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The 'rule of halves' does not apply in Peru: Awareness, treatment, and control of hypertension and diabetes in rural, urban and rural-to-urban migrants

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Abstract

Objective—To determine the awareness, treatment, and control of hypertension and diabetes by migration status.

Design—Cross-sectional study, secondary analyses of the PERU MIGRANT study.

Patients—Rural, rural-to-urban migrants, and urban participants.

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COMPETING INTERESTS

All authors declare that (1) no support from any organisation for the submitted work other than the funding grant; (2) no relationships with any organisation that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children do not have financial relationships that may be relevant to the submitted work; and (4) no non-financial interests that may be relevant to the submitted work.

CONTRIBUTORS

AGL conducted literature search and wrote the initial draft of this manuscript. ABO led the statistical analyses and provided critical inputs to various drafts. RHG and LS participated in the design of the study, actively supported the fieldwork phase of the study and provided critical input during data analysis and interpretation of results. JJM conceived and conducted the original study, developed the idea for this secondary analysis, and contributed to drafting various versions of this manuscript. All authors read and approved the final manuscript. All authors had full access to all of the data in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. JJM is the guarantor of the study.

Main outcome measures—Awareness, treatment and control of hypertension and diabetes mellitus were calculated using weights to account for participant's group size.

Results—Of the 205/987 (weighted prevalence 24.1%, 95%CI: 21.1%–27.1%) participants identified as hypertensive 48.3% were aware of their diagnosis, 40% of them were receiving treatment, and 30.4% of those receiving treatment were controlled. Diabetes was present in 33/987 (weighted prevalence 4.6%, 95%CI: 3.1%–6%) and diabetes awareness, treatment and control were 71.1%, 40.6%, and 7.7%, respectively. Sub-optimal control rates, defined as those not meeting blood pressure or glycaemia targets among those with the condition, were 95.1% for hypertension and 97% for diabetes. Higher awareness, treatment and control rates, for both hypertension and diabetes, were observed in rural-to-urban migrants and urban participants compared to rural participants. However, treatment rates were much lower among migrants compared to the urban group.

Conclusions—These results identify major unmet needs in awareness, treatment, and control of hypertension and diabetes. Particular challenges are lack of awareness of both hypertension and diabetes in rural areas, and poor levels of treatment and control among people who have migrated from rural into urban areas.

Keywords

Cardiovascular diseases; epidemiology; risk factors; rural health; urban health

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of mortality worldwide, and 80% of CVD deaths occur in low and middle-income countries (LMIC).[1] Additionally, a large proportion of people with CVD are still undiagnosed in LMIC, and even those aware of their diagnosis often have insufficient access to treatment.[2] To determine meaningful prevention and control strategies for CVD, it is vital to assess the current level of awareness, treatment, and control of CVD and its associated risk factors. This assessment is necessary to implement effective policies that will improve outcomes for chronic disease in LMIC.[3]

Hypertension and diabetes are both strong risk factors for CVD morbidity and mortality. Hypertension is a major modifiable risk factor, and treating and controlling systolic and diastolic blood pressure is associated with significant reductions in the risk of CVD.[4, 5] Diabetes is associated with outcomes including overall mortality and stroke.[6, 7] One challenge of the slow progression and lack of symptoms in both hypertension and diabetes, in particular in LMIC, is that many newly diagnosed patients already have developed complications.[8, 9] Both hypertension and diabetes carry major economic burdens at individual, health care and societal levels.[10–13] Therefore, early prevention, awareness, and treatment could significantly prevent the onset of complications and reduce the risk of CVD.

Introduced in the 1972, the concept of the 'rule of halves' suggest that approximately half of hypertension cases are undetected, that half of those detected are not treated, and that half of those treated are not controlled.[14, 15] The rule of halves has also been applied to other chronic diseases such as diabetes. This pattern has enormous repercussions for chronic disease prevention as well as planning and allocation of always constrained and limited resources.[16] Few studies have assessed awareness, treatment and control of hypertension and diabetes in LMIC, especially because in Peru, as well as many other similar countries, there is a lack of national surveys for chronic disease risk factors.[17] In addition, the exploration of these unmet needs by migration status is scarce in the literature.[18, 19]

The objective of this study was to report the level of hypertension and diabetes awareness, treatment and control among Peruvian adults with particular emphasis on rural, urban and migrant groups.

