Do older pedestrians have enough time to cross roads in Dublin? A critique of the Traffic Management Guidelines based on clinical research findings

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Abstract

Background: the safety of older pedestrians at urban intersections is a matter of gerontological concern. Many older pedestrians report inability to complete crossings in the time given by pedestrian lights. Standard times for pedestrian lights in Dublin pelican crossings are specified in the Traffic Management Guidelines (TMG). The Technology Research for Independent Living Centre is building a database of gait assessments of Irish community-dwelling older people using GAITRite™.

Objective: to compare the usual walking speed of our participants against that required by the TMG.

Design: cross-sectional observational study.

Setting: comprehensive geriatric assessment outpatient clinic.

Subjects: 355 community-dwelling older subjects aged ≥60 assessed between August 2007 and September 2008 (mean age 72.7, SD 7.2).

Methods: linear regression analysis between age and observed walking speed, followed by comparison of predicted walking speeds at four different ages (i.e. 60, 70, 80 and 89) against minimum walking speeds required to cross standard Irish roads when regulated by the pelican system.


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Do older pedestrians have enough time to cross roads in Dublin?

**Results:** age and walking speed had a strong inverse correlation $F(1, 353) = 108.48, P < 0.001, R^2 = 0.235$. The regression predicted a walking speed of $1.30 \text{ m/s}$ (95% confidence interval 1.24–1.35) at the age of 60, $1.10 \ (1.07–1.13)$ at 70, $0.91 \ (0.87–0.94)$ at 80 and $0.73 \ (0.66–0.80)$ at 89. Against these predicted walking speeds, standard crossing times appeared insufficient for very old people.

**Conclusions:** as currently defined in the TMG, maximum pedestrian crossing times at pelican crossings may represent a hazard for very old people. This should be addressed within the Irish authorities’ plan to improve safety and equality for older people.

**Keywords:** traffic accidents, aged, safety, standards, Ireland, elderly

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**Introduction**

The safety of older pedestrians at urban intersections is a matter of gerontological concern [1–4]. Older pedestrians often report inability to complete crossings in the time given by pedestrian lights, and there is evidence from outside Europe that this claim is sufficiently grounded [5, 6]. The National Council on Ageing and Older People in the Republic of Ireland has pointed out that older pedestrians are particularly vulnerable to death and injury from road traffic accidents, with pedestrian injuries to death ratios being highest among the 70+ years group [7]. Statistics from the Irish Road Safety Authority reveal that over the 10-year period 1996–2005 more than 500 people over the age of 65 died as pedestrians on Irish roads, making older people the most at-risk group [8]. According to the European Road Safety Observatory, 34.4% of pedestrian fatalities in Ireland occur amongst older people (aged >64), which is slightly below the European Union (EU-18) average (39.4%). In Greece, Italy and France, more than half of all pedestrian fatalities are older people, whilst in the UK the proportion is similar to Ireland at 35.9% [9]. Importantly, a large number of older pedestrians who survive road traffic accidents are unable to return home due to disability and require institutionalisation [7].

Pelican crossings (PEdestrian LIght CONtrolled crossings) are the most common type of urban controlled crossings in Ireland and feature three far-side pedestrian lights (green, amber and red) and near-side push button units. Their functioning is regulated by the Traffic Management Guidelines (TMG), issued in 2003 by the Department of the Environment and Local Government, the Department of Transport and the Dublin Transportation Office [10]. According to the TMG, ‘the green pedestrian aspect time is usually fixed at 6 seconds and is an invitation for pedestrians to start to cross the road. The amber pedestrian aspect varies with the width of the road, allowing a second for each 1.2 metres of road width that pedestrians cross. The amber aspect indicates that pedestrians can complete their crossing manoeuvre but should not start to cross’ (p. 190). The TMG state that in wide distributor roads ($\geq 10 \text{ m}$) or dual carriageways, consideration should be given to splitting the crossing into two parts and staggering the crossing points, with a central island of at least 3 m wide and fitted with pedestrian guardrails. The TMG acknowledge that these staggered crossings can be more efficient for traffic and safer for pedestrians. However, in practice, these types of staggered crossings are often unavailable.

