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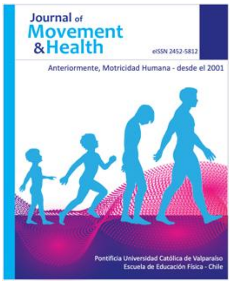

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Original article

Blood pressure, body composition, and physical fitness in Chilean schoolchildren

Presión arterial, composición corporal y condición física en escolares Chilenos

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Abstract

Objective: To describe blood pressure (BP), body composition, and physical fitness in schoolchildren from the Valparaíso region, comparing outcomes between normal weight and overweight/obese groups. **Methods:** This cross-sectional study included 150 children aged 6–10 years from public schools in Valparaíso, Chile. BP classification followed the Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. Body mass index (BMI) was categorized using the WHO growth reference. Physical fitness was assessed via handgrip strength, standing long jump, and the 20 m shuttle run test. **Results:** The prevalence of overweight/obesity was 58.7%. Overweight/obese children presented higher systolic BP than their normal-weight peers ($p = 0.005$), while diastolic BP showed no significant difference ($p = 0.073$). Elevated BP was frequent in both systolic (22%) and diastolic (32.7%) measures, with lower prevalence in the normal-BMI group. Adequate upper-body strength was observed in 52.0%, with a higher proportion in the overweight/obese group. In contrast, 45.3% met the criteria for adequate lower-body strength, and only 37.3% achieved adequate cardiorespiratory fitness, both of which were more prevalent among normal-weight children. **Conclusion:** Overweight/obese children showed higher systolic BP and less favorable fitness profiles, reinforcing the need for early monitoring in school settings.

Keywords: hypertension; physical activity; childhood; school; health

Resumen

Objetivo: Describir la presión arterial (PA), la composición corporal y la condición física en escolares de la región de Valparaíso, comparando los resultados entre los grupos de peso normal y sobrepeso/obesidad. **Métodos:** Este estudio transversal incluyó 150 niños de 6 a 10 años de escuelas públicas de Valparaíso, Chile. La clasificación de la PA siguió la Guía de Práctica Clínica para la Detección y el Manejo de la Hipertensión Arterial en Niños y Adolescentes. El índice de masa corporal (IMC) se categorizó utilizando la referencia de crecimiento de la OMS. La condición física se evaluó mediante la fuerza de prensión manual, el salto de longitud de pie y la prueba de carrera de ida y vuelta de 20 m. **Resultados:** La prevalencia de sobrepeso/obesidad fue del 58,7%, los cuales presentaron una presión arterial sistólica más alta que sus compañeros con peso normal (p = 0,005). La presión arterial diastólica no mostró diferencias significativas (p = 0,073). Se observó una fuerza adecuada en la parte superior del cuerpo en el 52,0%, con una mayor proporción en el grupo con sobrepeso/obesidad. Por el contrario, el 45,3% cumplió los criterios de fuerza adecuada en la parte inferior del cuerpo, y solo el 37,3% logró una aptitud cardiorrespiratoria adecuada; ambos factores fueron más prevalentes en los niños con peso normal. **Conclusión:** Los niños con sobrepeso/obesidad presentaron una presión arterial sistólica más alta y perfiles de aptitud física menos favorables, lo que refuerza la necesidad de un monitoreo temprano en el ámbito escolar.

Palabras clave: hipertensión; actividad física; infancia; escuela; salud

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Key points

- More than half of the schoolchildren (58.7%) were classified as overweight/obese.
- Overweight/obese children showed significantly higher systolic blood pressure.
- Overweight/obese children exhibited lower cardiorespiratory fitness and lower-limb strength

Introduction

Childhood is a period marked by rapid physical and physiological development, during which key health-related patterns begin to consolidate and may influence well-being later in life[1]. During these early years, body composition, cardiovascular function, and physical fitness undergo rapid changes that can influence long-term disease risk[2]. Specifically, global surveillance has shown a steady rise in childhood overweight, obesity, and related metabolic complications, positioning these conditions as major public health concerns[3].