METHODS

Setting and population

The design of the PERU MIGRANT (PEru's Rural to Urban MIGRANTs) study has been previously described and reported.[20, 21] Briefly, a cross-sectional survey was performed in 2007–2008 using a single-stage random sampling in participants aged 30 and over from the rural site of Ayacucho, the urban site of Lima, the capital of Peru, and rural to urban migrants from Ayacucho now residing in Lima. Ayacucho was one of the hardest hit by terrorism, resulting in a massive migration of the population to coastal cities, and especially to Lima.[22, 23] Both the urban and rural-urban migrant participants were selected from a periurban shantytown 25 km south of Lima, called Pampas de San Juan de Miraflores.

Variables definition

The outcomes of interest were hypertension and diabetes prevalence, awareness, and treatment. Systolic (SBP) and diastolic (DBP) blood pressures were measured using appropriately-sized cuffs for arm circumference in the sitting position using the right arm, supported at chest level. Three measurements at least five minutes apart using an oscillometric device (Omron M5-i, Omron, Japan) previously validated for adult population [24], were made. Mean of the last two blood pressure measurements were used for the analysis.[20] Hypertension was defined when systolic blood pressure ≥140 and/or diastolic ≥90 mm Hg, or upon a self-report of physician diagnosis.[25, 26] Stage-1 (SBP 140–159/DBP 90–99), stage-2 (SBP 160–179/DBP 100–109) hypertension as well as hypertensive crisis (SBP ≥ 180/DBP ≥ 110) were also evaluated as per guidelines.[25] Diabetes was defined as fasting blood glucose ≥126 mg/dL, or upon a self-report of a physician diagnosis.[27] Awareness was defined as a self-report of a physician diagnosis and/or receiving anti-hypertensive or anti-diabetic medications at the time of the interview. Treatment was defined as taking any anti-hypertensive or anti-diabetic medication at the time of interview, and this information was double-checked with the name of the medication reported by participants.[20] Hypertension control was defined as having systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg. Diabetes control was defined as having either fasting blood glucose <126 mg/dL or HbA1c <7.0%. Sub-optimal control rates were defined as those not meeting blood pressure or glycaemia control targets amongst all patients with the condition.

A detailed questionnaire collected age, sex, and socioeconomic information. A multi-deprivation index was also considered to evaluate socio-economic status as previously reported.[20] A current smoker was defined as having smoked within the last 6 months with a lifetime total of more than 100 cigarettes. Heavy alcohol use was defined as drinking 2 or more nights in the past month, having ever drunk 6 or more drinks at a time or having had at least 1 hangover episode during that time. Height and weight were measured to calculate body mass index (BMI) using standardized procedures as previously reported.[20] Obesity was defined as BMI ≥30 Kg/m^2, overweight as BMI ≥25 and <30 Kg/m^2, and normal weight as a BMI ≥18.5 and <25 Kg/m^2.[28] Laboratory measurements were performed on venous samples taken in the morning after a minimum of 8 hours fast to assess HbA1c and fasting glucose. Plasma glucose was measured using an enzymatic colorimetric method (GOD-PAP, Modular P-E/Roche- Cobas, Germany) and HbA1c was measured using high-performance liquid chromatography (D10- BIORAD, Germany), which is traceable to the Diabetes Control and Complications Trial reference study as certified by National Glycohemoglobin Standardization Program (NGSP).

Statistical analysis

Overall prevalence and 95% confidence intervals (95%CI) of hypertension and diabetes, as well as their awareness, treatment and control were calculated using weights to account for participant's group size. Chi-square or Fisher's exact test, where appropriate, were used to explore potential factors related to hypertension and diabetes awareness. Bonferroni's correction was applied in these multiple comparisons to decrease the possibility of false declarations of a difference.[29, 30] STATA 11 for Windows (Stata Corp, College Station, TX, USA) was used for all analyses.

Ethical approval

Ethical approval for this protocol was obtained from ethics committees at Universidad Peruana Cayetano Heredia in Peru and London School of Hygiene and Tropical Medicine in the UK. The purpose of the study was explained to each of the study participants and written informed consent was obtained.

RESULTS

Of the 989 participants in the original study, two were excluded from this analysis: one for not having blood tests and another one aged 29 years old. Of the remaining 987 individuals, 466 (47.2%) were male, average age 48 (SD ±12) years old. There were 199 (20.2%) participants from the rural group, 588 (59.6%) rural-to-urban migrants, and 199 (20.2%) from the urban group. Detailed characteristics of the study population are provided in Table 1.

The weighted prevalence of hypertension in the overall study was 24.1% (95%CI: 21.1%–27.1%), 33.2% in the urban group, 18% in the migrant group, and 16.6% in the rural group, ($p<0.001$). Similarly, overall weighted prevalence of diabetes was 4.5% (95%CI: 3.1%–6.0%), 6.5% in the urban group, 3.2% in the migrant group and 0.5% in the rural group ($p=0.004$).