The Manual of Contract Documents for Road Works was published by the Irish National Roads Authority in March 2000 and provides standard widths for different types of roads [11]. Figure 1 represents as dots different types of urban roads where pelican crossings are likely to be found, with their respective width and minimum walking speed needed to cross them assuming the existence of a non-staggered pelican crossing for pedestrians that functions exactly according to the TMG. As shown by the quadratic regression line, the pelican crossing system requires higher minimum pedestrian speeds as road widths increase, but the increase in required speed is non-linear and there is a marginal benefit for pedestrians at higher road widths.

The aim of this study was to assess whether these allocated times are sufficient for older people when they walk at their preferred walking speed. The study is justified on various grounds: firstly, in terms of the great public health relevance of the issue; secondly, in response to the lack of local literature; thirdly, to inform future policy developments in Ireland; and lastly, to provide researchers in other countries with a methodological approach that will facilitate international comparisons.

**Methods**

**Subjects and setting**

Three hundred fifty-five subjects assessed at the Technology Research for Independent Living (TRIL) Clinic (http://www.trilcentre.org/) in Dublin between August 2007 and September 2008. The TRIL Clinic offers an outpatient clinical service to community-dwelling people aged $\geq 60$ years in the form of a comprehensive geriatric assessment that incorporates the use of technologies to measure risk factors for falls, cognitive decline and lack of social connectedness. The TRIL Clinic has a national scope and encourages referrals from all over Ireland, including self-referrals. TRIL Clinic participants must be community-dwelling, aged...
as per TMG. The four parallel lines represent predicted walking speeds at the ages shown based on the regression model explained in the main text. The road types shown are: 1: Slip Roads, Interchange Links and Loops; 2: Reduced Single Carriageway (S2) (RCD/000/1); 3: Diverge Slip Roads Only; 2 Lane (RCD/000/10); 4: Slip Roads, Interchange Links and Loops; 2 Lane (RCD/000/9); 5: Type 3 Dual Carriageway (RCD/000/3); 6: Standard Single Carriageway (S2) (RCD/000/2); 7: Type 2 Dual Carriageway (D2AP) (RCD/000/4); and 8: Type 1 Dual Carriageway (D2AP) (RCD/000/5).

### Table 1. Characteristics of the participants of the study by age group

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Total sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>60–69 n = 133</td>
<td>80–89 n = 69</td>
</tr>
<tr>
<td>Age (mean ± SD)</td>
<td>65.3 (2.6)</td>
</tr>
<tr>
<td>Female gender (%)</td>
<td>64.7</td>
</tr>
<tr>
<td>Walking speed (m/s)</td>
<td>1.18 (0.24)</td>
</tr>
<tr>
<td>IADL score</td>
<td>25.9 (1.7)</td>
</tr>
<tr>
<td>MMSE score</td>
<td>28.1 (1.7)</td>
</tr>
<tr>
<td>Walking aid</td>
<td>2.2</td>
</tr>
<tr>
<td>Grip strength (kg)</td>
<td>55.4 (26.0)</td>
</tr>
<tr>
<td>BBS</td>
<td>53.7 (4.1)</td>
</tr>
<tr>
<td>TGUG (s)</td>
<td>8.0 (2.2)</td>
</tr>
<tr>
<td>Visual acuity (binocular LogMAR)</td>
<td>0.06 (0.12)</td>
</tr>
<tr>
<td>Poor hearing (pure tone audiogram)</td>
<td>6.7</td>
</tr>
<tr>
<td>Fear of falling (mFES)</td>
<td>9.5 (1.2)</td>
</tr>
<tr>
<td>Recurrent (≥2) falls in the past year</td>
<td>15.8</td>
</tr>
<tr>
<td>CCI</td>
<td>1.0 (1.3)</td>
</tr>
</tbody>
</table>

IADL, Instrumental Activities of Daily Living Score (Lawton and Brody’s scale); MMSE, Mini-Mental State Examination; BBS, Berg Balance Score; mFES, modified Falls Efficacy Scale; CCI, Charlson Comorbidity Index; TGUG, timed get up and go (seconds); LogMAR, log of the Minimal Angle of Resolution tested at a distance of 4 m.

