ARQUIVOS DE ASMA, ALERGIA E IMUNOLOGIA

Original Article

Effect of environmental exposure on the perceived health status of individuals from five Latin American countries

Influência da exposição ambiental na percepção do estado de saúde de indivíduos de cinco países latino-americanos

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ABSTRACT

Objective: The relationship between environmental exposure and health outcomes is well known. We investigated this relationship in five Latin American countries with different cultural backgrounds but similar Human Development Indexes. **Methods:** This was a cross-sectional study involving 3,016 individuals (18 to 75 years old) from Argentina (n=878), Brazil (n=1030), Mexico (n=272), Paraguay (n=508), and Peru (n=328). Participants were randomly selected and responded to a standardized questionnaire (including sociodemographic and environmental factors and lifestyle habits) derived from a clinical screening tool for air pollution risk. Based on their current health status, participants were categorized as having regular/bad/very bad or excellent/good health. Multivariate analysis was conducted, and data were presented as likelihood ratios and 95% confidence intervals (95%CI). The significance level was set at 5%. **Results:** Living in any of the study countries; indoor humidity (OR=1.68; 95%CI: 1.33-2.12); driving with the windows open (OR=1.31; 95%CI: 1.03-1.65); low family income (OR=1.59; 95%CI: 1.26-2.01); incomplete education (OR=1.54; 95%CI: 1.22-1.94); personal/family history of hypertension (OR=2.25; 95%CI: 01.64-3.09), chronic obstructive pulmonary disease/asthma (OR=1.74; 95%:CI: 1.28-2.36), diabetes (OR=3.74; 95%CI:2.23-6.29), obesity (OR=1.84; 95%CI: 1.84-3.19), or ocular comorbidities (OR=1.89; 95%CI: 1.55-2.30); and exercising outdoors (OR=1.60; 95%CI: 1.31-1.96) were significantly associated with a worse perceived health status. **Conclusions:** Despite the different exposures to

RESUMO

Objetivo: A relação entre exposição ambiental e risco à saúde é amplamente reconhecida e a avaliamos em cinco países da América Latina com condições culturais distintas, mas com Índices de Desenvolvimento Humano semelhantes. **Métodos:** Estudo transversal envolvendo 3.016 indivíduos (18 a 75 anos) oriundos de: Argentina (n = 878), Brasil (n = 1.030), México (n = 272), Paraguai (n = 508) e Peru (n = 328). A seleção foi aleatória e todos responderam questionário padronizado (fatores sociodemográficos, fatores ambientais e hábitos de vida) derivado do *Clinical Screening Tool for Air Pollution Risk*. Segundo o estado atual de saúde, foram categorizados em: saúde regular/má/péssima ou excelente/boa. Tendo-a como desfecho, realizou-se análise multivariada. Os dados foram apresentados como razão de verossimilhança (RV) e intervalos de confiança de 95% (IC 95%), tendo-se 5% o nível de significância. **Resultados:** Foram significantemente associados a pior percepção de situação de saúde: morar em qualquer um dos países, ter umidade na residência (OR = 1,68; IC 95%: 1,33-2,12), dirigir automóvel com janelas abertas (OR = 1,31; IC 95%: 1,03-1,65), ter baixa renda familiar (OR = 1,59; IC 95%: 1,26-2,01), nível educacional incompleto (OR = 1,54; IC 95%: 1,22-1,94), histórico pessoal/familiar de hipertensão arterial (OR = 2,25; IC 95%: 01,64-3,09), doença pulmonar obstrutiva crônica/asma (OR = 1,74; IC 95%: 1,28-2,36), diabete melito (OR = 3,74; IC 95%: 2,23-6,29), obesidade (OR = 1,84; IC 95%: 1,84-3,19) ou comorbidades oftalmológicas (OR = 1,89;

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which participants were subjected, some factors remain very significant. Low family income, exposure to pollution, and a history of chronic diseases were associated with the perception of a poor health condition.

Keywords: Environmental pollution, health, noncommunicable chronic diseases, smoking, asthma, cardiovascular diseases.

IC 95%: 1,55-2,30); realizar exercícios ao ar livre (OR = 1,60; IC 95%: 1,31-1,96). **Conclusões:** Apesar das diferentes exposições a que foram submetidos, alguns fatores permanecem muito significativos, e ter baixa renda familiar, expor-se à poluição e ter antecedentes de doenças crônicas foram associados à percepção de condição ruim de saúde.