Among patients unaware of their hypertension status (n = 106), systolic and diastolic blood pressure means were 153.8 (SD ±17.6) and 86.1 (SD ±10.8) mm Hg, respectively. Classifications of blood pressure in those unaware were: stage 1 hypertension 74 (69.8%), stage 2 hypertension 24 (22.6%), and 8 (7.6%) as hypertensive crisis. Among patients unaware of diabetes, fasting glucose mean was 203.3 (SD ±71.6) mg/dL, whereas HbA1c mean was 10.1% (SD ±3.1).

Levels of awareness, treatment, and control of hypertension and diabetes, overall and by specific group, are presented in Table 2. In general, only 4.9% of all hypertensive patients were controlled. In the case of diabetes, control using the fasting blood glucose criteria was only 3%. If control was defined using HbA1c criteria instead of fasting blood glucose, then none of the patients were controlled for diabetes.

There was strong evidence indicating that women were more likely to be aware of their hypertension status than men ($p<0.001$). There was weak evidence of differences in hypertension awareness rates by participants' group ($p = 0.085$) and smoking status ($p=0.02$). In the case of diabetes, there was no evidence of an association between awareness and sociodemographic variables. Other characteristics evaluated in participants aware of their hypertensive or diabetic diagnosis are presented in Table 3.

There was evidence of a difference in receiving treatment for hypertension by age ($p=0.001$) and weaker evidence if evaluated with socio-economic status ($p=0.03$). These associations were not observed for diabetes treatment (Supplementary Table 1).

Higher awareness rates, for both hypertension and diabetes, were observed in migrant and urban participants compared to rural participants. Yet, for corresponding treatment rates, migrants halved those of their urban counterparts.

DISCUSSION

We found that, in the case of hypertension, less than 50% were previously aware of their diagnosis, whereas, around 70% were aware among those with diabetes. Of those aware, for both hypertension and diabetes, only 40% were taking medication, yet the proportion of treated and controlled subjects were much lower. Amongst those unaware of their condition, mean blood pressure and glycaemia indicators at point of evaluation were considerable high. Importantly, out of all subjects with the condition, sub-optimal control rates – those not meeting blood pressure or glycaemia control targets amongst all patients with the condition – were extremely high at 95.1% and 97% in patients with hypertension and diabetes, respectively. These findings reveal major unmet needs in Peru, and suggest that the 'rule of halves' apply for awareness only, whilst poorer profiles are observed for treatment and control indicators.

We also found trends indicating that even though prevalence was significantly lower in the rural group for the conditions evaluated; this group also had the lowest level of hypertension and diabetes awareness. Therefore, while the burden of hypertension and diabetes is lower in rural areas, much higher gaps in unmet needs, in terms of awareness and treatment rates, are present in the rural setting. Yet, in the urban setting, rural-to-urban migrant show a worse treatment profile than urban counterparts unravelling newer care demands arising from urbanisation processes.

These sobering statistics pose major urgencies to better understand how the patterns of delays observed would affect individual and society. Assessing this problem from a LMIC perspective would require assessments at various levels including clinical, human capital, development and economic losses. Further action should avoid diagnosing late in the course of disease, together with complications, as well as decrease these major gaps in unmet needs.

Results in context of other studies

In Latin America, CVD is emerging as a leading cause of morbidity and mortality yet population-based data regarding the prevalence of CVD is scarce. A large population based study known as the Cardiovascular Risk Factor Multiple Evaluation in Latin America (CARMELA) study, conducted in seven major cities between 2003–2005, found high level of awareness for hypertension and diabetes, 64% and 78%, respectively, but low levels of treatment and control.[31] Of all urban centres studied in the region, Lima was found to have the lowest awareness, treatment and control rates at 47%, 29%, and 12%, respectively, compared to overall rates of 64%, 47%, and 24%.[31] Another population-based study completed in an urban setting in the Andean highlands of Peru, the PREVENCION study, found a hypertension prevalence of 15.7%, and awareness, treatment, and control of hypertension to be 48%, 40%, and 36%, respectively. Overall sub-optimal control among all hypertensive patients was 86%.[32] These results concur with our findings, yet better overall control rates were observed in this urban Andean setting.