≥60, able to mobilise independently with or without mobility aid and able to provide informed consent. Local research ethics committee approval was obtained (SJH/AMNCH Research Ethics Committee approval reference number 2007/06/13).

As part of its activity, the TRIL Clinic is building a database of gait assessments of older people using the GAITRite™ walkway system (CIR Systems, Inc., 60 Garlor Drive, Havertown, PA 19083, http://www.gaitrite.com/). The GAITRite™ has been shown to have good reliability for gait parameters in older people, including walking speed [12, 13]. Participants were asked to walk once along the walkway ‘as normal’ at their preferred walking speed, with no additional cognitive loading. Although it is known that
in healthy older people the ‘maximum’ walking speed (i.e. as fast as possible without running) can be about 30% higher than the ‘comfortable’ (i.e. preferred) speed [14], we used the latter because our sample included subjects with limited mobility who were unable to walk without assistance (e.g. walking stick or frame); in these subjects, the request of maximum walking speed would have been potentially hazardous and thus unethical. Whilst healthy older subjects may be able to safely increase their waking speed to the maximum whilst crossing roads, in this study we aimed at being inclusive with frail older subjects who are also pedestrians in real life.

Measurements
Table 1 summarises relevant participant characteristics by age group. The clinical assessment of the participants included measurements in the physical, cognitive, psychological and sensory domains. For a description, please see Appendix 1 in the supplementary data on the journal website (http://www.ageing.oxfordjournals.org/).

Statistical analyses
The baseline characteristics for each group were summarised as mean ± standard deviation (SD) or percentage (%) as appropriate. Walking speeds obtained from the GAITRite™ system were plotted against participants’ ages, and simple linear regression was conducted to investigate how well age predicts walking speed. Unstandardised predicted values for the regression were saved with 95% confidence intervals (CI) for the mean. To investigate the extent to which age was an independent predictor of walking speed in the presence of other confounders, backwards multiple linear regression was used. SPSS 16.0 was used for the statistical analyses.

Declaration of sources of funding
The TRIL Clinic is funded by Intel Corporation and the Industrial Development Agency (IDA) Ireland, with operational support from St James’s Hospital Dublin. The financial sponsors played no role in the design, execution, analysis and interpretation of data or writing of the study.

Results
The results of the simple linear regression were statistically significant $F (1, 353) = 108.48, P < 0.001$ (Figure 2). The identified equation to understand this relationship was Walking Speed = $2.47 - 0.020 \times (\text{Age})$. The regression predicted a walking speed of 1.30 m/s (95% CI 1.24–1.35) at the age of 60, 1.20 (1.16–1.24) at 65, 1.10 (1.07–1.13) at 70, 1.00 (0.97–1.03) at 75, 0.91 (0.87–0.94) at 80, 0.81 (0.76–0.86) at 85 and 0.73 (0.66–0.80) at 89. The adjusted $R^2$ value was 0.235. This indicates that 24% of the variance in walking speed was explained by age. According to Cohen [15], this is a medium-to-large effect size.

