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# Assessing risky and protective behaviors among pedestrians in the Dominican Republic: New evidence about pedestrian safety in the Caribbean

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ABSTRACT

*Introduction:* Research on pedestrians' behavior and safety in low and middle-income countries (LMICs) is scarce, compared to high-income economies. This study aimed to present the validation of the Walking Behavior Questionnaire (WBQ), which has not been tested before in the Dominican Republic, and to evaluate age differences in walking-related self-reported behaviors.
*Methods:* For this study, a nationwide sample of 1026 pedestrians answered a questionnaire on risky and safe walking behaviors. Psychometric properties of the WBQ, variable correlations and age-based differences in walking were tested.
*Results:* Overall, the WBQ presented an adequate structure, goodness-of-fit indexes, and high reliability. Significant correlations between walking-related variables and demographic factors, as well as key differences in walking behaviors among young people, adults, and aging adults were found.
*Conclusions:* These results provide a strong background for assessing walking behaviors through the WBQ (for the first time in an LMIC), as -apart from presenting fair psychometric properties-it highlights the existence of walking pattern-related and demographic differences in the risky behaviors performed by pedestrians.
*Implications:* In practical settings, this is the first large-scale behavioral questionnaire-based research on pedestrian safety conducted in the Dominican Republic, whose outcomes support the value of implementing effective evidence-based policies and educational interventions that consider age-related specificities for strengthening both healthier and safer walking. Furthermore, these implications may be applied in other countries of the region or with similar socio-economic features.

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## 1. Introduction

Given its non-contaminant, sustainable, and healthy features, walking continues to be promoted as a key transportation mode, and it is increasing in popularity within different population groups worldwide, including high-income countries (in which it is already more inserted within the local culture) and low- and middle-income economies. Indeed, recent studies prospectively addressing the potential impact of the COVID-19 pandemic on travel behavior place active transport (especially walking and cycling) as commuting means gaining popularity the most for the next few years (Barbieri et al., 2021; de Haas et al., 2020). Anyway, and even besides recent public health macro-issues, both public agencies and policymakers have constantly been developing strategies to increase walking, considering all the benefits it involves during the last few decades.

Notwithstanding, the motives for the population to choose walking as a means for many of their daily trips are not necessarily limited to health and welfare, but they are also related to convenience, especially if we address the case of low-and-middle-income countries (LMICs), such as the Dominican Republic. Both in this and other countries of the region, walking and public transportation are highly demanded (not to say *essential*) means of transport, as a high percentage of the population does not have access to a private vehicle and should make urban trips quite frequently (World Bank, 2018; Reis et al., 2013). In a recent study, 62 % of the general Dominican population reported walking as a means of accomplishing a substantial part of their daily commuting movements (INTRANT, 2020a). This percentage is especially considerable if we bear in mind that pedestrians are one of the least protected users and that around 17 % of fatally injured road users between the years 2016 and 2019 in the Dominican Republic were pedestrians (INTRANT, 2020b).

Also, and as road behavior of pedestrians has been stated as, perhaps, the main contributor to their crashes, the need arises for generating research tools aimed at improving scientific knowledge on safe and healthy active commuting (Useche et al., 2020; Deb et al., 2017; Reis et al., 2013). In this regard, to this date, not much has been researched about active transportation (specifically walking) in emerging economies of the Caribbean.

## 2. Literature review

### 2.1. Benefits and constraints of active transportation: the case of walking

As the available evidence raises up, daily walking gets associated to more and more physical and psychological benefits, some of them relatively unknown just a few decades ago. As relevant figures in this regard, recent studies have found that increased durations of active commuting have been associated with decreased mortality (Zhao et al., 2015), higher levels of physical activity, improved health over time (Audrey et al., 2014; Garrido-Méndez et al., 2017; Ogilvie et al., 2016; Yang et al., 2012), and enhanced functioning of several brain areas involved in problem-solving and reasoning (Wojtys, 2015).

Nevertheless, not all the possible benefits of walking are directly related to health; instead, many other spheres could get benefited if active transportation is enhanced (Panter et al., 2016; Peralta et al., 2020). For instance, recent studies have concluded that increasing the number and frequency of walking commuting trips might have positive effects for the economy, transportation efficiency and environmental sustainability (Baker et al., 2021; Möller et al., 2020). On the other hand, walking may encompass a series of both deliberate and unintentional risky behaviors potentially increasing the likelihood to get injured or to die as a result of a traffic crash, which in literature is commonly addressed as *risky walking* (Oviedo-Trespalacios et al., 2021; Useche; Hezaveh; Llamazares and Cherry, 2021; Useche et al., 2020).

### 2.2. Demographic and behavioral factors increasing risky walking

Several factors may influence traffic crashes involving pedestrians. Nevertheless, behavioral issues have been underlined by the literature as one key contributor to road crashes, especially those with more severe outcomes (Alavi et al., 2017; INTRANT, 2020a). In the past few years, the age of different types of road-traffic participants has been largely associated with their behaviors (for instance, misconducts, positive behaviors; Onieva-García et al., 2016; Park and Bae, 2020). For example, younger cyclists perform more deliberate dangerous behaviors (e.g., use of handheld/connected devices while riding), compared to adults and aging adults (Useche et al., 2019; Young et al., 2020). Furthermore, pedestrian-vehicle accidents (or rather, "crashes") involving older users are the most severe ones (Onieva-García et al., 2016; Park and Bae, 2020) due to different biological-maturation-related issues, such as increased frailty (Kim et al., 2008; Tarko and Azam, 2011).

Consequently, there is a need of understanding the behavioral patterns of different types of road users. For this purpose, the behavioral questionnaire (BQ) paradigm assesses the road behavior of different road users based on three dimensions: deliberate risky behaviors, unintended hazardous actions, and positive or protective behaviors (Useche et al., 2020). However, empirical knowledge on pedestrian behavior is a relatively recent topic of study, with most of the previous research focusing on motor-vehicle drivers (Driver Behavior Questionnaire [DBQ], Reason et al., 1990) and cyclists (Cycling Behavior Questionnaire [CBQ], Useche et al., 2018a; Bicycle Rider Behavior Questionnaire [BRBQ], Hezaveh et al., 2018).

In this regard, there is a big gap in what concerns the use of validated and empirically endorsed instruments intended for studying pedestrian behaviors, which is substantially scarce, given the lack of such research tools. Only a few authors have analyzed the road behavior of pedestrians with well-founded and validated instruments, (e.g.) Pedestrian Questionnaire Behavior (PBQ, Moyano-Díaz, 1997) or the Pedestrian Behavior Scale (PBS, Granié et al., 2013); more recently, Useche et al. (2020) developed and validated the Walking Behavior Questionnaire (WBQ) with Spanish pedestrians, inspired by the necessity of assessing behaviors which may

potentially threaten the security of these road users, such as distraction and inattention (Oviedo-Trespalacios et al., 2019; Young et al., 2020).

