ± 0.11
Av. Júlio Dinis (*Av. da República*)	3	3.65	0.06 ± 0.01
Av. da República (access to side plate)	4	3.00	0.11 ± 0.04
Av. da República (*Júlio Dinis*) 2nd crosswalk	5	10.90	1.00 ± 0.06
Av. da República (*Júlio Dinis*) 3rd crosswalk	6	13.90	0.63 ± 0
Av. de Berna (*Faculdade*) 1st crosswalk	7	9.40	0.53 ± 0.07
Av. de Berna (*Faculdade*) 2nd crosswalk	8	9.70	0.49 ± 0.15

(1) crosswalks are shown in Fig. 1; (2) crosswalks are shown in Fig. 2; (3) crosswalks are shown in Fig. 3.
SD: standard deviation

Table 3 – Percentage of patients who are able to cross the nine crosswalks that require > 0.4 m/s gait speed

Crosswalk	Speed (m/s) (mean)	Percentage	
		Usual speed	Maximum speed
1 (1)	2.17	0%	0%
3 (1)	1.02	46%	60%
5 (3)	1.00	49%	62%
2 (3)	0.86	60%	75%
6 (3)	0.63	84%	91%
1 (3)	0.61	85%	91%
1 (2)	0.57	88%	92%
7 (3)	0.53	91%	94%
8 (3)	0.49	92%	97%

(1) Pcrosswalks are shown in Fig. 1; (2) crosswalks are shown in Fig. 2; (3) crosswalks are shown in Fig. 3.

5% use an institutional transport (mainly using a parish council transport) and 4% usually come on foot.

Characteristics of signalised crosswalks

Twenty-six signalised crosswalks were analysed as regards their location, length and required walking speed to cross within the green time for pedestrians.

When analysing these values, we have found that a walking speed faster than 0.4 m/s (maximum value defined in the Portuguese legislation aimed at impaired mobility people) was required to cross nine (35%) of these.[9]

Patient values *vs.* Signalised crosswalk values

We have found that all the patients were able to safely cross 17 (65%) the signalised crosswalks, when analysing the walking speed (normal and maximum) and comparing with the required walking speed to safely cross each of the 26 crosswalks, while the remaining nine (35%) represented an obstacle to the patients in our group. These nine crosswalks are shown in Table 3, showing the walking speed required to safely cross them and the percentage of patients with the required ability to do so.

DISCUSSION

This study was aimed at assessing whether the green time in signalised crosswalks between HCC hospital and local public transports is enough for a safe crossing of elderly patients attending the PM&R outpatient clinic. The results suggested that, in case that the recommended required walking speed for impaired mobility people was respected, 99% of our group of patients would be able to safely go through the signalised crosswalks. However, we actually found that more than one third of the crosswalks around the HCC do not comply with this value and walking speeds >0.4 m/s are required. One of these, the one at *Avenida dos Combatentes* has been considered as the most significant with a minimum 2.17 m/s required walking speed (more than five times above the speed defined in the legislation for impaired mobility people), which is inadequate for people unable to walk faster, due to their age or pathology. Only three out of the nine different routes that were analysed had no trouble spots: one crosswalk-free route and two routes not including any crosswalk requiring walking speeds >0.4 m/s. It is worth mentioning that on the way out from the HCC in front of the Holiday Inn Hotel, there is no crosswalk to cross through *Rua Ivone Silva*, which represents a constraint for patients in need to cross that street to reach *Avenida 5 de Outubro*. All green times were based on at least four assessments obtained in different days of the week, at different moments of the day. Even though some fluctuations in green time values between the different assessments have been found, particularly at some specific crosswalks, these did not seem related to the different traffic flows or to the fact that these were taken on weekdays or during the weekend. The major trouble spots did not seem explained by constraints related to traffic flows and widely different green times were found in crosswalks sequentially located at the same traffic flow, as in the *Avenida 5 de Outubro*, for instance. This accessibility issue is particularly relevant considering that more than 2/3 (69%) of the patients in our group use public transports or come to the hospital on foot. It is worth mentioning that this situation also affects the patients attending the *Instituto Português de Reumatologia*, using some of the same walking routes. The way that walking speed of our group of patients was analysed represents one of the limitations of the study. Crossing a real signalised crosswalk requires a special attention and multisensory integration,[5] due to the exposure to obstacles (including slopes, levels, other pedestrians), noises, weather conditions, traffic conditions and traffic signal timing. The fear of falling may also reduce walking speed and is mainly found in outside activities. All these factors were not included in our simulation, which could have contributed to overestimated walking speeds in our group of patients.[10]

CONCLUSION

Walking speeds across signalised crosswalks as recommended by the legislation is appropriate. However, over one third of the signalised crosswalks around the HCC hospital do not comply with these. This is a relevant issue affecting mobility and putting patients at risk, increasing the chance of accident and the feeling of insecurity on the street and should be corrected.

HUMAN AND ANIMAL PROTECTION

The authors declare that the followed procedures were according to regulations established by the Ethics and Clinical Research Committee and according to the Helsinki Declaration of the World Medical Association.

DATA CONFIDENTIALITY

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest in writing this manuscript.

FINANCIAL SUPPORT

The authors declare that there was no public or private financial support in writing this manuscript.

REFERENCES

1. Censos.ine.ptCensos.ine.pt. Lisboa: Censos 2011 Resultados Definitivos - Região Lisboa; 2011 [consultado 2018 jun 6]. Disponível em: https://censos.ine.pt/xportal/xmain?xpid=CENSOS&xpgid=ine_censos_publicacao_det&menuBOUI=13707294&contexto=pu&PUBLICACOESpub_boui=156651739&PUBLICACOESmodo=2&selTab=tab1.
2. Bollard E, Fleming H. A study to investigate the walking speed of elderly adults with relation to pedestrian crossings. Physiother Theory Pract. 2013;29:142–9.
3. Autoridade Nacional de Segurança Rodoviária. Barcarena: Mais de 65 anos – Condução, Mobilidade e Segurança, 2014. [consultado 2019 jan 18]. Disponível em: http://www.ansr.pt/SegurancaRodoviaria/Conselhos/Documents/MAIORES%2065%20ANOS%20-%20CONDU%C3%87%C3%83O%20MOBILIDADE%20E%20SEGURAN%C3%87A.pdf.
4. Hoxie R, Rubenstein L. Are older pedestrians allowed enough time to cross intersections safely? J Am Geriatr Soc. 1994;42:241-4.
5. Onelcin P, Alver Y. The crossing speed and safety margin of pedestrians at signalized intersections. Transp Res Proc. 2017;22:3–12.
6. Brown K, Heather M, Hanson M, Firmani F, Liu D, McAllister M, et al. Gait speed and variability for usual pace and pedestrian crossing conditions in older adults using the GAITRite Walkway. Gerontol Geriatr Med. 2015;2:1–8.
7. Branco P. Validação da versão portuguesa da "Activities-specific Balance Confidence Scale". Rev Soc Port Med Fis Reab. 2010:19:20-5.
8. Branco P. Avaliação e modificação do risco de queda em idosos com recurso à posturografia dinâmica computorizada, Lisboa; NMS-FCM - Teses de Doutoramento2013. [consultado 2018 jul 2]. Disponível em: https://run.unl.pt/handle/10362/10526.
9. Decreto-Lei n.º 163/2006. Diário da República, I Série, nº 152 (2006/08/08). p.5670-89.
10. Amosun S, Burgess T, Groeneveldt L, Hodgson T. Are elderly pedestrians allowed enough time at pedestrian crossings in Cape Town, South Africa? Physiother Theory Pract. 2007;23:325-32.