A backwards multiple linear regression model was computed with age, gender, Mini-Mental State Examination (MMSE) score, grip strength, timed get up and go (TGUG), modified Falls Efficacy Scale (mFES), non age-adjusted Charlson Comorbidity Index (CCI) and visual acuity (binocular LogMAR) as predictors of walking speed. The final model included age ($P = 0.001$), grip strength ($P = 0.001$), TGUG ($P < 0.001$) and mFES ($P = 0.001$) as significant independent predictors of walking speed. The combination
of these variables significantly predicted walking speed, $F (4, 329) = 156.23, P < 0.001$. The adjusted $R^2$ value was 0.651 (65% of variance explained). Despite the greater variance explained with the multivariable model, the correlation between predicted gait velocities obtained via the single (i.e. based on age only) as opposed to the multivariable method was strong (Pearson’s $r (332) = 0.61$).

Minimum walking speeds required to cross the roads presented in Figure 1 were compared with the simple regression-derived predicted walking speeds at different ages to assess the extent to which older people would have time to cross those roads under the assumptions of the study (pelican crossing functioning exactly as per TMG and non-staggered crossing). As represented in Figure 1, an 89-year-old pedestrian would only be able to cross about 11 m, an 85-year-old 15 m and an 80-year-old 22 m. Pedestrians over the age of 89 would be unlikely to cross any of the standard road widths considered, and pedestrians between the ages of 80 and 89 could struggle at higher road widths. Putting it in another way, if a road of 12 m width (0.75 m/s required) was considered, pedestrians over the age of 88 would not, on average, be able to cross it. If a two-lane slip road was considered (14.8 m width, 0.81 m/s required), those ≥85 years of age would not be able to cross it. As represented in Figure 1 were compared with the simple regression- derived predicted gait velocities obtained via the single (i.e. based on age only) as opposed to the multivariable method was strong (Pearson’s $r (332) = 0.61$).

Discussion

The main aim of this study was to assess whether the standard times allocated by pelican pedestrian lights in Dublin are sufficient for older people when they walk at their preferred speed. Results suggested that pedestrians over the age of 80 are unlikely to have sufficient time, especially when crossing wider roads. The average walking speed of pedestrians aged ≥89 was likely to be lower than the minimum speed required to cross the narrowest standard road.

Our findings are consistent with previous research conducted in Canada and the USA [16], Australia [17] and South Africa [18]. Our study fills the evidence gap in Ireland and has the potential to influence local policy developments in the area of safety and social inclusion of older people. In addition, given the relative paucity of European data published on this issue, our study may stimulate similar research in other European countries, which could facilitate international comparisons and perhaps lead towards the development of harmonised European standards.

However, this study has limitations. Firstly, the sample is not random and therefore not necessarily representative of the population of older people in Dublin. As Table 1 shows, due to our recruitment criteria, our participants tended to be cognitively preserved (mean MMSE of 27 out of 30) with only mild cognitive impairment cases being included. The prevalence of dementia in Irish community-dwelling older people has been estimated at 5.5% [19], and the association of dementia with gait slowing [20, 21] and fatal pedestrian accidents [22] is well known. On the other hand, our participants scored high in Instrumental Activities of Daily Living (mean of 25 out of 27) and were able to mobilise independently with only 10% using a walking aid (most a simple walking stick). Their mean Berg Balance Score was above the cut-off of 45 points that is associated with increased risk of falls [23], and the average TUG time indicates good levels of physical mobility across age groups. For these reasons, frailty cases may have been underrepresented in our sample, which may have led to an overestimation of the predicted walking speeds.

In order to explore this issue further, we compared our results with those of the Survey of Health, Ageing and Retirement in Europe (SHARE) [24], which collected general physical health measures among nationally representative samples of men and women aged ≥50 years in 10 European countries. SHARE measured walking speed only among those aged ≥75 and used a cut-off point of ≤0.4 m/s as a measure of functional limitations. SHARE found that 17.2% (95% CI 13.0–22.5) of males and 26.6% (21.1–32.9) of females had a walking speed ≤0.40 m/s. In our sample, 122 participants were aged ≥75 (65.6% females, 34.4% males). The mean walking speeds were 0.88 m/s (SD 0.26) for males and 0.85 m/s (SD 0.28) for females. In contrast with SHARE, only 4.8% of males and 3.8% of females ≥75 had a walking speed ≤0.40 m/s.