Additionally, empirical evidence supporting behavioral questionnaires for highly vulnerable road users such as pedestrians is still limited in certain jurisdictions. On the other hand, many authors support the idea that well-validated questionnaires are needed to generate empirical knowledge on behavioral factors contributing to road safety. Therefore, this paper did not only focus on the application of the WBQ but also on performing its validation for the Dominican Republic in order to support the results of the study and its possible implications.

### 2.3. Objective and hypotheses of the study

This study had two core objectives: firstly, to perform and present the validation of the Walking Behavior Questionnaire (WBQ) among a nationwide sample of Dominican pedestrians; and secondly, to assess the age-related differences in walking-related patterns and self-reported road behaviors of pedestrians in the Dominican Republic.

It was hypothesized that: (*a*) in regard to the first study objective, the WBQ would be properly adjusted to its original structure (three dimensions), presenting adequate goodness-of-fit indices and fair psychometric properties, and that (*b*) there would be significant associations among the three factors of the WBQ (traffic violations, errors and positive behaviors), demographic variables -including pedestrians' age-, and walking-related factors (e.g. age, walking exposure, traffic norm knowledge, perceived risk, walking crashes).

## 3. Methods

### 3.1. Participants (Sample and population)

This transversal research examined the information retrieved from 1026 Dominican pedestrians from different cities of the country. Bearing in mind that no specific data exists on how many Dominicans walk regularly, the full Dominican census (almost 11 million inhabitants) was assumed as the population size.

The sample was representative of the Dominican population, with around 54 % of the participants being women and 46 % men. The full sample was aged $M = 31.9$ ($SD = 13.4$) years. Table 1 contains additional descriptive data of the participants.

### 3.2. Study Setting

This empirical research was based on a street-conducted and self-reported questionnaire that was applied following a random route

**Table 1**
Sociodemographic information and walking features of the participants.

| Independent variable | Classification | Frequency | Percentage |
|---|---|---|---|
| Gender | Women | 553 | 53.9 % |
| | Men | 473 | 46.1 % |
| Age Group | Young Adult (≤25) | 446 | 43.5 % |
| | Adult (26–50) | 461 | 44.9 % |
| | Aging Adult (>50) | 119 | 11.6 % |
| Educational level | Primary studies or lower | 47 | 4.6 % |
| | Secondary-high school | 318 | 31.0 % |
| | Technical studies | 84 | 8.2 % |
| | University studies | 486 | 47.4 % |
| | Post-graduate studies | 91 | 8.9 % |
| Occupation | Student | 473 | 46.1 % |
| | Employed | 410 | 40.0 % |
| | Self-employed | 83 | 8.1 % |
| | Unemployed | 19 | 1.9 % |
| | Retired | 5 | .5 % |
| | Householding | 16 | 1.6 % |
| | Other | 20 | 1.9 % |
| Main motivation for their walking trips | Daily trips (commuting) | 640 | 62.4 % |
| | Short trip to a specific place | 87 | 8.5 % |
| | Leisure trips (“going for a walk") | 95 | 9.3 % |
| | Fitness - exercise | 113 | 11.0 % |
| | Miscellaneous daily tasks (go shopping, picking up children …) | 91 | 8.9 % |
| Walking exposure (hours walking a week) | <1 h | 12 | 1.2 % |
| | 1–5 h | 496 | 48.4 % |
| | 6–10 h | 258 | 25.3 % |
| | 11–15 h | 72 | 7.0 % |
| | 16–20 h | 49 | 4.8 % |
| | 21–25 h | 18 | 1.8 % |
| | >25 h | 117 | 11.6 % |

survey sampling that constitutes a pseudo-probabilistic method, given that it allows researchers to easily access the population (especially in urban areas) under fixed selection criteria (Hoffmeyer-Zlotnik, 2003). Participants first entered the study during the data-gathering stage (conduction of the survey) and at that point were informed about the research aims. A research field associate invited the participants to partake in the research (face-to-face) and assisted them during the whole completion of the questionnaire. No participant complained about the burden of the intervention, or the time required to participate in the research. It was emphasized that the data would be exclusively used for statistical research purposes and their participation was anonymous.

An initial *n* of about 665 subjects was determined as minimum sample size, if a confidence interval [CI] of 95 % and a margin of error of 5 % are assumed, at the least favorable case as $p = q = 50$ %. Nevertheless, and as the response from potential partakers was quite positive and their involvement overreached the participation expectancies, the final sample was composed of 1026 individuals, which was comparable to sex and age of the overall Dominican census (Data obtained from SICEN; http://sicen.one.gob.do/). The partakers signed a formal written agreement containing information on the research purpose and anonymization of personal data. Participants were also informed that their participation was voluntary, and the retrieved data were going to be solely used to achieve the study objectives. No economic rewards and/or incentives were offered to participants. 41 questionnaires were rejected due to incomplete or unclear data, and thus, the response rate was about 80 %.

### 3.3. Description of the questionnaire

The research questionnaire was composed of three main parts or sections:

The initial section of the questionnaire inquired about personal and sociodemographic information, like birthdate, sex, academic achievements, and employment. Also, general walking features of the sample, such as walking exposure (ratio between hours per week and duration of the trip), were retrieved.

The behavioral questionnaire to be assessed (WBQ, Useche et al., 2020; 2021b) was included in section number two of the survey. This self-report instrument consists of a Likert scale that measures risky (errors and violations), and protective (or positive) pedestrian conducts by means of the original error/violation factorial construction proposed by the Behavioral Questionnaire (BQ) perspective. Many different questionnaires and surveys aimed at assessing behaviors of diverse types of road-users are gathered under this standpoint, such as the aforementioned Driving Behavior Questionnaire (DBQ; Reason et al., 1990), CBQ (Useche et al., 2018a), and BRBQ (Hezaveh et al., 2018). Nevertheless, each one of the items evaluated in the 30 items composing the WBQ is strictly associated with walking behavior, heeding the specific features of the pedestrians and their potential behaviors in risk-related situations. What is also innovative about the WBQ is the fact of introducing the dimension labeled "Positive Behaviors" within the pedestrians' behavior; as this has been previously done only with other types of road users (Özkan and Lajunen, 2005; Useche et al., 2018a, 2018c). This walking factor comprises intentional conducts and acts that contribute to the diminishment of the risk associated with walking journeys, and it can be relevant to geographic or environmental backgrounds due to the generalizability of the item contents. The WBQ consists of 30 questions gathered in the three abovementioned dimensions: *Traffic Violations* - 16 items; *Walking Errors* - 10 items; and *Positive (*or *protective) Behaviors* - 4 items. These items were designed using different safe and unsafe walking behaviors commonly observable worldwide, which can therefore be applied to different populations. For the full-item composition and key score-s/coefficients of the scale, please refer to section 4.1, where the WBQ measurement model is presented.

