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Differences in Early Cardiovascular Risk Markers in Adults from the Municipality of El Carmen de Chucurí

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Competing interests
The author declares no competing interests.

Abbreviations
BMI: Body Mass Index

Editorial Note
This study is a secondary result derived from a Master's thesis in Physical Activity and Sports Sciences at the University of Pamplona, titled *"Relationship between handgrip strength and early cardiovascular risk markers in adults in the municipality of El Carmen de Chucurí."*

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ABSTRACT

Introduction: There is a lack of studies comparing cardiovascular risk markers between urban and rural populations in specific local contexts.

Objective: To establish differences between rural and urban populations regarding early cardiovascular risk markers in adults from the municipality of El Carmen de Chucurí.

Method: A quantitative, non-experimental research design was conducted. From a total population of 20,500 inhabitants, a random sample of 815 sedentary subjects aged 18 to 40 years was selected (406 from rural areas and 409 from urban areas). Body Mass Index (BMI), body composition, handgrip strength, and blood pressure were assessed as early markers of cardiovascular risk.

Results: Men in the rural sector showed lower values for BMI (25.11 kg/m^2) and body fat percentage (23.11%) compared to the urban sector (BMI: 25.46 kg/m^2; body fat: 25.48%). Regarding blood pressure, rural men recorded a mean of 130.26 mmHg (systolic) and 82.04 mmHg (diastolic), while urban men showed 127.83 mmHg and 79.46 mmHg, respectively. In handgrip strength, urban men presented better results than rural men in both the right hand (44.96 kg vs. 43.44 kg) and the left hand (43.53 kg vs. 42.36 kg). Women in the urban sector also showed higher values compared to those in the rural sector (right hand: 28.11 kg vs. 27.70 kg; left hand: 27.56 kg vs. 27.31 kg).

Conclusions: *The population of Carmen de Chucurí presented homogeneous characteristics regarding cardiovascular risk markers when comparing rural and urban groups, with no significant clinical differences between them.*

Keywords: Body composition, Hand strength, Blood pressure, Public health

Diferencias en marcadores tempranos de riesgo cardiovascular en adultos del municipio de El Carmen de Chucurí

RESUMEN

Introducción: *Existen escasos estudios que comparen marcadores de riesgo cardiovascular en poblaciones urbanas y rurales en contextos locales específicos.*

Objetivo: *Establecer las diferencias entre la población rural y urbana en los marcadores tempranos de riesgo cardiovascular en adultos del municipio de El Carmen de Chucurí.*

Método: *Se realizó una investigación de enfoque cuantitativo con un diseño no*

Authors' Contribution
Conceptualization: OOR and CEGY
Data Curation: AVN, BJBV, and CEGY
Formal Analysis: BJBV and APLS
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experimental. La población total fue de 20500 habitantes, de la cual se seleccionó una muestra aleatoria de 815 sujetos sedentarios con edades entre 18 y 40 años (406 del sector rural y 409 del sector urbano). Se valoraron el índice de masa corporal (IMC), la composición corporal, la fuerza prensil y la presión arterial como marcadores tempranos de riesgo cardiovascular.

Resultados: *Los hombres del sector rural presentaron valores más bajos en el IMC (25,11 kg/m^2) y el porcentaje de grasa corporal (23,11%) en comparación con los del sector urbano (IMC 25,46 kg/m^2; grasa corporal 25,48%). En cuanto a la presión arterial, los hombres rurales registraron una media de 130,26 mmHg (sistólica) y 82,04 mmHg (diastólica), mientras que en el sector urbano los valores fueron de 127,83 mmHg y 79,46 mmHg, respectivamente. En la fuerza prensil, los hombres urbanos obtuvieron mejores resultados que los rurales, tanto en la mano derecha (44,96 kg vs. 43,44 kg) como en la izquierda (43,53 kg vs. 42,36 kg). Las mujeres del sector urbano también presentaron valores superiores en fuerza prensil (mano derecha: 28,11 kg; izquierda: 27,56 kg) frente a las del sector rural (mano derecha: 27,70 kg; izquierda: 27,31 kg).*

Conclusiones: *La población de El Carmen de Chucurí presentó características homogéneas en los marcadores de riesgo cardiovascular al comparar los sectores rural y urbano, sin diferencias clínicas significativas entre ambos grupos.*

Palabras clave: *Composición corporal, Fuerza de la mano, Presión arterial, Salud pública*

INTRODUCTION

Cardiovascular diseases (CVD) represent a critical public health challenge, being one of the leading causes of mortality both globally and nationally[1-3]. To understand their genesis, various studies have identified factors associated with their onset, termed "risk factors", which allow for the estimation of the global probability of developing cardiovascular events[4]. Extensive scientific evidence links the early identification of these risks with a significant reduction in morbidity and mortality; therefore, systematic screening of populations is recommended to determine their risk profile[5].