In Cuba, the CARMEN study for cardiovascular risk factors found that while overall hypertension awareness was high at 78.5%, there were sex differences in awareness, with 85.8% awareness in women, and only 65.3% awareness in men.[33] These results show much higher levels of hypertension awareness than our findings, yet the same higher awareness in women than men was observed. Similar results have been found in previous reports.[34, 35] However, this advantageous profile did not result in a higher rate of women on anti-hypertension medicine. The CARMEN study showed that a factor that may contribute to higher awareness was that women sought out primary care services with higher frequency than men. This deserves further explorations, as evidence indicates that health-seeking behaviour for other cardiovascular acute conditions, in similar poor periurban settings of Lima, would be lower in women.[36]

Using data of another LMIC, the hypertension prevalence in the Chinese adult population was nearly 19% in 2002. Of the 24% aware of their diagnosis, 78% were treated and only 24% were adequately controlled.[37] Rates of awareness were almost half of what we found in Peru, however, levels of treatment among those aware of their condition was high compared to our results. Interestingly, although more people are treated according to the China study, rates of control were similar in both settings indicating major challenges to adherence in these LMIC settings.

Population-based studies carried-out in high-income countries found a greater prevalence of hypertension paired with higher levels of awareness, treatment and control. For example, the United States 2003–2004 NHANES study found that hypertension prevalence in adults was 29.3%, but awareness, treatment, and control were 76%, 65%, and 56%, respectively.[38] Sub-optimal control rate among all hypertensive patients was 63%,[38] much lower than in our study. In 2006 in England, awareness, treatment, and control rates were 66%, 54%, and 52%, respectively and, sub-optimal control rate was 72%.[39] This indicates that Peru has larger gaps in unmet needs compared to high-income countries.

In the case of diabetes, literature is scarce, in particular in the Latin American region.[40, 41] One study in China reported a diabetes prevalence of 5.5%, whereas awareness of diagnosis was only 23%. Of those aware, 85% were receiving treatment, and 35% had their fasting glucose levels controlled.[42] In the United States, the rate of undiagnosed diabetes is extremely low, at 2.2%.[12] Based on this scenario, the annual cost of this problem was estimated at US $2,864 dollars per case.[13, 43] From a LMIC point of view, these figures represent significant underestimations because it assumes a landscape of low prevalence of undiagnosed diabetes, that people in this status will require lesser medical costs than those with an established diagnosis, the rate of complications at point-of-diagnoses are not considered, and out-of-pocket payments to cover health care common in settings with weaker health systems are high.

Implications of the study findings

The ‘rule of halves’ has been explored in developed settings,[44–46] and less so in other LMIC [47] and international migrants. [48] Although initially proposed for hypertension, this rule has also been applied to other conditions, including diabetes.[16] This rule provides a simple way to illustrate gaps and unmet needs in relation to access to care to chronic conditions. Our results indicate, overall, there are considerable unmet needs in diagnosing, treating and controlling both hypertension and diabetes in different geographical settings of Peru. Sub-optimal control rates observed, reaching nearly 100%, poses major public health challenges to address hypertension and diabetes in Peru, and other similar LMIC settings, together with significant economic losses.[49]

Results of awareness and treatment rates by migration status also show interesting findings. Although not significant, higher awareness rates, for both hypertension and diabetes, were observed in migrant and urban participants compared to rural participants. Yet, for corresponding treatment rates, migrant estimates halved those of their urban counterparts. This imbalance uncovers newer challenges in access to health services and care for chronic conditions, specifically for rural-to-urban migrant populations, thus mounting to ongoing challenges of urbanization.[50–52] Given that internal migration is one of the drivers of LMIC’s urbanization process,[51, 53] our focus in migration status sheds lights on chronic disease care in the context of growing demands derived from ongoing urban growth.[54]

As diabetes has a lower prevalence rate than hypertension, larger studies would be required to determine factors contributing to awareness, treatment and control in this condition. However, around two-thirds of diabetics live in LMIC, and the number of diabetes cases in these countries will increase by 170% by 2025.[55] As a result, research in this topic is relevant.

Limitations

Some limitations deserve to be acknowledged. First, the absolute numbers of diabetic cases were low. Thus, determining factors that contribute to the outcomes studied was challenging. Second, we could not pursue multivariable analyses due to limited sample size; as such a national survey could be better suited for such purposes. Third, some variables found to have $p<0.05$ could not be considered significant after their alpha level was corrected by the Bonferroni procedure for 15 comparisons (0.003). Fourth, the cross-sectional nature of the data might have affected the ascertainment of the outcomes studied. However, most of the definitions used were standard definitions used in epidemiological surveys and this trade-off was considered acceptable in light of the advantage of capturing new information from low-income settings.

