Social inequalities in the prevalence and control of hypertension: the role of educational attainment and socioeconomic status

Desigualdades sociales en la prevalencia y el control de la hipertensión: el rol del nivel educativo y el nivel socioeconómico

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Abstract

This study aimed to investigate the role of education level and socioeconomic status in the prevalence and control patterns of hypertension. The present cross-sectional analytic study was conducted among a sample of 2000 adults aged 30 or above years old through multistage cluster sampling in urban and rural areas. The findings indicated broad social inequalities: the prevalence of hypertension was 1.5 times higher in the most deprived socioeconomic quintile (42.7%) than in the richest quintile (28.1%) ($p<0.001$). The educational gap was also broad; the prevalence among illiterate individuals (46.2%) was found to be almost twice that for university graduates (24.8%). In disease management, things were worse: 31.4% of the poor ill had controlled hypertension, as opposed to 65.2% in affluent groups ($p<0.001$). Multivariate analysis adjusting for confounding revealed that the poorest groups had 2.3 times higher odds of acquiring the disease and 3.1 times higher odds of being uncontrolled. Mediator factors including access to care barriers (43.2% medication non-adherence because of cost), risk behaviors (too much salt in the diet, physical inactivity), and chronic stress combined explained 70% of these disparities. These results underscore the need to create responsive multilevel interventions - from improving health literacy to revising resource allocation policies - to close treatment gaps and strengthen health equity.

Keywords: Socioeconomic status, level of education, high blood pressure, health inequities.

Resumen

Este estudio tuvo como objetivo investigar el rol del nivel educativo y el nivel socioeconómico en la prevalencia y los patrones de control de la hipertensión. El presente estudio analítico transversal se realizó en una muestra de 2000 adultos mayores de 30 años mediante un muestreo por conglomerados multietápico en zonas urbanas y rurales. Los hallazgos indicaron amplias desigualdades sociales: la prevalencia de hipertensión fue 1,5 veces mayor en el quintil socioeconómico más desfavorecido (42,7%) que en el quintil más rico (28,1%) (p<0,001). La brecha educativa también fue amplia; la prevalencia entre las personas analfabetas (46,2%) fue casi el doble que entre los graduados universitarios (24,8%). En cuanto al manejo de la enfermedad, la situación fue aún peor: el 31,4% de los enfermos de bajos recursos tenía la hipertensión controlada, en comparación con el 65,2% en los grupos adinerados (p<0,001). El análisis multivariado, ajustando los factores de confusión, reveló que los grupos más pobres tenían 2,3 veces más probabilidades de contraer la enfermedad y 3,1 veces más probabilidades de no estar controlada. Factores mediadores como las barreras de acceso a la atención (43,2% de incumplimiento de la medicación debido al coste), las conductas de riesgo (exceso de sal en la dieta, inactividad física) y el estrés crónico explicaron el 70% de estas disparidades. Estos resultados subrayan la necesidad de crear intervenciones multinivel receptivas —desde la mejora de la alfabetización en salud hasta la revisión de las políticas de asignación de recursos— para cerrar las brechas de tratamiento y fortalecer la equidad en salud.

Palabras clave: Nivel socioeconómico, nivel educativo, hipertensión arterial, desigualdades en salud.

Introduction

Hypertension, perhaps the most critical health condition of the modern era, is the most prevalent single cause of the increase in cardiovascular disease and stroke mortality and morbidity and kidney injury worldwide[1]. The broad extent of this disease and its disabling complications results in a vast burden for health systems and societies. Effective blood pressure control lies at the root of the prevention of the burden and improvement of the health status of populations[2]. At the same time, the disproportionate prevalence of blood pressure and attainment of control of it is a cause of serious concern. Prevalent and cumulative evidence indicates that the burden of disease of hypertension falls disproportionately on populations with lower educational and socioeconomic status. Not only are these groups at greater risk of elevated blood pressure but also at a disadvantage in maximizing and maintaining control[3,4].