For instance, in Latin American countries and Chile in particular, have reported some of the highest prevalence rates worldwide[4]. The most recent nutritional mapping presented by the Chilean Aid and Scholarship Board (JUNAEB) showed that the prevalence of overweight and obesity among elementary school students reaches an alarming 50.9%[5]. Evidence indicates that high body mass index (BMI) has emerged as one of the strongest and most consistent predictors of elevated blood pressure in school-aged children[2,6]. These alterations frequently coexist with low fitness levels[7,8], highlighting the complex interplay between adiposity, cardiovascular function, and metabolic regulation.

Given this context, physical fitness is considered a relevant marker of children's current health status[9]. Adequate levels of muscular strength and cardiorespiratory fitness are associated with more favorable cardiovascular and metabolic profiles[10,11], whereas lower fitness performance tends to coexist with excess body weight, reduced physical activity levels, and a higher prevalence of hypertension[2,12]. This relationship may be partially explained by the fact that higher cardiorespiratory fitness is independently associated with blood pressure regulation in children, through improvements in vascular function, autonomic balance, and insulin sensitivity[13].

In this context, blood pressure represents a key cardiovascular health indicator in childhood, integrating the combined influence of adiposity, physical fitness, and metabolic regulation[14]. Although hypertension is traditionally viewed as an adult condition, elevated blood pressure is increasingly documented in younger populations[15]. Children with overweight or obesity are more likely to present higher systolic blood pressure (SBP) than their normal-weight peers, and early deviations in blood pressure values may be relevant for later cardiometabolic risk[16,17]. Given these trends, describing how blood pressure values vary across BMI categories in childhood can offer important insights into population health patterns.

Despite the importance of these indicators, regional evidence describing the combined distribution of BMI, blood pressure, and physical fitness in Chilean schoolchildren is scarce. Local descriptive studies provide useful baseline information to characterize population profiles, identify emerging patterns, and guide future research and screening efforts at the school level. In the Valparaíso region, where nutritional and lifestyle behaviors may differ from national averages, updated information is particularly relevant[18].

Therefore, the aim of this study was to describe blood pressure, body composition, and physical fitness indicators among schoolchildren from the Valparaíso region, comparing these outcomes between normal weight and overweight/obese groups. By focusing on BMI categories as the primary comparison groups, this study provides updated descriptive evidence on how body weight relates to blood pressure and physical fitness, contributing to the regional understanding of childhood health risks and underscoring the need for strengthened preventive strategies during early life.

Methods

Study Design and Sample

This cross-sectional study was conducted between August and November 2025 and adhered to the STROBE reporting guidelines (see Supplementary Material I). The study protocol was approved by the Bioethics Committee of the Pontificia Universidad Católica de Valparaíso, Chile (BIOEPUCV-H 928-2025), and all procedures complied with the ethical principles of the Declaration of Helsinki[19]. Informed consent was obtained from all four school principals and parents, and assent was obtained from the participating children. A total of 155 children (51.6% girls) aged 6 to 10 years from Valparaíso's public schools' region were initially recruited. Participating schools were invited based on the availability of institutional contacts and their willingness to collaborate. Accordingly, the sample reflects children attending participating public schools in the Valparaíso region. However, the BMI for five children classified as underweight (BMI <−1 SD) was excluded from the analyses. Children from 1st to 5th grade were invited to participate and were selected according to the following inclusion criteria: (a) age between 6 and 10 years; (b) absence of medical contraindications for cardiorespiratory fitness, muscular strength, and flexibility testing; (c) participation in regular school physical education classes (approximately 120 min/week); (d) not participating in any weight loss program; and (e) not using medications that could interfere with the study outcomes, such as anorexigenic drugs or others affecting body weight regulation. Exclusion criteria included: (a) uncontrolled hypothyroidism; and (b) presence of cardiac, pulmonary, or osteoarticular diseases that could pose a health risk during the assessments. Data collection was carried out at the participating schools by Physical Education teachers previously trained.