As for the last part, four supplementary measures inspired by the theoretical assumptions and existing associations between travel conducts, perceived risk, self-reported rule knowledge, distractions present in the road environment, and road crashes (Dinh et al., 2020; Useche et al., 2018b; Wells et al., 2018; Yu et al., 2020; Yue et al., 2020) were taken into account. The Risk Perception and Regulation Scale (RPRS; available at Useche et al., (2019)) was used to assess the perceived road risk and self-reported rule awareness. This Likert-based questionnaire consists of 12 questions (7 for assessing the perceived risk $\alpha = 0.851$ and 5 for general traffic norms $\alpha = 0.760$) ranging from 0 (no knowledge/risk perceived) to 4 (highest knowledge/risk perceived), and the score consists of the average of the added score of the statements of each factor.

Distractibility during trips was evaluated through the Inventory of Road Distractions (RDI, Useche et al., 2019). This 8-question ($\alpha = 0.652$) binary scale (1 = Yes; 0 = No) enquires about possible distractors that frequently occur within the traffic environment and may be precursors of risky walking behaviors (principally errors). The self-reported number of crashes suffered while walking was obtained by means of directly inquiring on "*the number of traffic accidents or crashes experienced while walking during the last 5 years*".

### 3.4. Ethics

The Research Ethics Committee of the University Research Institute on Traffic and Road Safety (INTRAS) at the University of Valencia granted permission to perform this study and certified that it responded to the general ethical principles in accordance with the Declaration of Helsinki, as required for the case of research using human subjects (IRB approval number HE0001251019). The risk level of the study was determined as very low, considering that no individual information was used, and the anonymity of the subjects was strictly maintained. All participants agreed to partake by signing the Informed Consent Form, containing information on the purpose, methods, and treatment of study data.

### 3.5. Data analyses

Initially, basic data treatment allowed us to carry out a descriptive analysis of the characteristics of the participants and their results in the additional questionnaires that were used. Afterwards, a rigorous confirmative procedure assessed the factorial arrangement of

the WBQ by means of competitive CFA-based (confirmatory) analyses using consecutive fit steps (forward), following a preliminary evaluation through EFA (exploratory) analyses performed under the assumption of maximum likelihood (a statistical method utilized to unveil the underlying structure of a relatively large set of items or variables) with Promax oblique rotations, that were chosen as it is the most sensible to first examine the solutions produced by one or more of the common methods of oblique rotation, allowing researchers to refine their understanding of the data (Fabrigar et al., 1999). As it allows researchers to set factor loadings on the same scale, data was standardized (Brown, 2006; Kaplan, 2000), thus being possible to compare the size of the factor loadings to assess. Considering the appropriate outcomes of the EFA, which endorse the questionnaire's fundamental postulations, and that similar behavioral questionnaire-based theoretical and experimental support for various types of road users were already available, the present investigation employed confirmatory models. This perspective comprised the "a priori" or baseline model to be compared. It is worth mentioning that CFA involves numerous benefits regarding the management of missing data, as well as of ordinal, categorical, and/or variables that are non-normally distributed (Finney and DiStefano, 2013). In addition, one relevant benefit of CFA is the possibility of determining which option (*i.e.*, proposed model) has the most appropriate and parsimonious fit, thus allowing the assessment of numerous models under diverse theoretical suppositions and conjectured constructions. IBM SPSS Statistics for Macintosh (Version 26.0; IBM Corp., Armonk, NY) was employed for building up these models.

As suggested in previous research, numerous estimators and coefficients from different types were used to weigh the model fit (see Marsh et al. (2004) for further information). These estimators were: Chi-square ($\chi^2$), discrepancy ratio ($\chi^2$/df); Root Mean Square Error of Approximation (RMSEA); Normed Fit Index (NFI), Tucket-Lewis Index (TLI) Confirmatory Fit Index (CFI). Goodness-of-fit cut-off points were established as proposed by Marsh et al. (2004): CFI/NFI indexes $> 0.90$, an RMSEA $< 0.08$, and a $\chi^2$/df ratio $< 5.0$ suggest an adequate model fit.

Moreover, the appropriateness of the model was assessed as well, employing the strength and coherence of the estimates, added to the absence of great/redundant modification indexes. Lastly, the internal consistency and reliability of the questionnaire and its items were estimated through (*i*) Cronbach's coefficients – α, and (*ii*) Composite Reliability Indexes (CRIs), an additional index based on the factor loadings and residuals found in the confirmatory outcomes. This indicator helps to overcome some of the traditional limitations of Cronbach's Alpha coefficients as a single way of determining the reliability (or not) of a questionnaire scale (Raykov and Marcoulides, 2011; Raykov, 2001).

## 4. Results

### 4.1. WBQ measurement model

The factorial structure and psychometric properties of the Walking Behavior Questionnaire were analyzed for the case of this nationwide sample in the Dominican Republic. Overall, Promax-based Exploratory Factor Analysis suggested a reasonably adequate structure for the WBQ (adjusting well to 3 factors; 54.17 % of variance explained; all item factor loadings – $\lambda_s > 0.40$). Since rotated solutions can be considered as interpretable and theoretically sensitive (Fabrigar et al., 1999; Kaplan, 2000), and various previous studies and their measurement models endorsed a three-factor structure of the WBQ (that can be considered as available evidence on its dimensionality), competitive CFA-based structural analyses were carried out, finding that the original factor composition of the scale presents overall adequate goodness-of-fit indexes.

Concretely, the three-factor adjusted model, which includes a very reduced set of large modification indexes and covariances between items, was the best possible factor solution for the WBQ, being the $X^2$/df discrepancy lower than 5.0, the Root Mean Square Error of Approximation $< .080$, and the core fit indexes (CFI/NFI/TLI) $> 0.900$, as suggested in expert literature (Marsh et al., 2004), as shown in Table 2.

Hence, and since this measurement model initially endorsed the value and pertinence of each one of the three latent constructs included in the questionnaire (*i.e.*, factors or dimensions), a set of validity and reliability indicators was obtained, as shown in Table 3. The validity, reliability, and consistency of the measures were tested through several key indexes: standardized factor loadings (λ coefficients), Composite Reliability Indexes (CRIs), and Cronbach's Alpha coefficients (α).

Overall, the factor loads (λ coefficients) presented by each of the 30 items composing the questionnaire were considered adequate since all of them were >0.400 (as graphically shown in Fig. 1), which added to the good fit of the model and contributed to discarding the need of the model deleting items presenting potential psychometric shortcomings. Also, the Composite Reliability Indexes (CRIs) of the three factors ranged between [0.985 and 0.993], while Cronbach's Alpha coefficients (α) were all over 0.890.

**Table 2**
Competitive factor analysis: Goodness-of-fit indices and model adjustment.

| Model | $X^2$ | df[1] | *p* | CMIN/df[2] | RMSEA[3] | 90 % CI for RMSEA | | CFI[4] | NFI[5] | TLI[6] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower threshold | Upper threshold | | | |
| One-factor model | 16693.704 | 406 | <.001 | 41.117 | .130 | .129 | .132 | .564 | .559 | .533 |
| Three-factor baseline model | 7026.470 | 402 | <.001 | 17.479 | .083 | .082 | .085 | .823 | .814 | .808 |
| Three-factor final model (**retained**) | 1642.228 | 370 | <.001 | 4.438 | .058 | .055 | .061 | .930 | .912 | .918 |

*Notes:* [1]df = Degrees of freedom; [2]CMIN/df = Disparity ratio between $X^2$ and df; [3]RMSEA = Root Mean Square Error of Approximation; [4]CFI = Confirmatory Fit Index; [5]NFI = Normed Fit Index; [6]Tucker-Lewis Index.