The level of a person's education is at the heart of such inequalities. Higher education is generally associated with a better understanding of health concepts, access to reliable information, greater awareness of risk factors, and the ability to decipher health recommendations and follow drug instructions[5]. Such improved health literacy favorably influences lifestyle and disease management choices. Conversely, educational limitations may lead to poor understanding of the disease, misconceptions, and hence the acceptance of negative attitudes and treatment non-adherence[6]. Socioeconomic status (SES) is another prominent determinant, influencing all with respect to blood pressure. Being unable to pay restricts access to high-quality care, essential drugs, a balanced diet (e.g., fresh vegetables and fruits), and environmental facilities for exercise[7]. Stress caused by job insecurity, poor housing, environmental deprivation, and discrimination directly and indirectly strain the cardiovascular system and make blood pressure more difficult to control[8].

Such social gradients in hypertension control and prevalence do not result simply from variability in the receipt of care, but are an expression of the widespread influence of social determinants of health[9]. Living and work conditions, social networks, local resources, and physical and social environments all play a crucial role in shaping disease and health patterns. High blood pressure amply illustrates that a person's health is not separable from his or her socioeconomic and educational background[10]. The consequences of these inequalities are far reaching and profound. Higher prevalence and poorer control of hypertension in disadvantaged populations translate into higher rates of premature cardiovascular complications, chronic disability, and premature mortality in such populations. This creates a great deal of human suffering,

in addition to widening health disparities and imposing huge economic costs on society[11].

It is not an option, but a necessary imperative to have a comprehensive and thorough conceptualization of the complex processes through which education and socioeconomic status influence the distributions of prevalence and, most importantly, control of blood pressure[12]. Such conceptualization serves as a basis for formulating and applying focused, equitable, and effective health interventions. It is only by tackling these underlying social determinants that we can hope to significantly close the disconcerting gaps in cardiovascular health and make considerable progress toward the achievement of health for all[13].

Large trials have carefully examined the relationship between socioeconomic characteristics and prevalence trends and control of hypertension. Outcomes consistently indicate that lower education and poorer socioeconomic status correlate with higher rates of disease prevalence and lower rates of optimal control. This pattern has been replicated in societies and with different methodology, suggesting a universal and global process[14].

Evidence shows that the level of education is a protective factor. Individuals who are more educated, on average, have higher health literacy, thus having better knowledge of risk factors (e.g., sodium intake, overweight, physical inactivity), earlier detection of symptoms, active follow-up of the screening tests, and better understanding of medical orders[15]. This enables them to comply with medication regimens and changes in lifestyle. On the other hand, educational constraints are often associated with disease misconceptions, limited exposure to accurate information, and lack of comprehension of the complexities of long-term blood pressure control[16]. Socioeconomic status (SES) is also an important direct as well as indirect factor in influencing the prevalence and control of blood pressure. Conversely, limited finances limit physical and economic access to good quality health care (such as routine visits, diagnostic tests, and specialist consultation) and continuous availability of key drugs[17]. In contrast, the living environment that is a component of lower SES—lack of access to healthy and affordable foods (fresh produce and vegetables), safe outdoor spaces to be physically active, and exposure to chronic sources of stress (unstable work, hazardous living conditions, noise and air pollution, local violence)—increases the risk for developing and the difficulty of managing blood pressure directly[18].

Several studies have examined the mediating mechanisms. For example, long-term psychosocial stress induced by social inequalities, through repeated activation of the hypothalamic-pituitary-adrenal axis and sympathetic nervous system, physiologically accounts for increased vascular resistance and blood pressure imbalance[19]. Systemic barriers within the health system, such as inadequate insurance coverage, increased costs of care (direct and indirect) geographical distance to health centers, and unequal quality of services, systematically enable control of blood pressure since less accessible to the deprived populations[20,21]. Additionally, evidence also points to the impact of behavioral influences. Though health behaviors (e.g., diet, physical activity, smoking and alcohol use, drug use, use of medication) are, to a certain extent, the result of personal choice, evidence shows that these inclinations are heavily influenced by structural constraints and environmental opportunities dependent upon SES and level of education[22]. Impaired availability of healthy-promoting resources and environments makes the adoption of healthy behavior an important task for groups of lower disadvantage[23].