Descritores: Poluição ambiental, saúde, doenças crônicas não transmissíveis, tabagismo, asma, doenças cardiovasculares.

Introduction

Air pollution is increasingly recognized as the greatest environmental threat to human health and well-being.[1] Air pollution is estimated to be responsible for millions of deaths, years of healthy life lost, and billions of dollars lost each year.[1-3]

There is ample scientific evidence linking pollution and socioeconomic and educational levels to health outcomes in the most vulnerable populations. This disparity is a risk factor that amplifies the health effects of pollution.[3-8]

Outdoor air pollutants, whether released from stationary sources (e.g., industrial facilities) or mobile sources (e.g., motor vehicles), and indoor air pollutants (tobacco smoke, biomass burning, volatile organic compounds [VOCs], etc.), pose a significant threat to air quality.[1,9]

Furthermore, housing quality plays a critical role in exposure to pollutants and allergens. Homes with inadequate infrastructure, prone to leaks and infiltration, create ideal conditions for the growth of allergens such as mold. Low-income populations and ethnic minorities are more likely to live in substandard housing, thereby increasing their exposure to these allergens.[8,10-12]

Approximately 70% of the 9 million deaths caused by air pollution each year are related to noncommunicable diseases (NCDs) such as heart disease, stroke, chronic obstructive pulmonary disease (COPD), lung cancer, etc.[4,5,13,14]

A pilot study conducted in the city of Uruguaiana, state of Rio Grande do Sul, Brazil, documented an association between exposure to outdoor air pollution and an increased risk of systemic arterial hypertension, chronic respiratory disease, and low socioeconomic status.[14]

The purposes of the present study were to assess the relationship between environmental conditions (e.g., exposure to environmental pollutants) and the perceived health status of individuals living in Latin America by using a standardized instrument.

Material and method

The present cross-sectional, quantitative study was conducted on 3016 individuals (aged 18 to 75 years) from 5 Latin American countries: Argentina (n = 878), Brazil (n = 1030), Mexico (n = 272), Paraguay (n = 508), and Peru (n = 328). All participants were randomly selected (convenience sample) and volunteered. They duly completed the standardized questionnaire on sociodemographic factors and exposure to environmental factors and lifestyle habits adapted from the Clinical Screening Tool for Air Pollution Risk.[15]

Data collection was conducted between June 2021 and June 2022 during medical consultations in primary care facilities, regardless of the reason for the visit. Individuals were asked about their sex, race, education level, marital status, employment, household income, place of residence, health status, diseases, alcohol consumption, exposure to pollution sources at work and home, exposure to fuel combustion (e.g., biomass, fossil fuels, etc.), alcohol consumption, home ventilation, cleaning products, cigarette smoking, regular exercise, etc.

In terms of economic level, patients were categorized according to whether their income was up to 2 minimum wages (MW) or more than 2 MW, as defined by government authorities in each country. Participants were categorized according to their current health status (self-defined): fair/poor/very poor health or excellent/good health.

Table 1 compiles the main socio-demographic characteristics of the countries participating in the study. Data for Brazil have already been published separately.[16]

Data analysis

Data were entered into an Excel® spreadsheet, and categorical variables were presented as frequency distributions and proportions. Nonparametric tests (chi-square or Fisher's exact test) were used for group comparisons. With health status (excellent/good vs. regular/poor/very poor) as the outcome, multivariate analysis followed by logistic regression was performed by considering each country individually and collectively. Data were presented as odds ratio (OR) and 95% confidence intervals (95% CI). Geographical, environmental, sociodemographic, health, and lifestyle variables were considered. A 5% significance level was used to reject the null hypothesis in all analyses. SPSS software (version 20) was used for statistical analysis.

The study was approved by the local research ethics committee at each participating center. All participants agreed to and signed the informed consent form.

Results

Table 2 presents the affirmative responses to the different questions that make up the questionnaire, provided by the participating individuals and distributed according to their country of origin. In all countries, except for Brazil and Peru, there was a preponderance of females, individuals under the age of 60, and self-identified whites.

In Mexico and Brazil, there was a preponderance of individuals with a high level of education. Most patients reported living in stable partnerships or marriages, being employed or self-employed, and having a satisfactory average income, except in Peru (27.7%). Urban dwellers predominated in all countries except Peru. The HDIs of the countries were similar, except for Argentina, which had the highest value (Table 1).