Historically, large-scale investigations such as the Framingham Heart Study have provided fundamental mathematical models for predicting cardiovascular risk[6,7]. Other longitudinal studies have allowed for the observation of how these risks behave over time[2,3], while contemporary research explores associations with educational levels and other social determinants, seeking more precise methods for risk calculation[5,8]. The global objective of these investigations is to establish effective intervention and risk reduction strategies across diverse populations[9].

Currently, widely validated reference markers are utilized:

- Blood pressure: Incorporated into the classic Framingham formula [5,9,10].
- Body fat percentage: A marker derived from Body Mass Index (BMI) that offers greater precision regarding the subject's body composition[11, 12].
- Handgrip strength: Used as a powerful predictor of health and cardiovascular risk in both early stages and adulthood[13-16].

At an international level, the evolution of these factors has been documented over decades (e.g., in the Czech Republic), alongside current statuses in regions such as Korea and Ibero-America[2,12]. Notable comparative studies in Latino populations (e.g., residents in Mexico versus immigrants in the United States) demonstrate how the residential environment influences the prevalence of risk factors[17]. Furthermore, research has extended to schoolchildren for early detection[13] and to populations with specific clinical conditions[18,19]. This evidence suggests that lifestyle is a key determinant in the differences observed between populations.

In the Colombian context, a robust association has been suggested between handgrip muscle strength and cardiovascular risk[15], even proposing general strength indices as starting points for prevention programs[14]. Additionally, international initiatives such as *"May Measurement Month"* have revealed a high prevalence of hypertension in the country, highlighting the urgency of preventive programs[3]. However, although comparisons exist between rural and urban schoolchildren showing a

higher prevalence of risks in urban settings[20], evidence in young adults remains limited.

Despite the relevance of these findings, a gap persists in Colombian literature regarding a detailed comparison of risk markers in young adults from rural and urban sectors. For this reason, the purpose of this study was to establish the differences in early cardiovascular risk markers (blood pressure, body composition, and handgrip strength) between the rural and urban populations of the municipality of El Carmen de Chucurí.

METHOD

Study Design and Population

A descriptive study with a quantitative approach and a non-experimental design was conducted. The reference population was the municipality of El Carmen de Chucurí, with a census of 20,500 inhabitants. Participants were selected through probabilistic sampling based on databases from the municipal administration and the government program *Prosperidad Social - Familias en Acción*.

The sample size was calculated using STATS® software, considering a 96% confidence level and a 4% margin of error. Although the initial representative sample size was 795 subjects (408 from the rural sector and 387 from the urban sector), the final effective sample consisted of 815 participants.

Selection Criteria and Variables

Subjects of both sexes, aged 18 to 40 years, were included. Participants were required to be free of musculoskeletal injuries at the time of testing. Sedentary status was a mandatory inclusion criterion, verified through clinical assessment.

- Independent Variable: Place of residence (urban or rural).
- Dependent Variables: Handgrip strength, blood pressure, Body Mass Index (BMI), body fat percentage, and muscle mass percentage.

Procedures and Instrumentation

Data collection took place between June and October 2019, following standardized protocols:

1. Handgrip Strength: Assessed using a Takei T.K.K. 5001 digital dynamometer (range 5-100 kg), considered the *gold standard* for this measurement[21]. The protocol proposed by the Fuprecol study was applied[22], with two attempts per limb and the maximum value recorded in kilograms (kg).
2. Body Composition: Body fat and muscle mass percentages were determined via bioelectrical impedance analysis (BIA) using an OMRON HBF-514C monitor[23]. International guidelines for BIA testing were strictly followed: prior fasting, abstinence from alcohol (48 h), caffeine (4 h), and intense physical exercise (12 h), with measurements taken after voiding[24].
3. Blood Pressure: Measured at rest using an OMRON HEM-4030 digital monitor, following American Heart Association (AHA) guidelines[25].
4. Body Mass Index (BMI): Calculated using the body mass obtained from the BIA scale and the previously measured height, according to the formula:

$$BMI = \frac{Body\ mass\ (kg)}{Height\ (m)^2}$$

Statistical Analysis

Data processing was performed using the IBM SPSS v.22 statistical package. A 95% confidence level was established ($p < 0.05$). To quantify the differences between the rural and urban populations, the effect size was calculated and categorized according to Cohen's scale[26]:

- Trivial: < 0.2
- Small: 0.2 - 0.5
- Moderate: 0.5 - 0.8
- Large: > 0.8

Ethical Considerations

The research was conducted in accordance with the principles of the Declaration of Helsinki. All participants received detailed information regarding the objectives and nature of the study, ensuring data confidentiality. Informed consent was obtained in writing prior to the start of the tests, respecting the participants' right to voluntary withdrawal at any stage of the process.