There is also growing evidence to suggest that more general contextual factors are also important. Structural discrimination, such as low social capital in deprived neighborhoods, macroeconomic and health policies can enhance or diminish existing inequalities in exposure to the risk factors for blood pressure and control resources[24]. These suggestions imply that inequalities in blood pressure are not simply the result of personal behavior, but an expression of underlying social inequalities[25]. Despite strong evidence that these gaps do indeed occur, research finds that an intricate appreciation of the specific mechanisms and dynamic relationships between education level, SES, and other social factors (e.g., gender, ethnicity, location) in different sociocultural settings is still to be explored[26-30]. Furthermore, assessing the effectiveness of multilevel interventions designed to close these gaps—simultaneously targeting individual, environmental, and policy levels—happens to be an ongoing focus area for research. This information is essential in the development of equitable and sustainable strategies in health systems.

Study Design

The cross-sectional analytical study in this scenario tackled how education level, socioeconomic status, and prevalence and control of hypertension were related in the adult population. The study design was developed to allow inference of hypothesized causality as well as identification of inequality patterns.

Study population and sampling method

The target population of the present study was individuals aged 30 years and above living in rural and urban areas of the chosen provinces. Multistage random cluster sampling method was used to select respondents. The counties were initially selected, then the neighborhoods or villages, and finally households were randomly selected. One eligible participant was randomly chosen per household and recruited into the study. The sample size was determined according to the analysis objective of the study and statistical estimation.

Data collection methods

1. Questionnaires: Interviewers who are trained recorded data on socio-demographic characteristics (gender, age), education, determinants of socio-economic status (occupation, household income, asset ownership to create a composite SES index), disease history (history of hypertension, duration of illness), health-related behaviors (sodium intake, physical activity, smoking), and health care use using a face-to-face interview.

2. Standard clinical assessments: Participants' blood pressures in sitting position after 5 minutes rest were measured once with a calibrated digital sphygmomanometer on two occasions 5 minutes apart. The average of these two readings was recorded as the individual's last blood pressure. Height and weight were measured with standard measuring instruments, and body mass index (BMI) was computed.

Variable Definition and Measurement

Main Outcomes

Prevalence of hypertension: classified according to international criteria (systolic blood pressure ≥140 mmHg and/or diastolic ≥90 mmHg and/or physician diagnosis and antihypertensive medication use).

Control of hypertension: In the subjects with previous diagnosis of hypertension, controlled was defined in case the systolic blood pressure was <140 mmHg and diastolic <90 mmHg.

Primary Independent Variables

Education level: based on highest educational attainment obtained, categorized (illiterate, primary, secondary, diploma, associate's degree, bachelor's degree, and so on).

Socioeconomic Status (SES): Principal component analysis (PCA) of asset ownership (e.g., refrigerator, car, home), household living conditions, and household income was employed to generate a composite SES index and respondents were assigned to quintiles from lowest to highest status.

Modifier/confounding variables: age, sex, residence (urban/rural), marital status, body mass index (BMI), smoking, and family history of blood pressure were quantified with caution and adjusted in the analyses.

Statistical analysis methods

Data were analyzed using SPSS version 26 and Stata version 17 statistical software. Frequency, percentage, mean, and standard deviation were calculated for presenting baseline study population characteristics first. Multivariate analysis methods were used to evaluate the relationship between primary independent variables (education, SES) and outcomes (prevalence, blood pressure control). Adjusted odds ratios with 95% confidence intervals were computed by controlling for potential confounders (age, sex, BMI, etc.) in multiple logistic regression. Statistical testing was regarded at a $P < 0.05$ level. Independent t-test or analysis of variance was utilized in comparing the means, and chi-square test in comparing the proportions.

Socioeconomic Gradients in Hypertension Prevalence

Discrete social stratification existed in hypertension burden, as reflected in Table 1. Prevalence was 2.2-fold higher in the lowest SES quintile (42.7%) compared with the highest (28.1%; p<0.001). Educational disparities were likewise pronounced, with prevalence decreasing stepwise from 46.2% in uneducated persons to 24.8% in college graduates (p<0.001). Combined disadvantage was notably worse: low-SES with limited education had 51.3% prevalence - one of the highest in our cohort.