**Table 3**
Results of the measurement model for the Walking Behavior Questionnaire (WBQ; retrieved from the original questionnaire).

| Factor | # | Component | Descriptive statistics | | Standardized factor loadings[3] | | Reliability measures | |
|---|---|---|---|---|---|---|---|---|
| | | | Mean[1] | SD[2] | λ[4] | SE[5] | CRI[6] | Cronbach's Alpha |
| Factor 1: Traffic Violations | 1 | Crossing in the middle of the road, not on the crosswalk, in a city street | 1.30 | 1.22 | .520 | .056 | .988 | .907 |
| | 2 | Crossing on the crosswalk when the traffic light is red | 1.22 | 1.40 | .401 | .077 | | |
| | 3 | Walking on the driveway because the sidewalk is very narrow or there are many pedestrians already walking on it | 1.49 | 1.25 | .526 | .070 | | |
| | 4 | Despite being relatively close to the crosswalk, crossing the road among cars | 1.08 | 1.17 | .623 | .069 | | |
| | 5 | Crossing at a run when the pedestrian traffic light is flashing, even if you make cars wait | .94 | 1.19 | .674 | .083 | | |
| | 6 | Making your place in order to overtake someone who is ahead of you, but is walking very slowly | 1.57 | 1.32 | .568 | .086 | | |
| | 7 | Walking on the bike lane, even for a short time | .65 | 1.04 | .625 | .070 | | |
| | 8 | Jumping a wall or a fence in order to shorten the way | .68 | 1.06 | .685 | .075 | | |
| | 9 | Running at the last moment, so you won't lose the public transportation | 1.26 | 1.26 | .610 | .084 | | |
| | 10 | Walking under the effects of alcohol or drugs | .45 | .99 | .706 | .070 | | |
| | 11 | Walking while listening to music with your headphones | 1.11 | 1.33 | .568 | .086 | | |
| | 12 | Walking while watching a video or checking your social media on your phone | .70 | 1.07 | .677 | .074 | | |
| | 13 | Walking while you send a text message or talk in a chat | .89 | 1.10 | .640 | .075 | | |
| | 14 | Walking while talking on the phone, with or without a "hands-free" device | 1.13 | 1.16 | .593 | .077 | | |
| | 15 | Walking so fast that people have to sidestep | .93 | 1.14 | .669 | .079 | | |
| | 16 | Zig-zagging among people to reach your destination faster | 1.24 | 1.27 | .624 | .086 | | |
| Factor 2: Errors | 17 | Walking while being distracted, so that a car has to stop or honk at you | .58 | .97 | .824 | .043 | .993 | .935 |
| | 18 | Bumping into someone because you were distracted | .69 | 1.00 | .779 | .034 | | |
| | 19 | Bumping into an object because you were distracted | .60 | .99 | .792 | .033 | | |
| | 20 | Forgetting, for a moment, the place you were going to | .71 | 1.05 | .714 | .037 | | |
| | 21 | Stumbling upon an obstacle, a bump, or a gap that you hadn't seen | 1.09 | 1.15 | .702 | .044 | | |
| | 22 | Suddenly stopping or changing direction, almost making someone bump into you (for instance, looking at a store window) | .70 | 1.06 | .800 | .037 | | |
| | 23 | Realizing that you have just crossed the road without looking in both directions | .69 | 1.06 | .763 | .037 | | |
| | 24 | Realizing that you have just crossed at a traffic light that was not green for pedestrians | .62 | 1.02 | .758 | .035 | | |
| | 25 | Almost bumping into someone while turning a corner, because you were not looking | .87 | 1.10 | .781 | .041 | | |
| | 26 | Looking at some billboard instead of focusing on traffic | .77 | 1.08 | .779 | .037 | | |
| Factor 3: Positive Behaviors | 27 | Looking at both sides of the road before crossing, even if you take precedence | 2.38 | 1.48 | .761 | .037 | .985 | .890 |
| | 28 | Waiting for the pedestrian traffic light to turn green before crossing, even when there are no vehicles approaching | 2.23 | 1.49 | .833 | .040 | | |
| | 29 | Trying to walk on the right side, to avoid bumping into another pedestrian who may come from the opposite direction | 2.29 | 1.43 | .863 | .039 | | |
| | 30 | Walking till the crosswalk to cross the road, even if it requires some more time | 2.19 | 1.39 | .829 | .038 | | |

*Notes:* [1]Arithmetic mean; [2]SD = Standard Deviation; [3]All $p < .0001$; [4]Factor loading; [5]SE = Standard Error; [6]CRI = Composite Reliability Index.

### *4.2. Correlation analysis*

The correlation analysis of the study has shown interesting and significant Pearson's association coefficients between pairs of variables included in the study. The full set of correlations and significance levels are shown in Table 4. As a summary:

Age was found to be inversely correlated with Walking exposure ($r = -0.072$*). This means that the older the subject, the fewer hours they walk per week. Also, older subjects showed higher walking normative awareness ($r = 0.068$*), and they committed fewer traffic violations ($r =$ -0.186**) and errors ($r = -0.087$**). In this regard, the subjects that walked more hours per week showed a higher self-reported knowledge of the traffic rules ($r = 0.076$*).

Participants with higher perceived risk presented more knowledge of traffic rules ($r = 0.772$**). Also, perceived risk was associated with more positive behaviors ($r = 0.390$**) and fewer walking crashes ($r = -0.067$*), and yet with more distractions ($r = 0.086$**). Participants with a higher knowledge of traffic rules reported more positive behaviors ($r = 0.364$**) and were involved in fewer walking crashes ($r = -0.068$*). Distractions were positively associated with traffic violations ($r = 0.142$**), errors ($r = 0.143$**), and

