Diseases of the rich? The social patterning of hypertension in six low and middle income countries.

Abstract: This paper identifies a general perception among development policymakers that health conditions such as hypertension and other non-communicable diseases (NCDs) disproportionately affect privileged socioeconomic groups. The paper argues that this framing of the issue is derived more by established discourses and institutional dynamics than by evidence. The paper then assesses the validity of this view, with reference to the social patterning of hypertension in China, Ghana, India, Mexico, the Russian Federation and South Africa. Using data for adults aged 50+ from the WHO Survey of Ageing and Adult Health, it finds the social patterning of hypertension prevalence varies markedly between the study countries, but that hypertension awareness and control rates are generally lower for less advantaged groups. This reveals a need to challenge misleading representations of NCD pandemics and for interventions that specifically target the poor.

Introduction.

Hypertension and non-communicable diseases (NCDs) are not as yet priority issues for international development. This is surprising, since NCDs already account for a higher share of mortality and illness in low and middle income countries (LMICs) than infectious diseases do, and are set to rapidly increase (WHO, 2010). Referring to the broader policy literature, the papers identifies reasons for this general neglect. These include a general perception that, in contrast to high income countries, in LMICs NCDs disproportionately affect relatively wealthy groups. Drawing on survey data for six countries, we examine the validity of this perception with particular reference to hypertension prevalence, awareness and effective control. In conclusion, we considers the wider applications of its findings for agenda-setting for NCDs in global health.

NCDs, hypertension and international development priorities.

NCDs include a range of health conditions, such as cardio-vascular diseases, cancers and diabetes. In 2008 they accounted for 63 per cent of all deaths globally, and 80 per cent of these deaths occurred in LMICs (WHO, 2010). In all world regions except Africa the number of deaths caused by NCDs in 2008 already exceeded those caused by infectious, maternal, perinatal and nutritional diseases combined. It is projected that this will be the case for Africa by 2030 (WHO, 2010). NCDs also account for around half the global burden of illness and disability (Beaglehole et al, 2011).

Hypertension is by some distance the leading risk factor for NCDs. WHO estimates that in 2008 hypertension was responsible for about 13 per cent of all global deaths (WHO, 2010).

Uncontrolled hypertension is a key, potentially preventable and readily treatable, risk factor for many prevalent diseases including stroke, ischaemic heart disease, renal insufficiency and dementia (Steyn et al, 2005; Ferri et al, 2011). Hypertension itself shares risks factors (such as obesity and lack of exercise) with other conditions, such as diabetes. As such, hypertension can be taken as broadly indicative of a wider set of NCD health risks and illness outcomes. There are also associations between hypertension and some forms of highly active antiretroviral therapy for HIV/AIDS (Crane et al, 2006).

Robust data on hypertension in LMICs are limited, due to a lack of emphasis on the epidemiological surveillance of NCDs (Banerjee, 2012). This is not helped by the asymptomatic nature of hypertension, which leads to low levels of awareness, reducing the reliability of data based on self-report, unless they are supported by diagnostic data. As such, estimates vary. Estimates from WHO and a Lancet meta-analysis both show rates of hypertension in developing regions now compare to those in high income ones (Kearney et al, 2005; WHO, 2010). According to the WHO study, Africa is the region with the highest estimated rates in the world -46 per cent for over 25s.[i]

Despite growing evidence of the prominence of NCDs in LMICs, these health conditions continue to receive a low priority as a development issue (Beaglehole et al, 2011; De Maeseneer et al 2012). It has been estimated that NCDs accounted for only 3 per cent of total global health assistance between 2001 and 2008 (Nugent and Feigl, 2010). In 2008/9 NCDs accounted for less than 4 per cent of health spending by the UK's Department for International Development (DFID). More than half of DFID's health budget went to HIV/AIDS, TB and malaria: conditions it labels "killer diseases" (Jones and Young, 2007). In 2011 a United Nations summit on NCDs proposed ten global targets, including a 25 per cent relative reduction in hypertension, but no specific funds were set aside by member states to achieve these targets (NCD Alliance, 2012). This imbalance can also be seen at the country level, such as the lack of reference to NCDs in the health sections of poverty reduction strategy papers.