CONCLUSIONS

Awareness, treatment and control of hypertension and diabetes are low. Particular challenges are lack of awareness of both hypertension and diabetes in rural areas, and poor levels of treatment and control among people who have migrated from rural into urban areas. Interventions aimed towards closing unmet needs gap in LMIC are much needed in order to prevent major human capital and economic losses.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics of the study population

	N	%
Sex		
Male	466	47.2
Female	521	52.8
Age categories		
30–39 yrs	281	28.5
40–49 yrs	282	28.6
50–59 yrs	271	27.5
60+ yrs	153	15.5
Education level		
None/some primary school	327	33.2
Primary school completed	151	15.3
Secondary school or above	507	51.5
Multi-deprivation index (SES)		
No	689	69.8
Yes	298	30.2
Body mass index (kg/m^2)*		
<25	410	41.6
25> and <30	377	38.3
>30	198	20.1
Current tobacco user		
No	877	88.9
Yes	110	11.1
Heavy alcohol use		
No	896	90.8
Yes	91	9.2
Group		
Rural	199	20.2
Migrant	589	59.7
Urban	199	20.2

*Results may not add up due to missing values

Table 2

Awareness, treatment and control of hypertension and diabetes

	Hypertension			Diabetes		
	n	**%**	**95%CI**	**n**	**%**	**95%CI**
Overall*						
Diagnosis awareness	99/205	48.3	40.8% – 55.9%	23/33	71.1	54.5% – 87.7%
Current treatment	34/99	40.0	29.5% – 50.5%	8/23	40.6	18.9% – 62.3%
Treated and controlled**	10/34	30.4	13.6% – 47.3%	1/8	7.7	--
Rural						
Diagnosis awareness	12/33	36.4	20.4% – 54.9%	0/1	0	--
Current treatment	2/12	16.7	2.1% – 48.4%	--	--	--
Treated and controlled	0/12	0	--	--	--	--
Migrant						
Diagnosis awareness	59/106	55.7	45.7% – 65.3%	14/19	73.7	51.9% – 95.5%
Current treatment	18/59	30.5	19.2% – 43.9%	3/14	21.4	4.7% – 50.8%
Treated and controlled	6/18	33.3	13.3% – 59.0%	1/3	33.3	0.8% – 90.6%
Urban						
Diagnosis awareness	28/66	42.4	30.3% – 55.2%	9/13	69.2	40.2% – 98.3%
Current treatment	14/28	50.0	30.6% – 69.4%	5/9	55.6	21.1% – 86.3%
Treated and controlled	4/14	28.6	8.4% – 58.1%	0/5	0.0	0

* Overall prevalence and 95%CI were calculated using weights to account for participant's group size, and this weighting was not applied in individual groups. 95%CI were not calculated when sample size was too small.

** In the case of diabetes, all results treated and controlled figures shown were calculated using fasting glucose. For overall treated and controlled diabetes, if HbA1c <7.0% were to be used, then 0/8 patients would meet the criteria.

Table 3

Sociodemographic and clinical variables associated with hypertension and diabetes awareness

	Hypertension awareness	p-value	Diabetes awareness	p-value
Group				
Rural	12/33 (36.4%)		0/3 (0.0%)	
Migrant	59/106 (55.7%)	0.09	14/19 (73.7%)	0.47
Urban	28/66 (42.4%)		9/13 (69.2%)	
Sex				
Male	22/83 (26.5%)	**<0.001**	11/24 (45.8%)	0.91
Female	77/122 (63.1%)		12/16 (68.8%)	
Age categories				
30–39 yrs	18/26 (69.2%)		3/4 (75.0%)	
40–49 yrs	20/44 (45.5%)	0.16	5/5 (100.0%)	0.21
50–59 yrs	28/63 (44.4%)		13/19 (68.4%)	
60 + yrs	33/72 (45.8%)		2/5 (40.0%)	
Education level				
None/some primary school	37/81 (45.7%)		6/12 50.0%)	
Primary school completed	18/35 (51.4%)	0.82	4/4 (100%)	0.17
Secondary school or above	44/89 (49.4%)		13/17 (76.5%)	
Multi-deprivation index (SES)				
No	67/134 (50.0%)	0.56	20/26 (76.9%)	0.16
Yes	32/71 (45.1%)		3/7 (42.9%)	
Current tobacco user				
No	93/181 (51.4%)	**0.017**	20/28 (71.4%)	0.63
Yes	6/24 (25%)		3/5 (60.0%)	
Heavy alcohol user				
No	92/185 (49.7%)	0.25	22/31 (71.0%)	0.52
Yes	7/20 (35%)		1/2 (50.0%)	
Body mass index (kg/m^2)				
<25	25/66 (37.9%)		3/4 (75.0%)	
25> and <30	41/77 (53.3%)	0.11	13/17 (76.5%)	0.66
>30	33/61 (54.1%)		7/12 (58.3%)	

*Fisher's exact test was used for p-values calculations