Table 3 shows the factors identified by univariate and multivariate analysis of variance for all the countries evaluated together. Table 3 shows the following factors were significantly associated with poorer health status: living in any of the countries studied, humidity in the home, driving a car windows open, low family income, incomplete schooling, personal/family history of hypertension, chronic obstructive pulmonary disease/asthma, type I or type II diabetes mellitus, obesity, ocular comorbidities, and exercising outdoors.

Table 4 shows the factors associated with poor health that were identified by multivariate analysis in each of the participating countries. Table 4 shows several factors were identified as risks, but not universally. Humidity in the home; living near a source of pollution; having paints, waxes, or incense at home; driving a car windows open; and systemic arterial hypertension, COPD/asthma, type I or type II diabetes mellitus, obesity, ocular comorbidities, smoking, and exercising outdoors were identified as risk factors in most countries. Other factors had mixed results,

Table 1
Sociodemographic characteristics of the countries included in the present study

Characteristics	Argentina	Brazil	Mexico	Paraguay	Peru
Estimated population (2023) in millions of people[17]	45.8	216.4	128.4	6.9	34.4
Human Development Index (HDI) (2021)[18]	0.842	0.754	0.758	0.717	0.762
Infant mortality (2021) in deaths per thousand live births[19]	9.0	15.88	10.65	16.91	16.69
Gross domestic product (GPD) per capita (2021) in millions of US dollars[20]	922.1	3.248	2463	88.91	430.3
Life expectancy at birth (years)[21]	77.82	74.74	76.69	77.9	74.7
GPD growth rate (2021) in %[22]	0.85	0.66	1.02	1.16	0.91

Table 2
Distribution of respondents with positive responses to the various items of the environmental health questionnaire by country of origin (N = 3016)