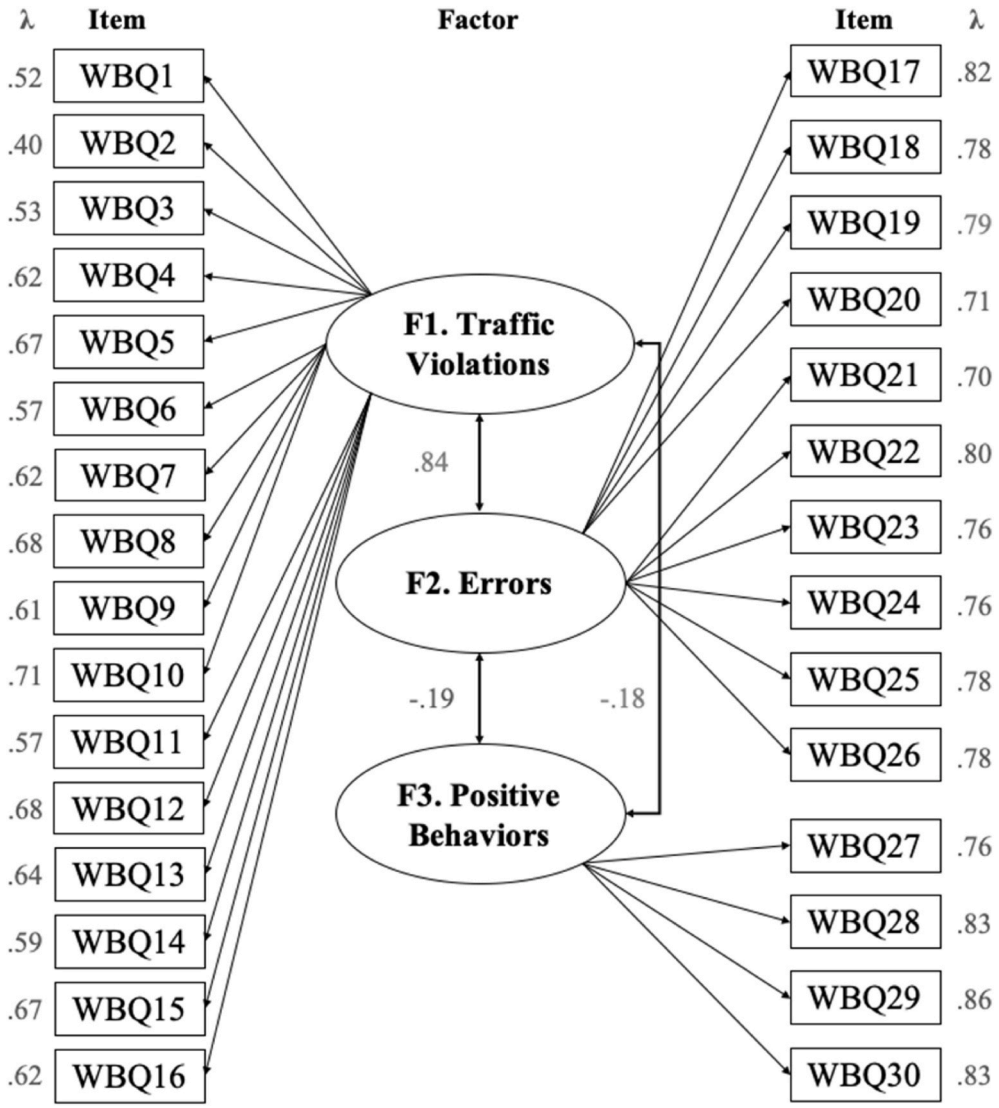


**Fig. 1.** Parameter estimates (λ – standardized) and inter-correlations among the main constructs. *Notes:* All estimates were statistically significant ($p < .001$); the digits inside the squares identify the original numbers of the questions in the WBQ (as also displayed in Table 3).

**Table 4**
Pearson's association coefficients in the three dimensions of the Walking Behavior Questionnaire (i.e., violations, errors, and positive behaviors) and additional walking information.

| | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| **1** | Age (years) | -.072* | .059 | .068* | -.016 | -.186** | -.087** | .006 | -.046 |
| **2** | Weekly Walking exposure | 1 | .006 | .076* | .013 | .045 | .05 | .033 | .041 |
| **3** | Perceived risk | | 1 | .772** | .086** | .041 | -.031 | .390** | -.067* |
| **4** | Knowledge of Traffic Rules | | | 1 | .023 | .017 | -.023 | .364** | -.068* |
| **5** | Road Distractions | | | | 1 | .142** | .143** | .057 | .105** |
| **6** | Traffic Violations | | | | | 1 | .755** | .216** | -.014 |
| **7** | Errors | | | | | | 1 | .166** | -.022 |
| **8** | Positive Behaviors | | | | | | | 1 | -.050 |
| **9** | Walking Crashes (5 years) | | | | | | | | 1 |

*Notes:* ** Correlation is statistically significant at $p < .01$; * Correlation is statistically significant at $p < .05$.

walking crashes ($r = 0.105$**). Participants committing more violations also committed more errors ($r = 0.755$**), and, on the other hand, performed more positive behaviors ($r = 0.216$**). Finally, errors positively correlated with positive behaviors ($r = 0.166$**). The full set of correlations is presented in Table 4.

### 4.3. Age-based comparative analyses: walking-related factors and behaviors

With the aim of comparing walking-related factors and behaviors of pedestrians from different age segments (young people, adults, and aging adults), Brown-Forshyte (B–F) comparative tests (robust mean analyses) were conducted, unveiling significant dissimilarities, as shown in Table 5. Overall, B–F outcomes suggest that there are statistically significant differences exist among the three age groups in terms of walking exposure, perceived risk, traffic violations, and errors (risky walking behaviors), but also in the number of walking crashes suffered in the last 5 years. No significant differences were obtained in the case of traffic-rule knowledge, road distractions, nor positive behaviors.

#### 4.3.1. Age-based Post-Hoc comparisons

In order to assess particular mean differences in regard to the scores obtained by the different study variables between two age-based groups, Tukey's HSD Post-Hoc analyses with a 95 % level of confidence' CIs were carried out.

The significant results, i.e., specific age-based differences, show that young pedestrians (aged under 25) report key differences with (*i*) adults (aged between 26 and 50) in terms of weekly walking exposure ($M_{dif} = 2.10$*; higher for younger pedestrians), perceived risk ($M_{dif} = -0.21$*; higher for adults), traffic violations ($M_{dif} = 0.19$*; higher for younger participants); and (*ii*) aging adults (over 51) in terms of both errors ($M_{dif} = 0.20$*) and traffic violations while walking ($M_{dif} = 0.39$*), similarly higher for younger pedestrians in both cases.

On the other hand, only one significant difference was found when comparing adults and aging adults, and it corresponds to traffic violations ($M_{dif} = 0.21$*), with aging adults being those who perform significantly fewer deliberate risky behaviors while walking. No significant difference was observed in the case of factor 3 of the WBQ (positive behaviors) across the three groups. The full set of Post-Hoc's results is available in Table 6 and can be graphically appreciated in Fig. 2.

## 5. Discussion

This study aimed at, firstly, performing and presenting the validation of the WBQ (Walking Behavior Questionnaire) among a nationwide sample of Dominican pedestrians and, secondly, at assessing the age-related differences in walking-related patterns and self-reported walking behaviors in a nationwide sample of Dominican pedestrians. Hence, the discussion of the findings will be guided by these two purposes, as can be seen below.

