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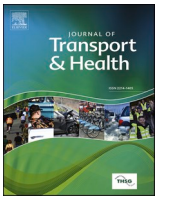

Who wants to change their transport habits to help reduce air pollution? A nationwide study in the caribbean

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ABSTRACT

Given its detrimental role in sustainability and community health, air pollution constitutes a global challenge nowadays, and urban transport has been proven to be a key contributor to the problem. At a population level, and especially in Low- and Middle-Income Countries (LMICs), measures for reducing contamination usually require deep behavioral changes and "sacrifices" among individuals who may (or may not) be willing to modify their habits.

Objective: This research, conducted in the Dominican Republic, aimed to assess the effect of individual factors, transport habits, and pollution-related concerns on the individual's will to act to reduce air pollution.

Methods: For this study, we counted on the participation of a nationwide sample of 1250 adult Dominican citizens (50% females; 50% males) with a mean age of 36.7 years.

Results: Overall, Dominicans tend to self-report a considerably high concern about transport air pollution, especially among women and inhabitants of urban areas. The willingness to act was significantly influenced by demographic factors, travel frequency, and pollution-related concerns. Also, both individual and socially perceived environmental concerns exert a statistical mediation between individual factors and the self-reported predisposition to help reduce pollution through behavioral changes.

Conclusions: The results of this study suggest that both individual and social pollution-related concerns influence the personal willingness to act against air pollution, although in different ways. Interestingly, while peoples' own concerns increase their willingness to act, solely perceiving a greater collective concern seems to dispirit individuals' will to take further action. Accordingly, developing further individual and collective initiatives to increase pollution-related responsiveness could be essential to face this growing problem in the Dominican Republic and the Caribbean.

1. Introduction

Among all the Sustainable Development Goals (SDGs) proclaimed by the 2030 Agenda for Sustainable Development, the fight against climate change stands out (United Nations Organization, 2015), especially as for the contribution of urban areas –which are commonly the most polluting– to the preservation of the environment (United Nations Organization, 2020; WMO, 1979; White, 1979).

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From a transport-focused point of view and given the close relationship between mobility and CO2 emissions, several agencies have suggested that changing people's transportation patterns might help to alleviate air pollution and prospectively improve the population's quality of life, happiness, and welfare United Nations Organization, 2020; WHO, 2018; IPCC, 2014). Interestingly, among countries largely depending on tourism (such as the Dominican Republic), air pollution has been found to make larger urban areas less attractive for tourists, the reason why tourism tends to move –except in extreme need– to less populated areas (Churchill et al., 2022; Moore, 2010; Spencer, 2019).

At the community level, recent studies have shown a relative degree of awareness of mid-term forecasts on air pollution and climate change, but further work is still needed amid a challenging panorama (Navarro, 2017; Ramírez et al., 2019). On the one hand, alongside several socioeconomic disparities, daily travel behaviors in Low and Middle-Income Countries (LMICs) remain highly dependent on motorized transport, and a part of the population is still reluctant to consider shifting to other means of travel (Cordero, 2012). On the other, the evidence suggests that really effective actions aimed at relieving climate change are not limited to awareness, but require a certain degree of will from people, since decarbonizing their mobility often implies substantial behavioral changes (Becerra et al., 2013).

1.1. *Mobility, pollution, people's awareness and willingness*

Almost all literature sources agree on the fact that changing daily transportation patterns is a key to boost environmental sustainability, as well as energy efficiency. For instance, during the last decades, the proportion of overall energy used by road transport increased from 23% (1971) to 29%, with a subsequent impact on air pollution rates (IEA, 2019). In this regard, and apart from invigorating modal shifts, and improving public transport offering, previous studies have highlighted the value of current Communication/Connected Technologies (ICTs) in reducing pollution, for instance, reducing unnecessary trips, using shared transport modes, and increasing remote work offer (Arnfalk, 2002; Hu et al., 2021; Useche et al., 2022).

At a population level, and apart from developing an effective climate policy (i.e., systematic actions to mitigate and adapt to climate change), invigorating people's adherence to it remains one of the biggest current challenges to strengthen the reduction of air pollution in most countries (Rains et al., 2019). According to previous studies, the social representation of neighborhood, town and country-level pollution, as well as its perceived risk for health and welfare, becomes fundamental to involve individuals in this type of measures and, subsequently, to improve their outcomes (Huang and Yang, 2020). Accordingly, studies such as Wise et al. (2020) have remarked that the success of the actions aimed at mitigating climate change mostly depends on the population's knowledge, awareness of the issue, and attitudinal factors essential to modifying their behavior.

Moving on to the urban mobility sphere, different and complementary strategies have been suggested by literature to achieve the purpose of increasing the number of daily *non-* or *less-polluting trips*, among which communicative actions aimed at raising public awareness (Faus et al., 2021; Henry and Gordon, 2003; Riley et al., 2021), enforcing transport cleanness with technology (Hu et al., 2021), increasing the mass transport offer (Ceder, 2021), and even improving the quality and satisfaction with *sustainable* trips (Fernández-Heredia et al., 2016) stand out.