Variables	Argentina 878 (%)	Brazil 1,030 (%)	Mexico 272 (%)	Paraguay 508 (%)	Peru 328 (%)
Sociodemographic factors					
Family income of up to 2 minimum wages	214 (24.4)	380 (36.9)	67 (24.6)	104 (20.5)	237 (72.3)
Female	664 (75.6)	651 (63.2)	192 (70.6)	306 (60.2)	232 (70.7)
Age group (years)					
Up to 25 years old	152 (17.3)	238 (23.2)	11 (4.0)	61 (12.0)	52 (15.8)
25 to 59 years old	673 (76.6)	725 (70.5)	242 (88.9)	371 (73.1)	255 (77.8)
Over 60 years old	53 (6.0)	65 (6.3)	19 (7.0)	76 (15.0)	21 (6.4)
Higher education degree or more	294 (33.5)	527 (51.2)	218 (80.1)	220 (43.3)	97 (29.6)
Race/skin color – white	803 (92.1)	415 (40.4)	148 (55.0)	473 (93.1)	88 (26.9)
Marital status – married/stable relationship	517 (58.9)	562 (54.6)	170 (62.5)	257 (50.6)	217 (66.2)
Unemployed	239 (27.2)	292 (28.3)	72 (26.5)	176 (34.6)	150 (45.7)
Environmental factors					
Spends most of the day in traffic/exposed to areas with heavy vehicle circulation	130 (14.8)	145 (14.1)	34 (12.5)	93 (18.3)	39 (11.9)
Uses a wood/charcoal/kerosene/solvent/other furnace	1 (0.4)	92 (18.4)	7 (3.7)	7 (3.7)	7 (3.7)
You are the household cook	7 (4.7)	510 (49.5)	168 (61.8)	161 (31.7)	194 (59.1)
Cooks for up to 2 hours	690 (83.0)	744 (78.8)	190 (75.1)	429 (89.4)	130 (43.8)
Humidity on the walls	216 (24.6)	176 (17.1)	62 (22.8)	318 (62.6)	60 (18.3)
Mold on the walls	122 (13.9)	171 (16.6)	19 (7.0)	260 (51.2)	16 (4.9)
Paints, waxes, repellents, or incense in the house	622 (70.8)	441 (42.8)	90 (33.1)	444 (87.4)	117 (35.7)
Bleach for house cleaning	728 (82.9)	675 (65.5)	16 (5.9)	380 (74.8)	231 (70.4)
Degreaser for house cleaning	250 (28.5)	262 (25.4)	45 (16.5)	89 (17.5)	24 (7.3)
Disinfectant for house cleaning	335 (38.2)	548 (53.2)	89 (32.7)	130 (25.6)	130 (25.6)
Source of pollution near the house	331 (37.7)	434 (42.1)	115 (42.3)	345 (67.9)	223 (68.0)
House in unpaved area	141 (16.1)	110 (10.7)	11 (4.1)	81 (15.9)	41 (12.5)
Open sewage near the house	36 (10.9)	76 (17.5)	7 (6.1)	21 (6.1)	0 (0.0)
Source of pollution near the place of work	187 (21.3)	301 (39.2)	84 (30.9)	217 (42.7)	53 (16.2)
Materials burned in the home	108 (12.3)	83 (8.1)	10 (3.7)	32 (6.3)	187 (57.0)
House in rural area	31 (3.5)	78 (7.6)	16 (5.9)	19 (3.7)	194 (59.1)
Open car windows while driving	237 (27.5)	4 (4.1)	71 (26.3)	55 (10.8)	48 (14.8)
Health-related factors					
Perceives health as fair/poor/very poor	123 (14.0)	296 (28.7)	65 (23.9)	166 (32.7)	79 (24.1)
Systemic arterial hypertension	77 (8.8)	80 (7.8)	36 (13.2)	122 (24.0)	10 (3.0)
Chronic obstructive pulmonary disease (COPD)/Asthma	52 (5.9)	86 (8.3)	34 (12.5)	104 (20.5)	17 (5.2)
Allergic rhinitis	178 (20.3)	337 (32.7)	97 (35.7)	275 (54.1)	38 (11.6)
Diabetes mellitus	15 (1.7)	21 (2.0)	13 (4.8)	62 (12.2)	11 (3.4)
Obesity	109 (12.4)	73 (7.1)	51 (18.8)	106 (20.9)	25 (7.6)
Ocular comorbidities	397 (45.2)	509 (49.4)	173 (63.6)	421 (82.9)	104 (31.7)
Itchy eyes	205 (23.3)	372 (36.1)	77 (28.3)	172 (33.9)	39 (11.9)
Dry eyes	257 (29.3)	226 (21.9)	83 (30.5)	75 (14.8)	20 (6.1)
Lifestyle habits-related factors					
Exercises outdoors	521 (59.3)	549 (53.3)	93 (34.2)	258 (50.8)	82 (25.0)
Exercises once a week	128 (14.5)	178 (17.2)	24 (8.8)	79 (15.6)	27 (8.2)
Current/former smoking	283 (32.2)	145 (14.1)	102 (37.5)	151 (29.7)	88 (26.8)
Lives with a smoker	181 (20.6)	182 (17.7)	60 (22.1)	69 (13.6)	25 (7.6)
Consumes alcohol	587 (66.9)	577 (56.0)	171 (62.9)	399 (78.5)	264 (80.5)
Consumes alcohol at least once a week	272 (31.1)	163 (15.9)	43 (15.8)	75 (17.5)	32 (9.8)
Consumes more than one liter a week	61 (10.3)	167 (27.1)	16 (9.2)	52 (24.8)	132 (50.2)

Table 3
Factors associated with self-reported poor health (fair/poor/very poor) among individuals from 5 Latin American countries: univariate and multivariate analysis (N = 3016)