Secondly, in addition to the sampling effect, the measurement conditions may have also contributed to the overestimation of predicted walking speeds. Predicted walking speeds were based on non-cognitively loaded and medically supervised laboratory measurements. Cognitive loading results in gait slowing [25, 26], and crossing roads in real environmental conditions requires a great deal of attention and multisensory integration, all of which was not required during the testing in our clinical laboratory. Our 5-m, supervised straight walk on the GAITRite™ has no obstacles/inclines or acoustic/light signals, so it requires a much lower level of sensory input from vision and hearing than what would be required in real traffic conditions. In addition, outdoor weather conditions such as cold, rain, poor visibility and/or wet or icy roads, all of which occur commonly in Dublin, may also have a slowing effect. Fear of falling can also have a slowing effect and typically affects outdoor more than indoor activities [27]. For all the above reasons, real population walking speeds could be lower than in our laboratory. Overestimating predicted walking speeds means that, in reality, older people would start experiencing difficulties in crossing roads at younger ages than the ones we suggested.

Lastly and as already stated, results are based on the assumption of non-staggered crossings and pelican lights functioning exactly according to the TMG. Apart from the availability of staggered crossings in some roads, exceptions exist in practice where pedestrian lights have been set to allow more time than the minimum specified in the guidelines. To our knowledge, there are no published criteria as to what determines deviations from the standards set in the TMG. The purpose of the TMG manual was ‘to provide a source of information and guidance on traffic management
issues’ and to lay ‘general best practice principles’ (p.12) [10], but responsibility for traffic management in urban areas remains within the local authorities [28].

In summary, the standard time allowed by Dublin pelican crossings appears insufficient for the older subgroup of older people, and there are reasons to believe that the problem could also affect older people before the eighth decade. In Ireland, as in the rest of industrialised countries, the number of older people living in the community will continue to grow over the next decades [29], so the issue of older pedestrian safety is bound to get worse unless remedial action is taken. We recommend this be addressed within the Irish government’s plan to combat discrimination and promote safety for older people. This may require a review of the TMG with a gerontological lens.

**Key points**

- Many older pedestrians report inability to complete crossings in the time given by pedestrian lights.
- Walking speed decreases linearly with age.
- We compared predicted walking speeds against minimum walking speeds required by Dublin pelican crossings.
- The standard crossing times appear insufficient for very old people.
- Implications emanate for public policy.

**Acknowledgements**

The Technology Research for Independent Living Centre focuses on the research of new technologies to enable people to live independent lives for as long as possible in the environment of their choosing. The Centre is a joint initiative between Intel and the Industrial Development Agency Ireland. The Centre is an active research collaboration between industry and academic partners including Intel, Trinity College Dublin, University College Dublin and the National University of Ireland Galway, and represents a multidisciplinary team of up to 70 researchers including ethnographers, designers, clinicians, economists and a range of scientists and technologists.

**Conflicts of interest**

None.

**Supplementary data**

Supplementary data mentioned in the text is available to subscribers at the journal website http://ageing.oxfordjournals.org.

**References**

The experiences of older adults in the community dying from cancer and non-cancer causes: a national survey of bereaved relatives

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Abstract

Background: there is limited understanding of symptoms and care in the last few months of life for adults dying from causes other than cancer.

Objective: the aim of the study is to compare the experiences in the community in the last 3 months of life of older adults dying from cancer and non-cancer causes.

Design: the study employed a retrospective cross-sectional survey of bereaved relatives.

Setting: the survey took place across eight cancer networks in England.

Subjects: a random sample of 1,266 adults who registered a death occurring in someone aged 65 and over between August 2002 and February 2004 was drawn.