1.2. *Contextual hints on urban mobility and pollution in the region*

In the Dominican Republic, fossil energy sources have been argued to be the main producers of greenhouse gases, systematically increasing environmental pollution in cities and towns. More specifically, the field of transport represents 41% of the useful energy used in consumer sectors (PNUD & GEF, 2018). It is estimated that emissions from vehicles represent approximately 48% of the total amount generated by fossil fuel consumption, which is accelerating climate change (Spomenka and Angelov, 2017). For this reason, from the Dominic Republic institutions, efforts are being made to reduce air pollution produced by motor vehicles through laws and measures that can improve the country's mobility, encouraging sustainable transportation (Alonso et al., 2021a; Law, 2017 nº 63-17).

In recent years, the National Institute of Public Health (INSP), in collaboration with the Pan American Health Organization (PAHO), conducted a study on air quality in Latin America and the Caribbean (see Riojas-Rodríguez et al., 2016). One of the main findings was that most of the cities assessed had levels of inhalable particulate matter above the values considered acceptable in international guidelines. In addition, there was a notable lack of information on this problem. In fact, only 77 cities out of the 17 countries analyzed had official data on pollutants concentrated in the atmosphere, and in some cases (including the Dominican Republic), data recording was incomplete. Specifically in Santo Domingo, the largest city, there is no programme for monitoring and recording air conditions, despite high concentrations of inhalable particulate matter (especially PM2.5) being detected. According to government sources, the main causes of this situation are pollutant vehicle emissions from the combustion of gasoline and diesel, as well as (outside the sphere of mobility) energy generation activities and the burning of solid waste (DGII, 2016).

In terms of vehicle fleet, the latest data indicate that there are about 4,842,367 registered private vehicles in the Dominican Republic, an increase from the previous year (DGII, 2022). In addition, approximately 52% of this fleet comprises vehicles over ten years old that use fossil fuels. In vehicle-owning terms, 60% of the population owns a private vehicle, so it is estimated that, daily, motor vehicles alone emit around 90, 324, 100 kg of carbon monoxide (CO) into the environment. However, more than half of the citizens make their regular trips by public transport (INTRANT, 2020). In this regard, the most commonly used means of transport are public buses and motorcycle taxis. Although a priori, the use of public transport is positive for mobility and pollution rates, this information needs to be put into context. In Dominican cities, both public buses and motorcycle taxis are poorly managed means of transport mostly without defined stops or fixed routes and timetables (Alonso et al., 2022). This means that they often circulate in oversupply, making stops in areas that obstruct the passage of other vehicles, and causing major traffic jams and congestion, thus increasing air pollutant

emissions and reducing their potential to strengthen sustainable mobility (DGII, 2022).

The situation in which the country was involved caused the Dominican Republic to make a commitment in 2015 to reduce its greenhouse gas emissions by 25% by 2030. That same year, the first imports of clean technology hybrid vehicles were achieved with the support of Law No. 103-13 on Incentives for the Importation of Non-Conventional Energy Vehicles (2013). However, little progress has been made in this line, with the number of electric or hybrid vehicles registered in the vehicle fleet being very residual (DGII, 2022). Despite this, the National Institute of Transit and Land Transport (INTRANT) and other entities responsible for transport in the Dominican Republic have developed specific initiatives and support to increase the hybrid or electric public transport fleet, and work on the creation of the first electric corridor in the country, to be located in Santo Domingo. In addition, they are working on the adaptation of various areas and regions of the country to allow the circulation of these vehicles. On the other hand, INTRANT has also announced financial aid to promote access to zero-emission motorcycles for passenger transport, including motorcycle taxis.

1.3. Study aims

The core aims of this study were: first, to assess the effects of demographic factors, trip patterns, and pollution-related perceptions on the individual willingness to take actions aimed at fixing the problem in a nationwide sample of Dominican citizens. Secondly, we aimed to test whether pollution concerns mediate between individuals' demographic factors, travel habits, and their self-reported willingness to act to reduce air pollution.

1.4. Theory-building of study hypotheses

Based on the available literature and coherently with the two study aims, the following two core hypotheses were developed.