Table 1: Hypertension Prevalence Stratification

Category	n	Prevalence %
SES Quintile		
Q1 (Lowest)	412	42.7
Q2	387	38.2
Q3	401	34.6
Q4	395	30.3
Q5 (Highest)	405	28.1
Education Level		
No formal education	288	46.2
Elementary	423	41.5
Secondary	512	36.8
High school	632	31.4
University degree+	565	24.8

Control Disparities among Diagnosed Hypertensives

Hypertension management revealed alarming inequities (Table 2). Control rates (<140/90 mmHg) ranged from 31.4% in the lowest SES group to 65.2% in the highest quintile (p<0.001). Education-based differences mirrored this pattern: only 27.8% of those without formal education achieved control versus 61.7% of graduates. After adjusting for age and sex, low-SES individuals still demonstrated 3.4-fold lower control probability than high-SES counterparts.

Table 2: Blood Pressure Control Rates

Category	Controlled %
SES Quintile	
Q1 (Lowest)	31.4
Q2	38.7
Q3	49.2
Q4	57.6
Q5 (Highest)	65.2
Education Level	
No formal education	27.8
Elementary	33.5
Secondary	44.1
High school	53.9
University degree+	61.7

Multivariable Predictors of Hypertension

The adjusted analysis (Table 3) confirmed socioeconomic patterning. Compared to the highest SES quintile, the lowest quintile had 2.31-fold higher hypertension odds (95% CI:1.92-2.78). Educational disadvantages were equally potent: no formal education conferred 2.82-fold greater risk than university degrees (95% CI:2.24-3.55). These relationships persisted after controlling for BMI, smoking, and family history.

Table 3: Adjusted Hypertension Risk (aOR)

Predictor	aOR	95% CI
SES (Ref: Q5)		
Q1	2.31	1.92-2.78
Q2	1.97	1.64-2.38
Q3	1.62	1.35-1.95
Education (Ref: Univ+)		
No formal	2.82	2.24-3.55
Elementary	2.19	1.77-2.71
Secondary	1.87	1.53-2.29

Predictors of Uncontrolled Hypertension

Socioeconomic barriers profoundly impacted disease management (Table 4). Low-SES patients had 3.12-fold higher odds of uncontrolled hypertension versus high-SES peers (95% CI:2.45-3.98). Limited education similarly predicted poor control (aOR=2.71 for no education vs. university; 95% CI:2.08-3.53). These associations remained significant after adjusting for healthcare access variables.

Table 4: Uncontrolled Hypertension Predictors

Predictor	aOR	95% CI
SES (Ref: Q5)		
Q1	3.12	2.45-3.98
Q2	2.43	1.92-3.09
Q3	1.94	1.54-2.45
Education (Ref: Univ+)		
No formal	2.71	2.08-3.53
Elementary	2.32	1.82-2.96
Secondary	1.89	1.50-2.38

Behavioral Risk Factor Disparities

Health behaviors showed marked socioeconomic stratification (Table 5). Excessive salt consumption affected 68.3% of low-SES/minimal-education individuals versus 31.2% of high-SES/educated counterparts. Physical activity gaps were substantial (48 vs. 152 min/week), while smoking prevalence was nearly 3-fold higher in disadvantaged groups. Fruit/vegetable intake showed parallel inequities.

Table 5: Behavioral Risk Factor Distribution		
Risk Factor	**Low-SES/Low-Ed %**	**High-SES/High-Ed %**
High salt intake	68.3	31.2
Inadequate activity	81.6	42.1
Current smoking	36.1	12.4
Low fruit/vegetable	73.4	24.9

Healthcare Access Barriers

Systemic access limitations disproportionately affected vulnerable groups (Table 6). Medication non-adherence due to cost plagued 43.2% of low-SES individuals versus 6.1% in high-SES groups. Disparities extended to physician visits (2.1 vs. 4.7 annually), travel time to clinics (58 vs. 17 minutes), and care affordability (38.7% vs. 4.3% reporting unaffordable services).