	Univariate		Multivariate	
			OR (95% CI)	
	OR (95% CI)	p	N = 2854 LR = -1252.57	p
Geographical aspects				
Country				
Peru	1.95 (1.42–2.67)	< 0.001	1.81 (1.08–3.03)	0.024
Paraguay	2.98 (2.28–3.89)	< 0.001	1.73 (1.23–2.43)	0.002
Mexico	1.93 (1.38–2.70)	< 0.001	1.73 (1.16–2.59)	0.008
Brazil	2.48 (1.96–3.13)	< 0.001	3.00 (2.19–4.11)	< 0.001
Argentina	1.00		1.00	
Environmental factors				
Place of residence				
Urban	0.86 (0.67–1.12)	0.263	1.03 (0.70-1.51)	0.890
Place where most of the time is spent				
Indoors	0.76 (0.60–0.98)	0.035		
You are the household cook				
Yes	0.93 (0.79–1.11)	0.428		
Mold on the walls				
Yes	1.57 (1.29–1.92)	< 0.001		
Humidity on the walls				
Yes	1.91 (1.60–2.28)	< 0.001	1.68 (1.33–2.12)	< 0.001
Source of pollution near the house				
Yes	1.68 (1.42–1.99)	< 0.001	1.21 (0.99–1.49)	0.065
Source of pollution near the place of work				
Yes	1.15 (0.96–1.38)	0.142	1.15 (0.96–1.38)	0.142
Materials burned in the home				
Yes	0.88 (0.69–1.12)	0.296		
Paints, waxes, repellents, or incense in the house				
Yes	1.23 (1.04–1.46)	0.017	1.10 (0.90–1.36)	0.355
Bleach for house cleaning				
Yes	0.91 (0.76–1.08)	0.290		
Open car windows while driving				
Yes/sometimes	1.54 (1.27–1.88)	< 0.001	1.31 (1.03–1.65)	0.025
Sociodemographic factors				
Family income (SM)				
Up to 2 minimum wages	1.47 (1.24–1.75)	< 0.001	1.59 (1.26–2.01)	< 0.001
Sex				
Male	0.95 (0.79–1.14)	0.571		
Age group (years)				
60 or more	1.21 (0.67–2.20)	0.524		
Incomplete higher education				
Yes	1.49 (1.26–1.77)	< 0.001	1.54 (1.22–1.94)	< 0.001
Race/skin color				
Black/brown	1.43 (1.18-1.73)	< 0.001	1.27 (0.98–1.65)	0.070

OR: odds ratio, LR: likelihood ratio, CI: confidence interval.

Table 3 *(continuation)*
Factors associated with self-reported poor health (fair/poor/very poor) among individuals from 5 Latin American countries: univariate and multivariate analysis (N = 3016)

	Univariate		Multivariate	
			OR (95% CI)	
	OR (95% CI)	p	N = 2854 LR = -1252.57	p
Health-related factors				
Systemic arterial hypertension				
Yes	3.67 (2.90–4.65)	< 0.001	2.25 (1.64–3.09)	< 0.001
Chronic obstructive pulmonary disease/asthma				
Yes	2.37 (1.85–3.04)	< 0.001	1.74 (1.28–2.36)	< 0.001
Type I or type II diabetes mellitus				
Yes	7.71 (5.20–11.42)	< 0.001	3.74 (2.23–6.29)	< 0.001
Obesity				
Yes	2.95 (2.35–3.70)	< 0.001	2.43 (1.84–3.19)	< 0.001
Ocular comorbidities				
Yes	1.80 (1.52–2.14)	< 0.001	1.89 (1.55–2.30)	< 0.001
Lifestyle habits-related factors				
Smokes				
I smoke/have smoked	1.21 (1.00–1.45)	0.050	1.15 (0.91–1.46)	0.251
Consumes alcohol at least once a week				
Yes	0.68 (0.54–0.85)	0.001	0.86 (0.66–1.13)	0.276
Exercise outdoors				
Yes	1.99 (1.68–2.36)	< 0.001	1.60 (1.31–1.96)	< 0.001

OR: odds ratio, LR: likelihood ratio, CI: confidence interval.

including both protective and risk factors, such as being woman and having incomplete education.

Discussion

The present study was conducted in 5 Latin American countries (Argentina, Brazil, Mexico, Paraguay, and Peru), as they represent about 70% of Latin America,[17] with mostly similar sociodemographic factors and HDIs but different cultural conditions[18] (Table 2).

Although there is evidence of the impact of environmental pollution on respiratory health in Latin America,[23] we are not aware of any studies conducted in primary care settings, such as the present one, that clearly show an association between perceived poor health and the environmental factors studied.

Of the factors associated with poor health revealed by multivariate analysis in each of the participating countries, several risk factors were identified, but not in a generalized way (Table 4).

Our study showed a significant association between the perception of poor health quality and both indoor and outdoor pollution factors. Living near a source of pollution, driving a car windows open, and exercising outdoors were identified as outdoor risk factors. Similarly, the use of candles, paints, waxes, repellents, and incense indoors was significantly

Table 4
Multivariate analysis of factors associated with self-reported poor health conditions among individuals living in 5 Latin American countries (N = 3016)