Blood Pressure

SBP and diastolic blood pressure (DBP) were assessed after the participant remained seated at rest for 10 minutes. When uncertainty regarding the measurement occurred, the procedure was repeated. Measurements were obtained on the right arm, positioned at heart level, using a previously calibrated digital sphygmomanometer with an appropriate cuff size according to arm circumference. Based on the Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents[20], "normal blood pressure" was defined as SBP and DBP values <90th percentile (based on age, sex, and height percentiles) on three or more occasions. "Prehypertension" or "elevated" was defined as SBP and/or DBP ≥90th percentile and <95th percentile (based on age, sex, and height tables). Elevated BP constitutes both prehypertension and hypertension, including stage 1 (≥95th percentile to <95th percentile + 12 mmHg, or 130/80 to 139/89 mmHg, whichever is lower) and stage 2 (≥95th percentile + 12 mm Hg, or ≥140/90 mmHg, whichever is lower). BMI-for-age obtained was classified as obesity when age- and gender-specific BMI values are ≥ +2SD and <+3SD.

Body Composition

The children were measured wearing pants, t-shirt, and no trainers when their body weight (kg) and height (cm) were measured. A digital balance was used for measuring weight with precision between 0.1 kg and 150 kg (OMROM, HN-289-LA, Kyoto, Japan), while height was measured using a portable stadiometer (SECA, model 213, GmbH Co., Hamburg, Germany). A nutritional status indicator, the body mass index (BMI), was determined using the World Health Organization (WHO) 2007 growth reference for children according to their age and sex[21]. According to WHO recommendations for children and adolescents ranged 5–19 years, the thresholds were as follow: underweight: <−1SD, normal: between >−1SD to <+1SD, overweight: between +1SD and <+2SD, and obesity: >+2SD.

Physical Fitness

Strength was assessed by measuring the upper- and lower-limbs performance[22]. Upper-limb strength was assessed using a handgrip strength test with a digital dynamometer (Jamar Plus+, Sammons Preston Rolyan, Bolingbrook, IL, USA). The device was adjusted to each participant's hand size and allowed measurements from 0 to 90 kg with an accuracy of 0.1 kg. The test was performed three times on each hand, alternating sides, with a 10–15 second rest between attempts. Participants completed the test in a standing position with the elbow flexed at 90°. The mean value of the three trials for each hand was calculated, and the final handgrip strength value was obtained as the average of both hands. Lower-limb strength was evaluated using the standing long jump test. Participants began behind a starting line and performed a maximal forward jump with both feet together upon receiving a verbal cue, landing with both feet simultaneously. Two attempts were completed with a 10–15 second pause between them. The longest distance, measured in centimeters, was recorded, and the average of both jumps was used as the final score. Cardiorespiratory fitness was assessed using the 20 m shuttle run test[22]. Participants ran back and forth between two lines set 20 m apart, following the pace dictated by an audio signal. The initial speed was 8.5 km/h, and it increased by 0.5 km/h at the end of each 1-minute stage. Participants were instructed to complete as many stages as possible, ensuring at least one foot reached the line before the beep. The test ended when the participant failed to reach the line on two consecutive beeps or voluntarily stopped due to fatigue. The final score was recorded as the last fully completed stage, and maximal aerobic capacity (VO_2max) was estimated using the standard Léger equation[23]. The performance levels for all three physical tests were classified according to the following percentile-based cut-offs: low (<25th percentile); normal (≥25th to <75th percentile) and high (≥75th percentile)[9].

Statistical analysis

Continuous variables were reported as means ± standard deviation (SD), while categorical variables were presented as counts and percentages. Normality was assessed using visual inspection of Q–Q plots of standardized residuals and the Shapiro–Wilk test. Although the Shapiro–Wilk test indicated deviations from normality (p <0.05), visual inspection of the Q–Q plots suggested no substantial departures from normality. Given the robustness of independent samples t-tests to moderate deviations from normality, parametric analyses were considered appropriate. Group differences in continuous variables (e.g., BMI, SBP, and DBP) were assessed using independent t-tests, and effect sizes were estimated using Cohen's *d*[24]. Comparisons of categorical variables were examined using the chi-square test, with effect sizes quantified using Cramer's V[25]. Statistical significance was set at p <0.05. All analyses were performed using Jamovi version 2.6.44.0.