RESULTS

The general characteristics of the sample are presented in **table 1**. The average age of the participants ranged between 27 and 29 years, indicating a young adult population. Regarding body composition, men from the urban sector exhibited a higher body mass (79.90 ± 11.90 kg) compared to their rural counterparts (72.55 ± 11.64 kg). However, the Body

Table 1. General characteristics of the participants.

Variables	Rural (n=406)		Urban (n=409)	
	Males (n=167)	Females (n=239)	Males (n=171)	Females (n=238)
Age (years)	28,14 ± 6,63	29,42 ± 6,64	27,94 ± 6,33	28,63 ± 6,00
Height (meters)	1,71 ± 0,06	1,59 ± 0,06	1,73 ± 0,10	1,60 ± 0,06
Body mass (kg)	72,55 ± 11,64	64,00 ± 9,88	79,90 ± 11,90	63,50 ± 10,41
BMI (kg/m^2)	25,22 ± 6,80	25,75 ± 4,62	25,46 ± 4,40	25,48 ± 9,17

Data are shown as mean ± standard deviation.

Table 2. Differences in body fat and muscle mass.

Variables	Males (n=338)		Effect size	Females (n=477)		Effect size
	Rural (n=167)	Urban (n=171)		Rural (n=239)	Urban (n=238)	
Body fat (%)	23,11 ± 9,33	25,48 ± 8,49	0,27	35,70 ± 8,09	34,45 ± 7,71	0,16
Muscle mass (%)	37,13 ± 6,78	35,72 ± 6,74	0,21	27,52 ± 4,71	28,82 ± 6,44	0,23

Data are shown as mean ± standard deviation.

Table 3. Differences in handgrip strength.

Strength	Males (n=338)		Effect size	Females (n=477)		Effect size
	Rural (n=167)	Urban (n=171)		Rural (n=239)	Urban (n=238)	
Right hand (kg)	43,44 ± 10,83	44,96 ± 10,12	0,14	27,70 ± 7,17	28,11 ± 7,36	0,05
Left hand (kg)	42,36 ± 10,71	43,53 ± 9,37	0,12	27,31 ± 7,15	27,56 ± 7,17	0,03

Los datos muestran media ± desviación estándar.

Mass Index (BMI) remained similar across all groups, with values suggesting a trend toward being overweight (exceeding 25 kg/m^2).

When analyzing detailed tissue composition (**Table 2**), interesting differences were identified based on the residential environment. In men, a small effect size was observed for both body fat (ES = 0.27) and muscle mass (ES = 0.21). Specifically, urban men presented a higher body fat percentage (25.48%) compared to rural men (23.11%), while the latter showed a higher muscle mass reserve (37.13% vs. 35.72%). In women, the difference in body fat percentage was trivial (ES = 0.16), although muscle mass showed a small effect size (ES = 0.23) in favor of the urban population.

Regarding handgrip strength (**Table 3**), the results demonstrated notable homogeneity between the groups. In both men and women, the differences between the rural and urban sectors were classified as trivial (ES < 0.20) for both hands. Despite this statistical classification, men in the urban sector recorded slightly higher absolute values in the right hand (44.96 ± 10.12 kg) compared to those in the rural sector (43.44 ± 10.83 kg).

Finally, blood pressure indicators (**Table 4**) revealed that men in the rural area presented higher systolic and diastolic figures (130.26/82.04 mmHg) than their urban counterparts (127.83/79.46 mmHg),

Table 4. Differences in systolic and diastolic blood pressure.

Blood pressure (BP)	Males (n=338)		Effect size	Females (n=477)		Effect size
	Rural (n=167)	Urban (n=171)		Rural (n=239)	Urban (n=238)	
Systolic BP (mmHg)	130,26 ± 19,47	127,83 ± 14,29	0,14	121,99 ± 14,81	117,95 ± 12,18	0,30
Diastolic BP (mmHg)	82,04 ± 15,27	79,46 ± 11,02	0,19	78,60 ± 10,40	77,32 ± 9,15	0,13

Data are shown as mean ± standard deviation.

albeit with a trivial effect size. A relevant finding was observed in the female population, where systolic blood pressure showed a small effect size (ES = 0.30), being higher in rural women (121.99 ± 14.81 mmHg) than in urban women (117.95 ± 12.18 mmHg).