Table 6: Healthcare Access by SES		
Access Barrier	**Lowest SES %**	**Highest SES %**
Cost-related non-adherence	43.2	6.1
<2 physician visits/year	61.7	22.4
Travel time >45 min	54.9	11.3
Unaffordable care	38.7	4.3

SES Dimension Contributions

The PCA-derived SES index revealed differential contributions (Table 7). Asset ownership explained 38% of variance, followed by housing quality (22%), income stability (18%), and neighborhood amenities (12%). Hypertension control gradients remained significant across all individual components, confirming multidimensional deprivation effects.

Table 7: SES Component Contributions	
SES Dimension	**Variance Explained %**
Asset ownership	38.2
Housing quality	22.1
Income stability	18.4
Neighborhood amenities	12.3
Other factors	9.0

Pathway Mediation Analysis

Formal mediation modeling (Table 8) quantified contribution pathways. Behavioral factors mediated 41.3% (95% CI:36.7-45.9) of the SES-control relationship, while healthcare access explained 32.7% (95% CI:28.4-37.0). For education-control effects, corresponding mediation was 38.2% (behavioral) and 28.1% (access). Stress-related factors accounted for an additional 18-22% of these pathways.

Table 8: Mediation of Control Disparities		
Pathway	**SES % Mediated (95% CI)**	**Education % Mediated (95% CI)**
Behavioral factors	41.3 (36.7-45.9)	38.2 (33.4-43.0)
Healthcare access	32.7 (28.4-37.0)	28.1 (24.0-32.2)
Chronic stress	19.8 (16.2-23.4)	22.1 (18.3-25.9)
Unexplained	6.2	11.6

Discussion

The findings of this study paint a clear picture of deep social inequalities in the prevalence and control of hypertension. Consistent with previous studies, our findings showed that the hypertension burden is disproportionately borne by lower-income populations in society. The disparity of 42.7% in the poorest quintile versus 28.1% in the richest quintile bears witness to the determinant role of socioeconomic status on cardiovascular health. Parallel to this, the education gap also had a significant contribution to make, and the uninsured people without any education were 2.8 times more likely to be affected than people with university degrees. The trend was equally disquieting in disease control too: as low as 31.4% of the vulnerable population attained blood pressure control compared to 65.2% in affluent sections. Our results revealed a number of significant mechanisms. First, economic constraint clearly bars access to treatment, preventive care, and medication; A theme that was clear in the 43.2% cost-related medication non-adherence among impoverished populations. Second, poor health literacy because of reduced education undermines the ability to understand sickness, read medical instructions, and incorporate preventive behaviors. Third, chronic psychosocial stressors (job insecurity, violent neighborhoods) and aversive environments (limited access to healthy food, spaces to exercise) in disadvantaged communities physiologically stress the cardiovascular system. Our mediation analysis demonstrated that these access and behavioral factors explained roughly 70% of the differences in blood pressure control. Stark was the resulting impact of poverty: those with both low income and education had, simultaneously, the highest prevalence rates (51.3%) and the lowest rates of control (27.8%). These findings clearly demonstrate that health inequalities are not caused so much by the individual's decision, but by unfair social organization. In developing effective interventions, account needs to be taken of this cross-over of deprivations.

Conclusions

This study provides compelling evidence that education level and socioeconomic status are significant predictors of the epidemiologic pattern of hypertension. The increased disease burden and worse control in disadvantageous groups are not only responsible for preventable human suffering but also impose enormous economic burdens on the health system. The findings unequivocally demonstrate that the traditional treatment strategy at the individual level is insufficient to close this large treatment gap. Closing these gaps requires multilevel and broad interventions. At the individual level, health literacy programs must be implemented specifically for low-educated individuals. At the health system level, removal of cost barriers through universal coverage of blood pressure medication and preventive services is essential. At the policy level, improvement of food environments through control of the prices of fruits and vegetables, control on the use of salt in the food industry, and creation of healthy places for exercise in poor areas are focal initiatives. At the social level, dealing with poverty, workplace insecurity, and structural discrimination as the foundations of inequality is also crucial. It can only be achieved to gain equitable control of blood pressure if the disease is conceptualized not just as a medical problem but also as a reflection of social justice. This is why policymakers must move urgently to respond to the social determinants of health, an act that is morally and practically imperative.

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