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Results

A total of 150 children (51.3% girls) aged 6 to 10 years (mean age: 9.05 ± 1.55) were included in the analyses. Regarding sex-specific context, no differences were observed in basic demographic characteristics. However, SBP differed between sexes, with higher values observed in boys, whereas no such variation was found for DBP (p = 0.109). When blood pressure was classified as normal or high, no sex-related variation was identified. In contrast, physical fitness showed clear sex-related patterns: boys exhibited greater upper body strength than girls (p = 0.013), while girls exhibited higher cardiorespiratory fitness compared with boys (p = 0.029). Table 1 provides a detailed description of anthropometric, blood pressure, and physical fitness indicators stratified by sex.

Table 1. Descriptive characteristics of the schoolchildren stratified by sex.

Variables	Overall (n = 150)	Boys (n = 73)	Girls (n = 77)	p-value
Age (years)	9.05 ± 1.55	9.23 ± 1.53	8.92 ± 1.56	0.210
Weight (kg)	36.6 ± 11.6	37.1 ± 10.4	36.9 ± 12.7	0.930
Height (cm)	134 ± 10.4	135 ± 0.09	134 ± 0.12	0.922
Body mass index (kg/m²)	19.9 ± 4.17	20.2 ± 4.06	20.0 ± 4.14	0.730
Blood Pressure				
Overall				
- *Systolic (mmHg)*	102 ± 14.7	105.0 ± 16.8	100.1 ± 12.0	**0.042**
- *Diastolic (mmHg)*	68.1 ± 10.4	69.6 ± 11.2	65.5 ± 9.11	0.109
Stage				
- *Normal*	94 (62.7%)	42 (57.5%)	52 (67.5%)	0.206
- *High*	56 (37.3%)	31 (42.5%)	25 (32.5%)	
Physical fitness (low and normal/high)				
Upper body strength				
- *Low*	72 (48.0%)	44 (60.3%)	28 (36.4%)	**0.013**
- *Normal/High*	78 (52.0%)	29 (39.7%)	49 (63.6%)	
Lower body strength				
- *Low*	82 (54.7%)	44 (60.3%)	38 (49.4%)	0.390
- *Normal/High*	68 (45.3%)	29 (39.7%)	39 (50.6%)	
Maximum oxygen uptake (VO_2máx)				
- *Low*	94 (62.7%)	53 (72.6%)	41 (52.3%)	**0.029**
- *Normal/High*	56 (37.3%)	20 (27.4%)	24 (47.7%)	

Note: The "stage" term is used to classify the severity of high blood pressure in children and adolescents in order to guide diagnosis, assessment, and clinical treatment based on the Clinical Practice Guideline. In the present analysis, the category "High" blood pressure includes elevated blood pressure, stage 1 hypertension, and stage 2 hypertension combined.

Based on BMI categories, 58.7% (88/150) were classified as overweight or obese. Regarding blood pressure, SBP were significantly lower in the normal-BMI group (98.5 ± 9.31 mmHg) than in the overweight/obese group (105 ± 17.0 mmHg; p = 0.005), while no significant difference was observed for DBP (p = 0.073). Additionally, the prevalence of elevated blood pressure (systolic or diastolic) was lower among children with normal BMI compared with those in the overweight/obese group. For physical fitness, significant differences were observed across all three physical tests. Children with normal BMI exhibited greater lower-limb strength and cardiorespiratory fitness compared with the overweight/obese group (p <0.001 and p = 0.002, respectively). In contrast, upper-body strength was significantly higher in the overweight/obese group (p = 0.038). Effect sizes ranged from −1.96 to 0.32, indicating large effects for body weight and body mass index, small effects for SBP, and moderate effects for all three physical

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fitness variables. A detailed overview of anthropometric, blood pressure, and physical fitness indicators is presented in Table 2.

Table 2. Body composition, blood pressure and physical fitness indicators according to normal weight and overweight/obese schoolchildren.