**Table 5**
Descriptive data and Brown-Forshyte (B–F) robust mean comparisons. Categorical factor: Age group.

| Study Variable | Age Group | Mean | SD[1] | SE[2] | 95 % CI[3] | | Brown-Forshyte (B–F) test | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lower | Upper | Statistic[4] | df1 | df2 | Sig.[5] |
| Weekly Walking Exposure | Young People | 11.72 | 13.44 | .64 | 10.47 | 12.97 | 3.101 | 2 | 491.76 | <.05 |
| | Adults | 9.62 | 12.27 | .57 | 8.50 | 10.74 | | | | |
| | Aging Adults | 10.07 | 13.00 | 1.19 | 7.71 | 12.43 | | | | |
| Knowledge of Traffic Rules | Young People | 2.83 | 1.10 | .05 | 2.73 | 2.93 | 1.550 | 2 | 435.03 | .213 |
| | Adults | 2.97 | 1.15 | .05 | 2.86 | 3.07 | | | | |
| | Aging Adults | 2.88 | 1.23 | .11 | 2.66 | 3.10 | | | | |
| Perceived Risk | Young People | 2.79 | 1.12 | .05 | 2.69 | 2.89 | 4.305 | 2 | 447.39 | <.01 |
| | Adults | 3.00 | 1.12 | .05 | 2.90 | 3.10 | | | | |
| | Aging Adults | 2.78 | 1.20 | .11 | 2.56 | 3.00 | | | | |
| Road Distractions | Young People | 4.97 | 2.18 | .10 | 4.76 | 5.17 | 2.143 | 2 | 391.20 | .119 |
| | Adults | 5.11 | 2.46 | .11 | 4.89 | 5.34 | | | | |
| | Aging Adults | 4.58 | 2.72 | .25 | 4.09 | 5.07 | | | | |
| Traffic Violations | Young People | 1.17 | .72 | .03 | 1.10 | 1.24 | 15.790 | 2 | 543.02 | <.001 |
| | Adults | .98 | .81 | .04 | .91 | 1.06 | | | | |
| | Aging Adults | .77 | .72 | .07 | .64 | .91 | | | | |
| Errors | Young People | .79 | .80 | .04 | .72 | .87 | 3.332 | 2 | 595.92 | <.05 |
| | Adults | .71 | .87 | .04 | .63 | .79 | | | | |
| | Aging Adults | .59 | .75 | .07 | .46 | .73 | | | | |
| Positive Behaviors | Young People | 2.30 | 1.20 | .06 | 2.19 | 2.41 | .257 | 2 | 449.36 | .773 |
| | Adults | 2.26 | 1.29 | .06 | 2.14 | 2.38 | | | | |
| | Aging Adults | 2.22 | 1.33 | .12 | 1.98 | 2.46 | | | | |
| Walking Crashes (5 years) | Young People | .29 | .98 | .05 | .20 | .38 | 3.028 | 2 | 1013.51 | <.05 |
| | Adults | .31 | .93 | .04 | .23 | .40 | | | | |
| | Aging Adults | .13 | .36 | .03 | .06 | .19 | | | | |

*Notes:* [1]Standard Deviation; [2]Standard Error; [3]Confidence Interval at 95 %; [4]Asymptotically distributed (F); [5]p-value obtained for B–F Robust Tests of Equality of Means.

**Table 6**
HSD (Tukey) Post-Hoc tests for comparing variable scores between paired age-based groups.

| Dependent Variable | Group (I)[1] | Group (J)[2] | Diff. (I-J)[3] | SE[4] | Sig.[5] | 95 % CI[6] | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Weekly Walking exposure | Young People | Adults | 2.10* | .86 | .04 | .09 | 4.11 |
| | | Aging Adults | 1.65 | 1.33 | .43 | −1.47 | 4.77 |
| | Adults | Young People | −2.10* | .86 | .04 | −4.11 | -.09 |
| | | Aging Adults | -.45 | 1.32 | .94 | −3.56 | 2.66 |
| | Aging Adults | Young People | −1.65 | 1.33 | .43 | −4.77 | 1.47 |
| | | Adults | .45 | 1.32 | .94 | −2.66 | 3.56 |
| Knowledge of Traffic Rules | Young People | Adults | -.14 | .08 | .17 | -.31 | .04 |
| | | Aging Adults | -.05 | .12 | .90 | -.33 | .23 |
| | Adults | Young People | .14 | .08 | .17 | -.04 | .31 |
| | | Aging Adults | .09 | .12 | .74 | -.19 | .36 |
| | Aging Adults | Young People | .05 | .12 | .90 | -.23 | .33 |
| | | Adults | -.09 | .12 | .74 | -.36 | .19 |
| Perceived Risk | Young People | Adults | -.21* | .07 | .01 | -.39 | -.03 |
| | | Aging Adults | .01 | .12 | 1.00 | -.26 | .28 |
| | Adults | Young People | .21* | .07 | .01 | .03 | .39 |
| | | Aging Adults | .22 | .12 | .14 | -.05 | .49 |
| | Aging Adults | Young People | -.01 | .12 | 1.00 | -.28 | .26 |
| | | Adults | -.22 | .12 | .14 | -.49 | .05 |
| Road Distractions | Young People | Adults | -.14 | .16 | .63 | -.51 | .23 |
| | | Aging Adults | .39 | .25 | .26 | -.19 | .96 |
| | Adults | Young People | .14 | .16 | .63 | -.23 | .51 |
| | | Aging Adults | .53 | .24 | .08 | -.04 | 1.10 |
| | Aging Adults | Young People | -.39 | .25 | .26 | -.96 | .19 |
| | | Adults | -.53 | .24 | .08 | −1.10 | .04 |
| Traffic Violations | Young People | Adults | .19* | .05 | .00 | .07 | .31 |
| | | Aging Adults | .39* | .08 | .00 | .21 | .58 |
| | Adults | Young People | -.19* | .05 | .00 | -.31 | -.07 |
| | | Aging Adults | .21* | .08 | .02 | .03 | .39 |
| | Aging Adults | Young People | -.39* | .08 | .00 | -.58 | -.21 |
| | | Adults | -.21* | .08 | .02 | -.39 | -.03 |
| Errors | Young People | Adults | .08 | .06 | .27 | -.04 | .21 |
| | | Aging Adults | .20* | .09 | .05 | .00 | .40 |
| | Adults | Young People | -.08 | .06 | .27 | -.21 | .04 |
| | | Aging Adults | .12 | .09 | .36 | -.08 | .32 |
| | Aging Adults | Young People | -.20* | .09 | .05 | -.40 | .00 |
| | | Adults | -.12 | .09 | .36 | -.32 | .08 |
| Positive Behaviors | Young People | Adults | .04 | .08 | .86 | -.15 | .24 |
| | | Aging Adults | .08 | .13 | .79 | -.22 | .39 |
| | Adults | Young People | -.04 | .08 | .86 | -.24 | .15 |
| | | Aging Adults | .04 | .13 | .95 | -.26 | .34 |
| | Aging Adults | Young People | -.08 | .13 | .79 | -.39 | .22 |
| | | Adults | -.04 | .13 | .95 | -.34 | .26 |
| Walking Crashes (5 years) | Young People | Adults | -.02 | .06 | .92 | -.16 | .12 |
| | | Aging Adults | .17 | .09 | .18 | -.05 | .39 |
| | Adults | Young People | .02 | .06 | .92 | -.12 | .16 |
| | | Aging Adults | .19 | .09 | .11 | -.03 | .41 |
| | Aging Adults | Young People | -.17 | .09 | .18 | -.39 | .05 |
| | | Adults | -.19 | .09 | .11 | -.41 | .03 |

*Notes:* [1]Reference Group; [2]Contrasting Group; [3]Mean Difference; [4]Standard Error; [5]p-value; [6]Interval at 95 % of Confidence; *The mean difference was significant at $p < .05$.