	Argentina		Brazil		Mexico		Paraguay		Peru	
	N = 854 LR = -281.2		N = 1021 LR = -519.8		N = 267 LR = -113.6		N = 428 LR = -178.84		N = 324 LR = -115.6	
Variables	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**
Environmental factors										
House in urban area			0.55 (0.34–0.89)	0.014						
Place where most of the time is spent										
You are the household cook			1.37 (1.04–1.79)	0.024						
Mold on the walls	2.07 (1.29–3.33)	0.003								
Humidity on the walls	3.11 (2.09 –4.62)	< 0.001			2.14 (1.15–3.97)	0.016	1.68 (1.13–2.49)	0.011	1.95 (1.07–3.57)	0.031
Source of pollution near the house	1.58 (1.07–2.31)	0.020	1.79 (1.37–2.35)	0.001			1.85 (1.22–2.82)	0.004		
Source of pollution near the place of work							0.57 (0.39–0.84)	0.005		
Materials burned at home			1.62 (1.02–2.58)	0.041						
Paints, waxes, repellents, or incense in the house			1.50 (1.15–1.98)	0.003	2.10 (1.18–3.72)	0.011				
Open car windows while driving	2.07 (1.25–3.43)	0.005					3.13 (1.44–6.78)	0.004	4.01 (1.39–11.55)	0.01
Sociodemographic factors										
Family income of up to 2 minimum wages	1.92 (1.28–2.88)	0.002	1.78 (1.35–2.34)	< 0.001						
Female			0.60 (0.45–0.81)	0.001					1.97 (1.16–3.35)	0.013

OR: odds ratio, LR: likelihood ratio, CI: confidence interval.

Table 4 *(continuation)*

Multivariate analysis of factors associated with self-reported poor health conditions among individuals living in 5 Latin American countries (N = 3016)

	Argentina		Brazil		Mexico		Paraguay		Peru	
	N = 854 LR = -281.2		N = 1021 LR = -519.8		N = 267 LR = -113.6		N = 428 LR = -178.84		N = 324 LR = -115.6	
Variables	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**
Sociodemographic factors										
Over 60 years old							16.36 (7.00-38.2)	< 0.001	17.6 (5.02-61.76)	< 0.01
Incomplete higher education	0.25 (0.07-0.91)	0.001	1.53 (1.17-2.01)	0.002			1.68 (1.14-2.46)	0.008		
Black race	–	–	–	–	–	–	3.88 (1.3-11.47)	0.014	–	–
Health–related factors										
Systemic arterial hypertension	2.57 (1.49–4.42)	0.001	2.30 (1.45–3.65)	< 0.001			8.20 (5.2–12.91)	< 0.001	7.97 (2.01–31.62)	0.003
COPD/Asthma	3.30 (1.79–6.1)	0.001	1.80 (1.14–2.83)	0.011	2.21 (1.04–4.72)	0.040	2.42 (1.56–3.76)	< 0.001		
Type I or type II diabetes mellitus	4.25 (1.49–12.16)	0.007	2.79 (1.17–6.65)	0.020	4.04 (1.31–12.5)	0.015	15.14 (7.4–30.79)	< 0.001	9.24 (2.39–35.75)	0.001
Obesity	2.76 (1.72–4.43)	< 0.001	1.93 (1.19–3.13)	0.008	2.52 (1.32–4.84)	0.005	5.55 (3.51–8.77)	< 0.001	3.89 (1.70–8.93)	0.002
Ocular comorbidities	1.89 (1.19–3.00)	0.007	2.21 (1.59–3.07)	< 0.001	3.90 (1.87–8.16)	< 0.001	–	–	–	–
Factors related to lifestyle habits										
Current/past smoking	1.98 (1.33–2.96)	0.001	2.18 (1.64–2.90)	< 0.001	3.03 (1.62–5.68)	0.001			1.97 (1.18–3.29)	0.009
Exercising outdoors	2.07 (1.41–3.05)	< 0.001	1.32 (1.01–1.74)	0.042			4.64 (3.08–6.97)	< 0.001	2.18 (1.11–4.28)	0.023

OR: odds ratio, LR: likelihood ratio, CI: confidence interval.

associated with poor health quality. Our findings are similar to those of other researchers who have demonstrated the strong impact of environmental pollution on health quality.[24]

Low- and middle-income populations suffer disproportionately from the effects of transport pollution, in part because they use older and inefficient diesel vehicles, or because they live or work in densely populated, high-traffic areas near sources of pollution.[14]

A recent systematic review found moderate to high levels of evidence for an association between long-term exposure to traffic-related air pollution (TRAP) and adverse health outcomes, including all-cause mortality, circulatory disease, ischemic heart disease, lung cancer, and asthma. This suggests that exposure to TRAP continues to be a significant public health concern and deserves greater attention from the public and policymakers.[25]