Variables	Normal (n = 62)	OW/OB (n = 88)	p-value	*Effect size*
Age (years)	9.10 ± 1.43	9.05 ± 1.63	0.818	0.04
Weight (kg)	29.6 ± 5.58	42.2 ± 11.9	**<0.001**	-1.29
Height (cm)	132 ± 0.10	136 ± 0.11	0.055	-0.32
Body mass index (kg/m^2)	16.7 ± 1.16	22.5 ± 3.71	**<0.001**	-1.96
Blood Pressure				
Overall				
- *Systolic (mmHg)*	98.5 ± 9.31	105 ± 17.0	**0.005**	-0.47
- *Diastolic (mmHg)*	66.5 ± 7.94	69.5 ± 11.4	0.073	-0.30
Stage				
- *Normal*	46 (30.7%)	48 (32.0%)	**0.014**	0.20
- *High*	16 (10.7%)	40 (26.7%)		
Physical fitness (low and normal/high)				
Upper body strength				
- *Low*	36 (24.0%)	36 (24.0%)	**0.038**	0.20
- *Normal/High*	26 (17.3%)	52 (34.7%)		
Lower body strength				
- *Low*	24 (16.0%)	58 (38.7%)	**<0.001**	0.32
- *Normal/High*	38 (25.3%)	30 (20.0%)		
Maximum oxygen uptake (VO_2máx)				
- *Low*	30 (20.0%)	64 (42.7%)	**0.002**	0.27
- *Normal/High*	32 (21.3%)	24 (16.0%)		

Note: The "stage" term is used to classify the severity of high blood pressure in children and adolescents in order to guide diagnosis, assessment, and clinical treatment based on the Clinical Practice Guideline. In the present analysis, the category "High" blood pressure includes elevated blood pressure, stage 1 hypertension, and stage 2 hypertension combined. OW/OB, overweight/obesity.

Discussion

This study provides updated descriptive evidence on blood pressure, body composition, and physical fitness indicators in a sample of schoolchildren aged 6–10 years from the Valparaíso region. Overall, more than half of the participants were classified as overweight or obese, and children in this group presented higher SBP compared with their normal-BMI peers. These findings align with previous research showing a consistent association between higher BMI and elevated blood pressure in childhood, suggesting that adiposity may already influence hemodynamic parameters at early ages[2,12].

The prevalence of overweight and obesity observed in this study is comparable to national reports indicating persistently high rates of excess body weight among Chilean children[4]. Although the present data are descriptive, they reinforce the relevance of monitoring weight status during the early school years. Excess body weight in early life may contribute to hemodynamic changes, such as increased vascular resistance, sympathetic activation, pro-inflammatory status, and structural adaptations of the cardiovascular system[26]. The significantly higher SBP in the overweight/obese group aligns with this evidence and underscores the importance of routine cardiovascular screening in school settings, particularly in populations with rising obesity rates[27].

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In addition to weight status, sex-specific patterns were observed in selected cardiovascular and physical fitness indicators. Although no differences were found in basic demographic characteristics, boys exhibited higher SBP than girls, while DBP showed no difference. These findings are consistent with previous reports suggesting early sex-related differences in SBP, potentially linked to maturational, hormonal, or autonomic factors, even before puberty[28]. In contrast, physical fitness showed distinct sex-related profiles. Consistent with previous literature, boys exhibited greater upper body strength than girls, a pattern commonly reported in childhood and attributed to differences in neuromuscular development and motor performance[29]. By contrast, girls revealed higher cardiorespiratory fitness in the present sample. Although most studies report superior cardiorespiratory fitness in boys[30,31], this discrepancy may be partly explained by differences in age range and developmental stage. While existing evidence primarily focuses on pre-adolescent or early pubertal populations, the present study included younger children (6–10 years), among whom sex-related differences may follow different trajectories.

In terms of physical fitness, children with normal BMI showed greater lower-limb strength compared with the overweight/obese group. Previous literature indicates that excess body weight negatively affects weight-bearing motor tasks, which may explain the observed difference[2]. Conversely, upper-limb strength is less influenced by body mass, which likely accounts for the more favorable outcomes observed in the overweight/obese group[2,32]. Additionally, although the shuttle run test did reveal a greater performance among normal-BMI children, overall cardiorespiratory fitness levels were low, with fewer than 38% of participants meeting recommendation thresholds. This finding is particularly relevant in the Chilean context, where alarmingly low adherence to 24-hour movement guidelines has been reported among adolescents, suggesting that insufficient physical activity and related movement behaviors may already be established early in life[33]. This pattern aligns with reports showing insufficient children's fitness performance across different countries and highlights the need for targeted strategies to improve physical activity and functional capacity during early childhood[34,35].