Hypothesis 1. Demographic factors, transport habits, and the degree of interaction with Information and Communication Technologies (ICTs) and pollution-related concerns might significantly influence the Dominicans' willingness to take action to face the problem. This hypothesis is grounded on the following findings from previous studies:

- Educational status has been shown to have effects on the awareness of environmental problems, and predispose pro-environmental attitudes and behaviors. Previous studies conducted in other countries, such as Wang et al. (2022) and Yusuf and Fajri (2022), provide good evidence that focusing on the population's educational attainment would help to increase its levels of pro-environmental patterns at a population level.
- Current trip patterns of individuals (including trip modes and how often they use them) have been suggested to influence their pollution-related perceptions and will to partake in environmentally-friendly modal shifts, such as moving to public or active transportation (Borhan et al., 2014; Oviedo-Trespalacios et al., 2021). Moreover, studies conducted in Asian and Latin American countries endorse the assumption that transport means used by individuals, as well as those offered, are linked to their expectations of reduced pollution and shift willingness (Fan and Chen, 2020; Guzman et al., 2023).
- Individuals' degree of interaction with Information and Communication Technologies (ICTs) has been claimed to modulate their likelihood to shift to active transportation and road behaviors, since it would increase access to information, development of environmental concern, and willingness to act (Alonso et al., 2021; Perez-Ramos et al., 2021; Useche et al., 2021). For instance, recent studies such as Ai et al. (2021) and Xiao et al. (2022) suggest that access to the internet, social media, and other connected sources facilitates subjects' involvement in pro-environmental behaviors. Other studies, such as Becker et al. (2023) suggest that using technological advances in mobility such as wearable sensors may increase their concerns about air pollution and its potential health impacts, which could motivate protective action.
- Individual and perceived social concerns about air pollution stand out as key issues for explaining peoples' will for environmentally-related behavioral changes (Cruz and Manata, 2020; Latkin et al., 2021). Previous studies have highlighted that an increased environmental concern is associated with a greater likelihood to perform pro-environmental behaviors inside and outside the sphere of mobility, aimed at reducing pollution, global warming, and other current socially highlighted threats (Balundė et al., 2019; Manca et al., 2022).

Hypothesis 2. The degree of concern about air pollution may exert a statistical mediation between demographic and trip-related variables and individuals' self-reported willingness for action. In this regard, several studies have argued that even though factors such as education, access to information, and first-hand knowledge of environmental issues (e.g., perceiving them as a result of frequently using polluting transport means) may increase awareness, action could not be necessarily triggered by this (Lv et al., 2021; Shen and Wang, 2022). For instance, awareness-raising campaigns, apart from being well-recalled by people, seem to have a very limited effect on their actual behavior (Pol et al., 2001; Faus et al., 2023). Instead, although information remains essential to explain environmentally-friendlier behaviors, evidence suggests that psychosocial factors such as psychological concern would increase individuals' step into action to face phenomena such as pollution and climate change (Latkin et al., 2021).

This way, this research wants to contribute to filling the existing knowledge gap on user-based transport pollution-reducing behaviors in Caribbean countries as, to the best of our knowledge, no previous research has addressed this issue from a psychosocial and attitudinal approach in the region.

2. Methods and materials

2.1. Participants and procedure

The study sample comprised 1250 individuals (general population) from the Dominican Republic, with a proportional sample distribution to the national census. Half of them were females, and half were males. The demographic variables of reference were: gender, age (always ≥18), province, and habitat. According to the type of road user and the possibility that they may travel daily by more than one means of transport, 61% use private vehicles for their regular journeys as drivers or passengers, 21.8% travel daily by public transport, and 67% usually commute by walking. The full set of sample demographics is presented in Table 1.

To achieve nationwide representativeness, the minimum sample size needed was estimated at $n = 680$ individuals, assuming a level of confidence of 95%, a maximum margin of error of 5% ($\alpha = 0.05$), and a beta (β) of 0.20, which allows for an 80% power. Although this sample size did not account for different types of drivers (professional (35.1%) and non-professional (64.9%), which were anyway distributed proportionally to population data), the sample size was substantially increased to represent these groups better on descriptive terms.

Participants responded to the survey in a face-to-face approach, using computer-assisted interviews at public locations in both urban and rural areas, covering the 31 different regions of the Dominican Republic. There was no prior contact with participants. The data collection took place alongside the National Survey on Mobility of the Dominican Republic 2019, specifically between November 24th and December 7th (INTRANT, 2020).

2.2. Description of the questionnaire

The questionnaire presented to participants included questions related to urban mobility phenomena. For this version of the national survey, some relevant topics in light of the Sustainable Development Goals (SDGs) for 2030, adopted during the last lustrum by the United Nations, were emphasized. Specifically, topics such as daily mobility habits, use of public and private transportation, active mobility (e.g., walking and cycling), air pollution, road safety problems and potential actions were addressed. In order to achieve the proposed objectives, the following variables were considered:

Sociodemographic variables and daily transport patterns: Age (continuous variable); Educational level (ordinal); City/town size (ordinal; grouped in accordance to the number of inhabitants).

Motorized and non-motorized trips: Average number of weekly trips performed by both motor and non-motorized means of transport.

Interaction with ICTs: the overall degree of interaction of participants with *Information and Communication Technologies* (ICTs; e.g., smartphones, tablets, navigators, wearables, and other internet-connected devices), measured in a single-item scale ranging from 1 (very scarce interaction) and 5 (very high interaction), previously used to assess the self-reported involvement on these technologies use (Useche et al., 2021).