### *5.1. Validity and value of the WBQ for measuring pedestrian behavior*

For what concerns the first objective, we have previously mentioned how important it is to preliminarily assess the psychometric properties of the measurement tools used for evaluating road behaviors under the behavioral questionnaire paradigm. In this regard, the obtained results support the idea that the WBQ has a dimensional structure and reliability that are adequate to ensure a psychometric value, as well as to measure both risky and positive walking behaviors in this population. Apart from presenting considerably good fit coefficients, the Walking Behavior Questionnaire scored high consistency indexes (all $\alpha > 0.89$, and CRIs $>0.90$) in all its core dimensions, and reasonably good factor loads both at the exploratory and the confirmatory factor analyses were observed in its 30 original items, with lambda values (factor loadings) ranging from ranging $[0.396 < \lambda < 0.863]$. Therefore, and bearing in mind its accordance to the previous empirical applications of the tool in other countries, the WBQ can be considered adequately adjusted to its theoretical latent variable model, with a plausible and considerably parsimonious three-dimension structure: traffic violations, errors, and positive behaviors, as initially suggested during its validation among Spanish pedestrians (Useche et al., 2020 and 2021b).

Also, the presented results follow the shared theoretical background of other self-reported instruments that are grounded in the

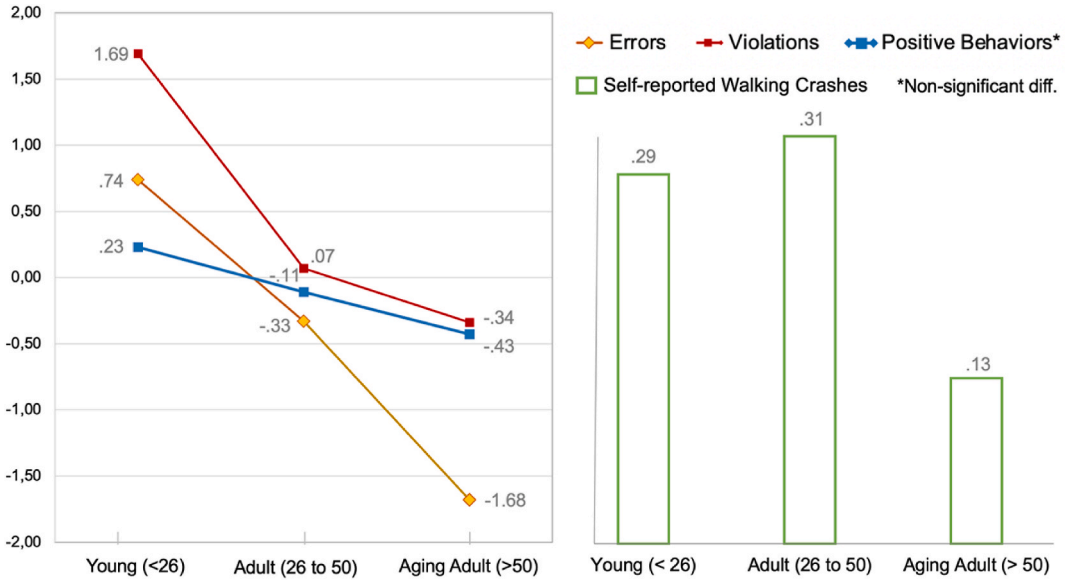


**Fig. 2.** Graphical trends found for walking behaviors: traffic violations, errors, and positive behaviors (standardized values - left) and self-reported walking crashes (right) among the three age-based groups of Dominican pedestrians.

behavioral questionnaire (BQ) perspective and measure road safety behaviors, differentiating between intentional and unintentional risky conducts (Deb et al., 2017; Hezaveh et al., 2018; Reason et al., 1990; Useche et al., 2018a). It is essential to bear in mind the distinction between voluntary (violations) and involuntary (errors) risky behavior when promoting secure conduct through traffic law enforcement, policymaking, education in road safety, and other social-based issues (Martí-Belda et al., 2019).

Also, talking about the correlations observed between WBQ factors and further walking-related variables, interesting results have been observed. First of all, the pedestrians' perceived risk and self-reported rule knowledge were significantly related to their protective behaviors, but (more important as a visible outcome) with the fact of reporting fewer walking crash as well, as observed in some other previous studies (Deb et al., 2017). Conversely, and as was expected, road distractions were positively associated with further risk-related variables, such as traffic violations, errors, and walking crashes, as reported in the existing literature (Wells et al., 2018). It is also worth highlighting that traffic violations were significantly correlated with errors and positive behaviors. This suggests the non-excluding character of risky and positive deliberate behaviors if we consider that new approaches on *positive road behavior* state that its meaning cannot be conceived as the mere nonexistence of risky conducts, but rather as other types of measures and habits contributing to avoiding road risks and pre-crash scenarios (Özkan and Lajunen, 2005; Yu et al., 2020).

Another important finding is that errors (unintentional risky walking behaviors) were significantly associated with positive behaviors. To understand this, it is important to be aware of the nature of positive behavior, which is conscious and proactive, while errors on the road might be rather associated with individual skills used to adequately perform (in this case) walking. However, it is important to consider that recent evidence shows that errors likely constitute the main behavioral contributor to walking crashes (Useche et al., 2020; Yu et al., 2020; Yue et al., 2020) and that emerging issues related to walking safety research (e.g., walking under the influence, or ITC device' using while walking) might contribute to worsening the problem of walking errors (Oviedo-Trespalacios et al., 2021; 2019; Useche et al., 2021).

### 5.2. *What were the "most frequent" walking misbehaviors of dominican pedestrians?*

As it can be seen in Table 3, the main traffic violations reported by participants were: walking at different paces than the rest of the pedestrians (e.g., running and zigzagging among people; items 6, 9, and 16); not respecting the traffic lights and signals, and walking on the driveway (items 1, 2, and 3), as well as using the cellphone while walking (items 11 and 14). Precisely, the last one has been recently documented as not only a frequent behavior but also a contributor to falls and traffic crashes suffered by both motorized (*i.e.*, drivers) and non-motorized (*i.e.*, cyclists and pedestrians) road users (Oviedo-Trespalacios et al., 2019; Young et al., 2020).

Secondly, the most frequently reported errors while walking among Dominican pedestrians were those related to their problematic interaction with obstacles on the road and with other road users, mainly associated with attention lapses, coherent with what previously found in similar researches performed in other countries (Useche, Hezaveh, Llamazares & Cherry, 2021). In this regard, it is worth remembering that walking errors (second factor of the WBQ) were closely correlated with distracting sources. Generally, distraction and other forms of inattention have been linked with errors on the road and, subsequently, safety-critical situations (Cinnamon et al., 2011; Useche et al., 2020).