Together, these findings illustrate a pattern in which a considerable proportion of young children show indicators that may be relevant for future health monitoring, including high BMI, elevated SBP, and modest physical fitness levels. Although the magnitude and implications of these indicators cannot be fully determined from this study, the results contribute to a growing body of regional and national evidence describing health-related characteristics in school-aged children. This information may support future efforts aimed at understanding how weight status and physical fitness interact with cardiovascular indicators during childhood.

Perspectives

From a practical perspective, these findings highlight the importance of early, school-based strategies aimed at promoting healthy weight status, cardiovascular health, and physical fitness. Schools represent a key setting for the implementation of regular health monitoring, physical education programs, and targeted interventions adapted to age and sex-specific needs. Integrating these approaches into school health policies may contribute to early prevention efforts and support healthier developmental trajectories during childhood.

Strengths and Limitations

A strength of this study is the comprehensive assessment of several health-related indicators, including body composition, blood pressure, and physical fitness, which allowed for an integrated description of the characteristics of this sample of schoolchildren. The use of standardized measurement procedures and internationally recognized classification criteria enhances the comparability of the findings with previous literature.

However, several limitations should be acknowledged. First, the cross-sectional design prevents the establishment of temporal or causal relationships between BMI, blood pressure, and physical fitness. Second, the sample size was modest and drawn from a limited number of public schools in one region, which may restrict the generalizability of the findings to other areas or populations. Third, blood pressure was measured on a single occasion; although standardized procedures were followed, repeated measurements across different days would improve diagnostic accuracy. Finally, performance in physical fitness tests may be influenced by motivation, familiarity with the tasks, or environmental conditions, factors not controlled for in the present study.

Conclusion

In this descriptive study of schoolchildren from the Valparaíso region, higher BMI levels were accompanied by higher SBP, less favorable lower-limb strength, and lower cardiorespiratory fitness. Although no causal inferences can be drawn, these findings highlight the importance of early monitoring of weight status, blood pressure, and physical fitness in school environments. The results provide updated regional information that may support future research and screening initiatives focused on childhood health.

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Supplementary Material I. STROBE Statement. Checklist of items that should be included in reports of cross-sectional studies.

	Item	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Provided in the Abstract (page 1)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Provided in the Abstract (page 1)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Included in the Introduction section (pages 2 and 3)
Objectives	3	State specific objectives, including any prespecified hypotheses Included in the Introduction section (page 3)
Methods		
Study design	4	Present key elements of study design early in the paper Included in the Methods section (pages 3 to 5)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Included in the Methods section (page 3)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants Included in the Methods section (page 3)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Included in the Methods section (pages 3 to 5)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Included in the Methods section (pages 3 to 5)
Bias	9	Describe any efforts to address potential sources of bias This was addressed in the "Methods section" (page 5) This was addressed in the "Strengths and limitation's section" (page 9)
Study size	10	Explain how the study size was arrived at Included in the Methods (page 3)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Included in the Methods section (page 5)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Included in the Methods section (page 5)
		(*b*) Describe any methods used to examine subgroups and interactions Included in the Methods section (page 5)
		(*c*) Explain how missing data were addressed Included in the Methods section (page 3)
		(*d*) If applicable, describe analytical methods taking account of sampling strategy Included in the Methods section (page 3)
		(*e*) Describe any sensitivity analyses Not applicable
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Included in the Methods section (pages 3 to 5)

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		(b) Give reasons for non-participation at each stage Included in the Methods section (pages 3)
		(c) Consider use of a flow diagram Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Included in the Results section (pages 5 and 7)
		(b) Indicate number of participants with missing data for each variable of interest Not applicable
Outcome data	15*	Report numbers of outcome events or summary measures Included in the Results section (pages 5 and 7)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Not applicable
		(*b*) Report category boundaries when continuous variables were categorized Included in the Methods section (pages 3 to 5)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses Included in the Results on pages 5 to 7
Discussion		
Key results	18	Summarise key results with reference to study objectives Included in the Discussion section (pages 7 and 8)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Included in the Discussion section (page 7) Included in the Strengths and limitations section (page 9)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Included in the Discussion section (pages 7 to 9)
Generalisability	21	Discuss the generalisability (external validity) of the study results Included in the Discussion section (pages 7 to 9)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Included in the pages 9 and 10

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.