Concern levels: these two variables were measured by means of a short set of 6 questions. This questionnaire used a scale between [0–10], where 0 = not concerned at all, and 10 = very much concerned. Two levels of analysis were defined.

1) *Own concern degree:* the extent to which individuals consider they are aware of the problem of air pollution caused by transport (3-items; $\alpha = 0.769$). *Example item: " to what extent are you concerned about the issue of pollution in cities?".*

Table 1
Sociodemographic data of the study sample.

Demographic feature		N	%
Gender	Male	625	50%
	Female	625	50%
	Total	1250	100%
Age group	18–24	260	20.6%
	25–34	311	24.7%
	35–49	356	29%
	50–64	221	17.5%
	≥65	102	8.1%
	Total	1250	100%
Do you drive a motor vehicle?	Yes	580	46%
	No	670	54%
	Total	1250	100%
Do you currently hold a driving license?	Yes	273	21.7%
	No	977	78.7%
	Total	1250	100%
Do you normally drive?	Yes	470	37.3%
	No	780	62.7%
	Total	1250	100%
Type of driver	Professional	202	35.1%
	Private	373	64.9%
	Total	575	100%

2) *Perceived social concern*: the extent to which individuals believe there is a concern about vehicle-related air pollution within their society (3-items; $\alpha = 0.815$). *Example item: "to what extent do you believe the members of your community mind about air pollution?".*

Willingness for action: This can be understood as the extent to which participants are willing to contribute to reducing atmospheric emissions through their own actions. This attitudinal factor was measured through a single item (i.e., *To what extent would you be willing to change your transport habits to reduce air pollution, even it that implies substantial changes in your daily mobility?*) using a scale ranging between 0 (not important at all) and 10 (very important).

2.3. Data analysis

For this study, descriptive analyses were carried out to describe and characterize the assessment of the proposed measures and the importance that the Dominican Republic's population gives to pollution in their country. Moreover, Pearson's correlations were used to establish possible statistical relations among the analyzed variables. Both Student's *T* and Welch's *T*-based robust tests were used to assess whether significant differences between population groups exist. Once the data were obtained, pertinent statistical analyses were carried out using © IBM SPSS (Statistical Package for Social Sciences), version 26.0.

Regarding the second objective of the study, Structural Equation Modeling (SEM) with maximum likelihood analyses (MLA) was carried out. The aim of this procedure was to statistically explain individuals' willingness to act to reduce air transport pollution on the basis of their demographic factors, ICT interaction, and transportation habits, used as predictors or exogenous variables. Paths were drawn in order to differentially study the effect of the study variables on (*i*) individuals' degree of concern for transport-related pollution, (*ii*) the perceived degree of concern in their society, and (*iii*) the importance attributed to taking actions to reduce air pollution caused by motor vehicles.

This confirmatory procedure was chosen bearing in mind the possibility of testing statistical mediations through hypothesis-based paths (Gunzler et al., 2013; Leth-Steensen and Gallitto, 2016), as well as to include both continuous and discrete (categorical and ordinal) factors in the model for estimating dependent variables (Rhemtulla et al., 2012). As for goodness of fit indexes, the model adequacy was weighed through different estimators, as suggested in specialized sources such as Hu and Bentler (1999). The criteria to determine a satisfactory model fit was defined by a CMIN/df ratio (between Chi-square value and degrees of freedom used) under 5; a set of fit indexes (Confirmatory Fit Index – CFI; Normed Fit Index – NFI; and Incremental Fit Index – IFI) greater than 0.900; and a Root Mean Square Error of Approximation (RMSEA) lower than 0.070. Differential cut-off criteria (significance levels) of $p < .05$, $p < .01$, $p < .001$ were applied. Structural Equation Modeling was carried out using AMOS software, version 26.0.

2.4. Ethics

As this was a study supported by the Dominican government, there was a maximum adherence to personal information handling protocols in compliance with the existing laws on data protection and ethical guidelines. Participants' involvement in this study was totally voluntary and anonymous. All participants gave their consent before participating in the study after the research staff provided them with an explanation of the research objectives and all the previously mentioned considerations.

The study was approved by the Ethics Committee of the Research Institute on Traffic and Road Safety of the University of Valencia (IRB approval number: HE0001241120).

3. Results and discussion

3.1. Descriptive outcomes

Overall, the descriptive outcomes of this study suggest that self-reported concern about transport-related air pollution seems considerably high, having reported an average value of $M = 8.81$ ($SD = 2.45$) for the case of the general population. However, there are also some key differences if the demographic profiles of inhabitants are considered. Namely, it was observed that women and inhabitants of urban zones manifest the highest levels of concern, as detailed in Table 2.

Coherently with the gender differences found, previous studies remark how environmental concern has been argued to be a highly *gendered* matter since various decades ago, with females predominantly (and consistently) showing greater levels of it, same as in previous studies (Arcury et al., 1987; Cruz and Manata, 2020). On the other hand, no significant differences were found when comparing individuals in accordance with either the type of vehicle they drive the most (if applicable), their main reason for driving, or depending on the most used transportation mode. In other words, scores tended to be homogeneous regardless of whether the person was a frequent driver, a pedestrian, or a public transport user.