DISCUSSION

The analysis of macro-anthropometric and physiological variables in adults from El Carmen de Chucurí reveals a notable homogeneity between urban and rural populations. Regarding body composition, although rural men showed slightly lower BMI and body fat values (25.11 kg/m^2; 23.11%) compared to their urban counterparts (25.46 kg/m^2; 25.48%), these differences were not clinically drastic. According to Das *et al.*[27], these findings are consistent with the study by Singh and coworkers in Asian populations, where minimal and statistically insignificant differences in BMI were observed between rural (21.7 kg/m^2) and urban (22.8 kg/m^2) inhabitants. This trend suggests that urbanization and modernization processes have homogenized lifestyles, extending behaviors such as physical inactivity and unhealthy eating habits to rural areas, thus impacting cardiovascular risk markers globally (**Figure**).

Regarding blood pressure, figures in rural men (130.26/82.04 mmHg) and urban men (127.83/79.46 mmHg) showed no significant discrepancies. Similar results were documented in Benin[28], where a nationwide survey reported mean values of 129.8/79.7 mmHg in urban settings versus 129.6/78.4 mmHg in rural areas, with no significant differences between sexes or environments. Furthermore, research in Sweden[29] corroborates that, after adjusting for age and sex, the residential environment does not independently influence systolic or diastolic blood pressure. These findings confirm that blood pressure is more closely linked to individual lifestyles and genetic factors than to geographic location.

In relation to handgrip strength, although urban men recorded slightly higher values (44.96 kg right hand) than rural men (43.44 kg), the magnitude of these differences was trivial according to the effect size. Notably, the strength levels in El Carmen de Chucurí are higher than those reported in other national and international studies[16,22,30-32]. For instance, in research conducted in the United States and other

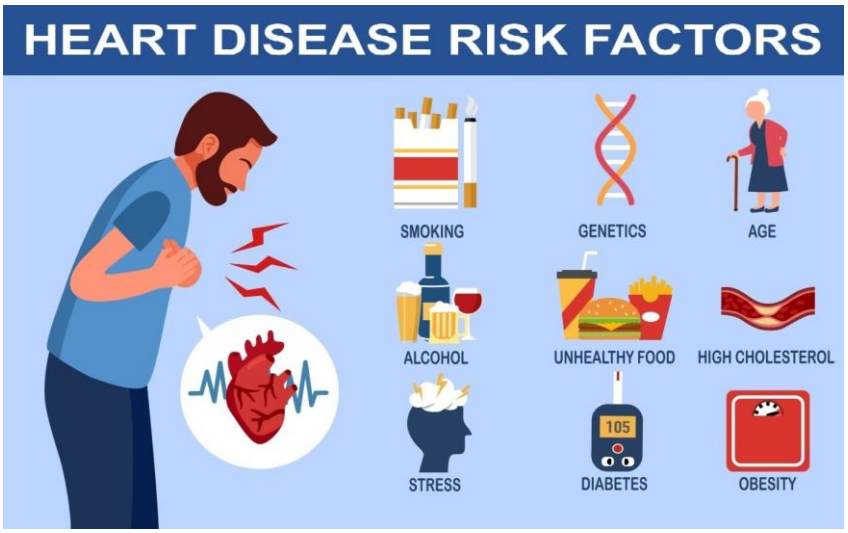

Figure. Cardiovascular disease risk factors or markers.

contexts[30,31], maximum average values of 44.8 kg in men and 26.7 kg in women have been reported, values that are surpassed by the sample studied here. This superior strength could be attributed to the fact that a large portion of the population, regardless of residence, is engaged in manual or labor-intensive occupations that require high physical demand.

Finally, this study emphasizes that geographic location in municipalities of this nature has a minimal influence on cardiovascular risk, mainly affecting body fat percentage. The homogeneity observed in blood pressure and handgrip strength may be due to the similarity in occupational demands in both environments within this specific municipality. Future research is recommended to conduct comparative studies in major capital cities, where socioeconomic differences and occupational profiles between metropolitan and rural areas are typically much more pronounced, which could yield more marked differences in cardiovascular risk profiles.

CONCLUSIONS

When comparing early cardiovascular risk markers in adults from the municipality of El Carmen de Chucurí, it is concluded that rural and urban populations present homogeneous characteristics. There are no significant differences in blood pressure or handgrip strength between both environments, suggesting that cardiovascular risk factors are uniformly distributed among the young and adult population of this region, likely conditioned by similar lifestyles and occupational profiles.

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