Finally, positive behaviors consist of cautious walking habits that can prevent individuals from suffering a walking crash, especially since they can reduce pre-crash scenarios (Yue et al., 2020), and they had a homogenously high self-reported score (means ranged

between [2.19–2.38]). The most frequently reported protective habits were looking at both sides of the road before crossing, even when the subject had the preference (item 27) and walking on the right side (item 29). Hence, it is worth discussing this fact in the glance of the common method biases, as it can be seen in the "Limitations of the Study" section. Nevertheless, it draws out attention to how, although usually inter-subject differences are observed in this regard, there were no clear patterns (significant differences, for instance, in terms of age) in regard to positive behaviors performed by pedestrians in the Dominican Republic, as it will be discussed in the next section.

### 5.3. Age-based differences: are aging adults the "safest" pedestrians?

Regarding the age-based differences in walking patterns and self-reported behaviors, young people reported walking significantly more hours a week than adults, as found in previous research (Paul et al., 2019), which could be considered an *invigorating* indicator for keeping up with the promotion of active traveling among young people. However, if poorly planned or implemented, pedestrians will continue engaging in risky behaviors or be exposed to unsafe infrastructure, ultimately increasing road trauma (Möller et al., 2020; Reis et al., 2013).

It is also important to consider that these relatively high levels of walking could be the product of limited access to motorized transport due to socio-economic reasons, which makes it even more important to develop systemic strategies to promote safe walking among young people. In terms of weekly walking, it is attention-worthy how aging adults (who seem to be the most "well-behaved" age group) tend to walk more than adults aged between 26 and 50.

Furthermore, older pedestrians have shown higher degrees of knowledge of traffic norms applied to walking, and it is worth remembering that (coherently) pedestrians' age was negatively correlated with traffic violations and errors. In this regard, significantly fewer violations were reported by aging adults than by other adults and young people, and also that adults reported fewer violations than young people.

Even though psychomotor skills are not expected to remain the same throughout life and could influence error rates, aging adults reported statistically fewer errors while walking, especially if compared to pedestrians under 26 years of age. Although no prior investigations have encountered any significant correlations between age and traffic rule knowledge (Tajvar et al., 2015), other studies have reported more risky behaviors -including errors-in younger individuals, which also suggests that road safety education improves the knowledge of subjects on traffic norms (Alonso et al., 2018).

Finally, it is worth remarking that no significant differences in terms of positive behaviors were found among pedestrians when segmented by age group (see Tables 4–6). These behaviors appear to be more culturally specific rather than age-specific. In this regard, previous expert literature reported that the amount of road safety-related education and formation typically given to pedestrians (e.g., along their schooling process) is greater in Hispanic countries (such as Spain) than in Latin American LMICs (Alonso et al., 2018; Useche et al., 2020).

Besides, the homogeneity in positive behaviors across age groups could be explained by the absence of Road Safety Education (RSE), which generally contributes to the development of "positive" behavioral skills in LMICs if designed, implemented, and systematically assessed, as some recent studies have highlighted (INTRANT, 2020a, 2020b; Adlakha et al., 2018). Hence, it is important to consider the need of developing further strategies to create and promote protective walking-related habits that may foster user-based skills aimed at preventing walking crashes related to risky road behaviors.

### 5.4. Limitations of the study and future directions

The present investigation was theoretically funded, using the evidence retrieved from a substantially large sample from the Dominican Republic. All the information was cautiously collected, managed, and examined, considering the most appropriate statistical procedures and parameters for each one of the analyses presented. Nevertheless, a self-report methodology was used, and, thus, certain biases may affect the obtained results.

First of all, the CMBs (also known as "common method biases") associated with self-reports might cause partakers to answer with convenience, notably in terms of public behavior and conducts. Regarding this, the hereunder listed details were highlighted in the survey: *a)* the data protection and anonymity; *b)* the nonexistence of appropriate/non-appropriate responses, therefore encouraging subjects to give honest responses with actual significance for the research purpose, and *c)* the exclusively scientific background of the objective of the data collection. Secondly, gender-based studies may be interesting for characterizing the walking behavioral patterns of each population.

Finally, it is worth highlighting the advantages of using wide sample sizes when carrying out predictive models for assessing the possible explanatory role of variables such as the age of the population and their mental health indicators on walking behavior.

## 6. Conclusions

This study is the first empirical research assessing walking risky and positive behaviors under the behavioral questionnaire paradigm in the Dominican Republic. It presents the validation of a questionnaire to assess walking behavior in the Dominican Republic. Bearing in mind the positive results obtained, this research provides the authorities of this, and other countries of the region and/or with similar socio-economic features, with a tool to evaluate their pedestrian behavior (WBQ) and considering the results, being able to promote safety policies.

Regarding the specific sample analyzed, it is worth highlighting the age-based differences in risky walking behaviors, but not in

positive behaviors, among Dominican pedestrians. This could provide a strong background for the public administration to use this tool in the assessment of behavioral patterns of pedestrians in consideration of demographic factors, and to perform studies in other countries of the region, whose pedestrian crash records are similarly concerning.

In addition to its validity and multiple practical applications for behavioral-based pedestrian safety research, the WBQ could also be used to enhance the targeting of key road risky behaviors, so that they could be addressed through (e.g.) road safety education policies and urbanistic interventions, contributing to strengthening walking safety and decreasing the burden of traffic crashes involving pedestrians in the Dominican Republic.

### 6.1. Directions for further research

Bearing in mind the relevant results encountered in this study, the authors would like to provide a few bullet points on possible directions in future research:

- This study details the validation of the Walking Behavior Questionnaire (WBQ) in the Dominican Republic, also constituting the first similar nationwide behavioral questionnaire-based research on pedestrian safety. Although this can be interpreted as a *Unique Selling Proposition* (USP – that the authors believe it is), this should not remain the unique study addressing pedestrian behavior in the country.
- Despite the difficulties and significant costs that it may represent, further research addressing other research problems and approaches (e.g., mixed methods) useful to address walking safety would contribute to depict new insights on this field, given the importance that walking trips (and their safety) have in a country such as the Dominican Republic.
- This is a Low-Middle Income Country (LMIC) that keeps many similar characteristics to others in the region in economic, political and social terms. However, cultural issues and specific dynamics remain key issues potentially influencing walking behavior, making it important to further empirically researching in these other countries instead of overgeneralizing the results from the present study. In other words, and as discussed above, effective interventions and policy guidelines may get enriched from a good knowledge of the specific context from each country, and other researchers are encouraged to contribute to filling up the research gaps of many LMICs in this and other regions.

## Author contribution statement

For this study, S.A.U. conceived and designed the study setting and research tools; F.A. supervised the research and supported the data collection; S.A.U. carried out the conceptualization, methodology, investigation, and data curation processes; S.A.U. and J.G. analyzed the data (formal analysis); S.A.U. and O.O. contributed reagents/materials/software/analysis tools; S.A.U. and O.O. wrote and revised the paper.

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## Declaration of competing interest

The authors declare no competing interests.

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