In relation to the extent to which citizens believe that the levels of pollution produced by vehicles and circulation in cities should be controlled, the tendency is maintained both in the general results and depending on the sociodemographic variables of gender, age, and habitat, as shown in Table 3.

As for the second participants' habitat, inhabitants of urban areas comparatively self-reported greater degrees of environmental concern. This is coherent with the found in previous studies such as Satterthwaite (1993) and Zheng et al. (2019), which support the idea that, although there is more pollution in them, people living in cities tend to be more aware of the importance of environmental issues, something that does not occur to a similar extent in rural areas.

Also, although it is noteworthy that empirical evidence in this regard remains scarce among Low and Middle-Income Countries

(LMICs), whose gentrification tends to have particular dynamics according to contextual features and needs (Freitas et al., 2020), studies conducted in countries such as China (Liao et al., 2015) and Ghana (White and Hunter, 2009) remark the frequent lack of awareness on environmental pollution issues inside individuals' habitat, a phenomenon known as "environmental hyperopia" that, although present in both developed and developing countries, impairs both pro-environmental perceptions and behavioral outcomes (Gartin et al., 2020; Schultz et al., 2014).

3.2. Structural analyses

The resulting Structural Equation Model presented in Table 4 (graphically in Fig. 1), shows that the relationship between demographic factors and the willingness for action could be mediated by two variables related to awareness on the matter: citizens' own concern (above rows of Table 4) and the degree of concern perceived in society. All standardized parameter estimates are presented in Fig. 1, in which the unidirectional arrows indicate the direction of the explanatory relationship between the study variables included in the model.

3.2.1. Direct and indirect effects

As depicted in Table 4 (and Fig. 1, as a summary), **eleven direct effects** were significant. As initially hypothesized, both individuals' concern about pollution and the concern they perceive in society as a whole significantly influence their willingness to take action to reduce air pollution caused by motor vehicles.

Age positively and significantly predicted the degree of perceived social concern, but not the individuals' concern or willingness to act on vehicle-caused air pollution. Educational level exerts a positive effect on individuals' concern about pollution, but also on the need for action itself, i.e., individuals with a higher education degree are more aware of this matter, and they attribute more importance to actions against it.

Additionally, city/town size and income levels were found to negatively affect the individuals' concern about pollution. Regarding transportation habits, the frequency of both motorized and non-motorized trips positively affected the attributed willingness for action, although not on the perceived social or personal degree of concern. However, only a higher frequency of non-motorized trips (e.g., walking or biking) significantly predicted a higher degree of importance attributed to acting against this problem.

Finally, the degree to which individuals interacted with Information and Communication Technologies (ICTs) positively increased their concern about pollution and the attributed willingness for action, but not their perception of the social concern in this regard. In other words, perceived social concern seems not to be significantly influenced by users' degree of interaction with new technologies.

As for the case of significant effects mediated by other study variables, **three indirect effects** (total mediations) were found: firstly, the relationship between age and self-reported willingness for action was fully mediated by the degree to which Dominicans perceive that there is a social concern (among others) for vehicle-caused air pollution. In practical terms, a greater perceived social concern tends to uniformly predict a lesser (own) willingness for action. This interesting fact will be addressed below in the discussion.

In the second case, neither income level nor city/town size exerted a significant effect on the dependent variable (willingness for action), being rather fully mediated by the individual degree of concern about air pollution, whose relationship to the latter remains positive and significant, as shown in the "indirect effects" chart of Fig. 1.

3.3. Hypothesis-based outcomes

The aims of this study were twofold: first, to assess the effects of demographic factors, trip patterns, and pollution-related perceptions on the individual willingness to take actions aimed at fixing the problem in a nationwide sample of Dominican citizens (see *Hypothesis 1*); and second, to test whether pollution concerns mediate between individuals' demographic factors, travel habits, and

Table 2
Degree of concern about air pollution among Dominican citizens.

Factor		N	M[a]	SD[b]
Self-reported concern over air pollution [0–10]		1250	8.81	2.45
Demographic variables		N	M	SD
Gender* $t_{(1254.84)} = -2.82$; $p = .005$	Male	625	8.61	2.50
	Female	625	9.00	2.38
Habitat* $t_{(297.76)} = 2.69$; $p = .007$	Urban	1019	8.91	2.32
	Rural	231	8.35	2.93
	N	r[c]	*p-value*	
Age	1250	−.046	.104	

Notes for the table.
* Mean difference/correlation is significant at the level $p < .05$; ** Mean difference/correlation is significant at the level $p < .001$.
[a] M = Arithmetic mean.
[b] SD = Standard Deviation.
[c] r = Pearson's correlation coefficient [0–1].

Table 3
Perceived degree of how much pollution (produced by vehicles) should be controlled.