Storing paints, waxes, and burning incense or candles at home were also considered risk factors. The generation of aerosol particles can result from various combustion activities, such as cooking, smoking, and burning candles and incense.[26] Burning incense and candles, typically indoors, produces ultrafine particles larger than those produced by smoking, frying meat, or cooking on an electric stove. These particles tend to deposit in the alveolar region.[27]

The presence of humidity and mold on walls, often associated with low socioeconomic status and poor household sanitation, are significant risk factors for chronic respiratory diseases such as rhinitis and asthma, which significantly affect quality of life.[28]

Within the spectrum of elements that increase the risk of poor health, we have also identified the incidence of NCDs such as hypertension, chronic obstructive pulmonary disease/asthma, type I and type II diabetes mellitus, obesity as well as adverse ocular conditions and tobacco use.[29,30] In addition, air pollution may be responsible for the generation of reactive oxygen species, which can disrupt the methylation and demethylation cycle in the nucleus, causing widespread and localized epigenetic modifications. These modifications can directly alter methylation of CpG sites or affect the activity of the enzymes involved. This process can lead to metabolic disorders characterized by conditions such as dyslipidemia and increased insulin resistance.[29,30]

The link between pollution and NCDs is real and complex, especially considering that indoor air pollution is responsible for 25% of all deaths from stroke, 15% of ischemic heart disease deaths, and 33% of chronic obstructive pulmonary disease cases.[31] A systematic review and meta-analysis of the association between air pollution and cardiovascular disease (CVD) concluded the strongest evidence was observed between higher short- and long-term exposure to air pollution and all-cause mortality and morbidity from CVD, stroke, blood pressure, and ischemic heart disease.[32]

A systematic review of the health effects of TRAP and diabetes in the adult population indicates an increased risk of disease with higher exposure to NO_2, associated with a higher prevalence of diabetes (RR = 1.09; 95% CI: 1.02–1.17 per 10 μg/m^3).[33]

Ocular comorbidities stood out from another risk factors. Exposure to particulate matter was associated with significant thickening of the epithelial layers of the cornea and conjunctiva. These effects, if prolonged, may cause irreversible changes in corneal refractive power and visual processes. When exposed to PM, corneal epithelial cells release pro-inflammatory cytokines: interleukin (IL)-6, IL-8, tumor necrosis factor-alpha, IL-1, and monocyte chemoattractant protein-1 (MCP-1). In addition, there is a reduction in cell viability and proliferation and altered production of mucin.[34,35]

The presence of diesel exhaust particles (DEP), tobacco smoke, and biomass burning has been associated with oxidative stress in corneal epithelial cells and cataracts, particularly in women.[36,37]

The strong association between obesity, chronic respiratory disease, cardiovascular disease, environmental pollution, and poor quality of life found in the present study is explained by a complex mechanism involving mechanical, metabolic, and epigenetic factors, the release of pro-inflammatory ILs and the respiratory and intestinal microbiota.[38,39]

Because of this complexity, the treatment and prevention of this current epidemic, with its significant implications for the future, is an enormous challenge.[38,39]

In the present study, smoking was associated with poor health perception. Cigarette smoking, which is increasingly prevalent in lower social classes, has a significant impact on chronic respiratory diseases (e.g., asthma and COPD), cardiovascular diseases, high morbidity and mortality, with economic consequences for the patient and a high-cost burden for health care systems.[40,41]

Our study has limitations. First, as a cross-sectional study, it does not allow causal interpretation; however, our study provides a snapshot of the environmental factors that influence the perception of health status among adults in 5 South American countries within a small-time window. Second, the data were obtained through a questionnaire, which is a simple and inexpensive method of identifying environmental risk factors to which patients are exposed.

The assessment of potential health risks posed by a specific pollutant does not, by its very nature, reflect the multiple environmental and social stressors faced by vulnerable communities, which may interact to cause adverse health effects.[42]

Conclusion

In this context, the objective of this study was to identify possible sociodemographic, socioeconomic, environmental and lifestyle factors associated with adverse health outcomes in adults from 5 Latin American countries. More equitable environmental policies, continued research on the effects of these exposures, and public education are essential to mitigate adverse health effects and promote a healthier and more equitable environment for all communities.

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