Factor		N	M[a]	SD[b]
To what extent do you consider that the levels of pollution produced by vehicles and circulation in cities should be controlled?		1250	8.83	2.33
Sociodemographic variables		N	M	SD
Gender* $t_{(1248.42)} = -2.60$; $p = .009$	Male	625	8.66	2.42
	Female	625	9.00	2.22
Habitat* $t_{(304.88)} = 2.75$; $p = .006$	Urban	1019	8.93	2.23
	Rural	231	8.41	2.69

	N	r[c]	*p-value*
Age*	1250	−.061	.030

Notes for the table.
* Mean difference/correlation is significant at the level $p < .050$; ** Mean difference/correlation is significant at the level $p < .001$.
[a] M = Arithmetic mean.
[b] SD = Standard Deviation.
[c] *r* = Pearson's correlation coefficient [0–1].

their self-reported willingness to act to reduce air pollution (see *Hypothesis 2*). This section has been structured in order to sequentially discuss the specific (and most relevant) findings gathered in regard to each one of them.

3.3.1. *Hypothesis 1: do individual factors and perception affect individuals' will to act?*

As for the first study aim, it was expected that demographic factors, transport habits, and the degree of interaction with ICTs and pollution concerns might significantly influence individuals' willingness to take actions aimed at facing the problem, a key attitudinal

Table 4
Variables included in the model, estimates, and significance levels of the SEM paths for explaining the subjective perception of the need for actions on urban pollution.

Model metrics

Test outcome: $x^2 = 13.444$; $p = .002$
Ordinal indices: NFI = .913; CFI = .933; IFI = .938 (all above .900)
Root Mean Squared Error of Approximation (RMSEA) = .043, $IC_{90\%}$ = [.030-.056] (maximum set at .060)
Minimum discrepancy: CMIN/df = 3.316 (assumed as optimal if < 5.0)

Variable			Std.P.C.[a]	S.E.[b]	C.R.[c]	*p*[d]
Age (years)	→	Own Concern	−.022	.005	−.737	.461
Educational level	→	Own Concern	.029	.037	.981	.327
Income level	→	Own Concern	−.052	.000	−1.842	*
City Size	→	Own Concern	−.083	.175	−2.984	**
Motorized trip frequency	→	Own Concern	−.017	.159	−.624	.533
Non-motorized trip frequency	→	Own Concern	.125	.022	4.415	***
Interaction with ICTs	→	Own Concern	.084	.023	3.001	**
Age (years)	→	Perceived Social Concern	.059	.043	2.013	*
Educational level	→	Perceived Social Concern	−.081	.333	−2.704	**
Income level	→	Perceived Social Concern	−.045	.000	−1.591	.112
City Size	→	Perceived Social Concern	.008	1.599	.297	.766
Non-motorized trip frequency	→	Perceived Social Concern	.004	.199	.155	.877
Motorized trip frequency	→	Perceived Social Concern	−.010	1.449	−.375	.707
Interaction with ICTs	→	Perceived Social Concern	.026	.212	.912	.362
Age	→	Willingness for Action	−.011	.004	−.396	.692
Educational level	→	Willingness for Action	.073	.032	2.648	**
Income level	→	Willingness for Action	−.021	.000	−.798	.425
City Size	→	Willingness for Action	−.039	.155	−1.497	.134
Non-motorized trip frequency	→	Willingness for Action	.107	.019	4.025	***
Motorized trip frequency	→	Willingness for Action	.112	.140	4.334	***
Interaction with ICTs	→	Willingness for Action	.134	.021	5.092	***
Own Concern	→	Willingness for Action	.291	.025	11.103	***
Perceived Social Concern	→	Willingness for Action	−.075	.003	−2.896	**

Notes for the Table.
*Path is significant at the level $p < .050$; ** Path is significant at the level $p < .010$; *** Path is significant at the level $p < .001$.
[a] Std.P.C. = Standardized Path Coefficients (can be interpreted as linear regression weights).
[b] S.E. = Standard Error.
[c] C.R. = Critical Ratio.
[d] *p*-value.

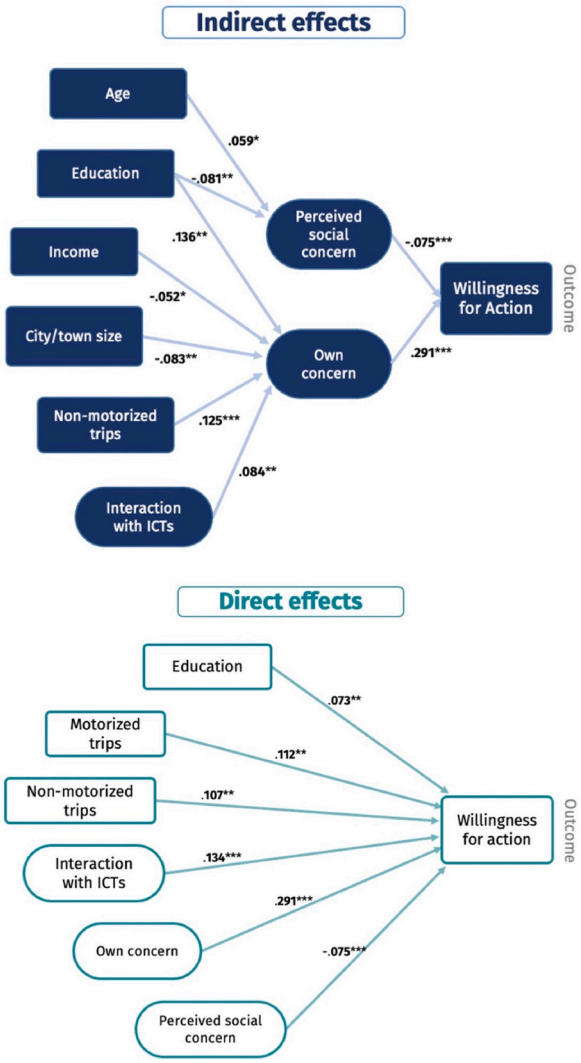

Fig. 1. SEM direct (above) and indirect (below) effects over "willingness for action". *Notes for the figure:* All solid lines represent significant paths (as shown in Table 4); ellipses represent inferred (latent) factors, while squares represent observed variables.

outcome. In this regard, the structural equation modeling procedure has shown theoretically parsimonious statistical effects on "willingness for action" have been found, among which there stand out:

Firstly, concern levels were significantly influenced by sociodemographic factors. For instance, and coherently with other studies, educational attainment has been found to be related to an increased level of environmental pollution-related own concern (Plombon, 2011; Wang et al., 2022). On the other hand, a greater frequency of non-motorized trips is significantly associated with a greater concern for pollution. This makes sense if it is considered that pedestrians and cyclists, despite being fewer pollution generators than motor vehicle drivers, tend to be those inhaling the most toxic particles condensed in the polluted air (Cepeda et al., 2017; De Nazelle et al., 2017). In addition, the literature supports that opting for sustainable modes of travel may be related to an increased concern about pollution and be a way to take action to reduce it (Rajé et al., 2018; Shi et al., 2017). Secondly, and as for willingness to act as direct predictors, both educational attainment and ICT interaction have shown a positive and significant effect (Faus et al., 2022). From an empirical point of view, the little existing data suggests that raising environmental concerns remains useful for raising positive behavioral changes, although only to a certain extent (Lee et al., 2015; Minelgaité and Liobikiené, 2021; Wang et al., 2022).

Further, it stands out that, although own concern levels were only significantly explained by the frequency of non-motorized trips, the willingness to act is also greater among individuals performing both non-motorized and motorized trips. Although the evidence in this regard is still scarce, some studies suggest that pro-environmental behaviors of motorized users can be triggered as a response to facing problems and challenges typical of the road environment (e.g., daily driving under adverse conditions), which can reduce psychological distance with environmental issues and increase motivation for seeking solutions and improvements (Ünal et al., 2018; Yang et al., 2022).

Also, it is worth remarking that in this study, pollution concerns were addressed from two levels: individual (i.e., how concerned our participants were), and social (i.e., to what extent they perceive others are environmentally concerned), finding that their effects indeed differ. On the one hand, greater degrees of own concern explain a greater willingness for action, coherently with previous studies addressing the coherence between perception/belief and attitude in environmental behavior settings (Yang et al., 2022). Overall, most of them associate perceiving environmental problems with having a more receptive, positive, or active attitude towards their solution, even if it implies individual efforts, restrictions, or even certain 'sacrifices' (Vassanadumrongdee and Matsuoka, 2005).

On the other hand, a greater perceived social concern was related to a lesser individual will to act. One possible interpretation of this phenomenon is that the belief of a concerned social group might enhance some *relaxation* at the individual level. This idea is in line with other studies finding a lesser sense of responsibility among people, assuming that "others will take care of it" for certain relevant social issues, including environmental affairs (Inoue et al., 2017; Ramírez et al., 2019). Also, there is a possible relationship with bystander bias, in which, in the face of a negative event, the more people are aware of the problem, the more likely it is that no one will act (Rubio-Martínez et al., 2019). Previous studies have argued that this particular issue can be considered somewhat *dangerous*, as it can produce the opposite effect to the one sought, leading to fewer and fewer people taking action against transport-related pollution (Shen, et al., 2018; Alonso et al., 2021b).

3.3.2. Hypothesis 2: does environmental concern mediate these relationships?

As a second study objective, this study aimed to test whether pollution concerns mediate between individuals' demographic factors, travel habits, and their self-reported willingness to act to reduce air pollution, hypothesizing that the degrees of concern about air pollution may exert a mediating role between demographic and trip-related variables and individuals' self-reported willingness for action.

In this sense, own pollution-related concern was the strongest mediator in these relationships, suggesting that increasing it would help to invigorate individuals' will to act in transport settings pro-environmentally. However, the value of this affirmation is relative, as it does not necessarily guarantee action. For instance, studies such as Badland and Duncan (2009) have suggested that despite recognizing the importance of pollution for health and the environment, this knowledge does not affect one's habitual movements, walks, or bike rides. Indeed, in some cases, air pollution has been found to be often considered a mere discomfort of which people tend to be aware, rather than an actual threat to health and welfare (Semenza et al., 2008). On the other hand, what the literature endorses the most is a greater likelihood for action in cases in which consequences can be forecasted in the near future, or are already experienced, raising active concerns that may drive positive behavioral changes aimed at fixing specific issues (e.g., "reducing the already existing pollution in my city)". This has been, indeed, suggested by some of the few studies already existing in the Pan-American region (Díaz et al., 2020; Mateer et al., 2022).

Coherently, this study proposed that pollution concerns might help link individual (e.g., demographic, trip-related) and attitudinal factors (i.e., willingness to act), finding that although in different ways, this mediation would be both statistically plausible and reasonable if interpreted in the light of previous pieces of evidence.

However, the contribution of this first study must be said to be limited to explaining factors that predict action (and not the action itself). Our results must be evaluated through subsequent studies and evaluations addressing the behavior of citizens -and not the intention to perform it, which may substantially differ-as a central unit of analysis (Henry and Gordon, 2003). Other relevant limitations and implications are presented and briefly discussed below.

3.4. Limitations of the study and further research

Although this nationwide research had some key strengths, such as (*i*) addressing a scarcely studied issue in the region; (*ii*) having achieved a good model fit; and (*iii*) privileging parsimonious (and literature-based) interpretations, it is worth acknowledging some shortcomings potentially affecting the study outcomes, as well as their validity.

Firstly, and regardless of the anonymous approach to participants, we cannot assure the non-interference of common method biases (branded in the literature as CMBs). This is a common shortcoming of self-report-based designs (Nasaescu et al., 2020). Also, this study addressed noticeably sensitive topics (e.g., climate change, personal behavior, and attitudes) which can be affected by phenomena such as social desirability and politically correct answers. Therefore, readers are invited to interpret this data with caution, as we are unable to guess the actual influence of these biases in this type of design.

Also, our number of variables is limited, and there might be several other factors not addressed in this research potentially influencing citizens' attitudes and potential behaviors. Said otherwise, the number of items that a government survey allows comprising is considerably reduced. Therefore, our study variables are calculated on the basis of a limited number of items, making it impossible to cover all the facts/issues that would be desirable. Further, even though it practically affects all current empirical research, the latest social changes in terms of transportation and concerns raised by the recent COVID pandemic should be considered for time-framing the results presented in this research.

Lastly, we would like to encourage researchers studying this topic to carry out complementary data collection techniques (e.g., surveys, focus groups), in order to increase the understanding of the topic "beyond numbers".

4. Conclusions

This empirical research, conducted in the Dominican Republic, analyzed the effect of demographic factors, travel habits, and pollution-related perceptions on individuals' willingness to act to solve the problem.

The first descriptive conclusion drawn from the study data is that there is a relatively high self-reported concern about transport air pollution. This concern is especially greater among women and the inhabitants of urban areas. However, there were no significant differences when analyzing according to types of road user.

Secondly, the SEM-based analyses suggest that individuals' willingness to act for air pollution improvement can be explained by demographic variables, trip patterns, and interaction with ICTs, but only in a partial way. In addition, pollution concerns allow a reasonable link (via statistical mediation) between individual factors and the attitudinal predisposition (i.e., *willingness for action*).

There is, however, a "flip side" of the coin: solely perceiving a greater social awareness seems to negatively influence personal willingness for action. A plausible explanation is that a greater social concern could make individuals externalize the responsibility for solving the problem, thus suggesting the need for more information and efforts aimed at strengthening the collective involvement in the "sustainabilization" of transport habits.

4.1. Implications for practice

To the best of our knowledge, this is the first study addressing a similar issue from a psychosocial and attitudinal approach in the Caribbean. For this reason, and with regard to the practical applications of the study, the results can benefit different stakeholders.

- Governmental authorities would find it useful to know the degrees of concern and willingness of the population in regard to transport-related air pollution.
- Secondly, agencies from other countries in the region might find these outcomes useful, especially if the similarity of the present transport dynamics and problems in the Caribbean is considered.
- Finally, these outcomes can serve as a relevant background for further researchers studying the actual environmental behaviors of the population beyond their stated preferences and intentions, which is the scope of the current study.

Author contributions

For this study, F.A. and S.A.U., conceived, designed and supervised the research and performed the data collection; S.A.U. and M.F. analyzed the data; F.A. and C.E. contributed reagents/materials/software/analysis tools; S.A.U. and M.F. wrote the paper; S.A.U. performed the paper revisions. All authors have read and agreed to the published version of the manuscript.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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