Why are NCDs neglected, given the evidence of their rising prevalence? Social constructionist policy theory posits that the specific framing of policy issues and the nature of global policy communities can exert an equal or greater influence than objective, scientific evidence on priority-setting (Shiffman, 2009). Until recently, global institutional communities with particular interests in NCDs were weakly-articulated and uninfluential (Alleyne et al, 2013). More generally, global health agencies have remained focussed on historical health priorities, such as infectious disease, failing to respond to the changing epidemiology. At the same time, the NCD agenda has been resisted by powerful economic interests, such as global food alcohol and tobacco industries (Moodie et al, 2013).

Equally, the framing of NCDs as a global development concern has faced numerous difficulties. Unlike pandemics of infectious diseases, NCDs are not usually viewed as threatening by the populations of high income countries. The term “NCD” is itself problematic, given its lack of recognition by the general public. Another key difficulty, of particular relevance to policy-makers in development agencies, is the perceived relationship between NCDs and poverty. A recent WHO report on NCDs observed that there is a persistent perception that NCDs primarily affect wealthier groups in LMICs (WHO, 2010). This perception is influenced by the wider notion of epidemiological transition (ET) away from so-called “diseases of poverty” (infectious and nutritional) to so-called “diseases of affluence” (including NCDs) (Omran, 2005). Although rates of many NCDs are higher in poorer regions than richer ones, ET continues to frame global health thinking. This can be seen by a continued tendency within global health discourse to apply the label "diseases of poverty" to infectious conditions such as HIV/AIDS, TB and malaria. For example, a WHO report on health priorities for low income countries labelled infectious, nutritional and maternal conditions "poverty-related diseases", and NCDs as "developed country diseases" (WHO, 2004a). Whilst the report does make the point that NCDs are accounting for a growing share of mortality and illness in LMICs, this labelling implies that the poorest groups within these countries are relatively unaffected by NCDs. This is an entrenched view which the authors have frequently encountered among influential development policy-makers.

Epidemiological research demonstrating strong associations between being overweight or obese and the risk of many NCDs feeds into this view, albeit based on an assumption that being overweight does not occur among poorer groups (Neuman et al, 2011). At the same time, it is widely claimed that NCDs are strongly associated with urbanisation and population ageing (WHO 2010, Yach et al, 2004). This suggests that NCDs are relatively unimportant for rural populations and younger age groups, who tend to be prioritised in development policy. More generally, the evidence to support the view that NCDs disproportionately affect richer, more privileged socio-economic strata is not as robust or as consistent as these claims imply. In high income countries like the UK, there is a clear social gradient whereby lower socio-economic status is clearly associated with a higher risk of hypertension (Hotchkiss et al, 2011; Singh-Manoux et al, 2008). There is also evidence from the UK that levels of hypertension awareness (and hence control) tend to be lower for poorer groups (Johnston et al, 2009). Historical records for developed countries show a reversal of the social health gradient as a result of growing prosperity and changed lifestyles

(Chan et al, 2002). This involved a shift in NCD patterns from conditions that disproportionately affected the rich, to disproportionately affecting the poor.

The question is whether developing countries will follow the same trend and at what point this will occur, but the limited available evidence does not provide a conclusive answer (Gwatkin, 2013; Subramanian et al, 2013; Di Cesare et al, 2013). Current knowledge about where “tipping points” are likely to occur in the social gradient of health remains limited (Suhrcke et al, 2006). The few available studies of hypertension gradients in LMICs produce divergent results. For example, a study from Cuba showed that higher levels of education were associated with higher rates of hypertension for men but lower rates for women (Ordunez et al, 2005). A separate study in India found hypertension was significantly more prevalent in lower education groups for both men and women (Reddy et al, 2007), and similar results were reported for rural Uganda (Murphy et al, 2014). There is no evidence on levels of awareness or control of hypertension across socio-economic strata in LMICs. This is an important knowledge gap –if rates of control are lower for the poor, their exposure to stroke and other health risks will be higher than for other groups with equivalent rates of hypertension prevalence.

Similarly, there is only limited evidence to evaluate the claim that NCDs disproportionately affect urban populations. In fact, recent surveys of mortality and illness among rural populations in LMICs report higher than expected rates of NCDs (Joshi et al, 2006; Kahn et al 2006). Whilst age is a risk factor for hypertension and most NCDs, data for developed countries show large variations in age-specific rates, indicating a large degree of elasticity in the relationship between chronological age and risk (WHO, 2004b).

Despite the growing body of evidence that suggests otherwise, perceived associations of NCDs with developed countries (or groups within LMICs who enjoy developed country lifestyles) partly explains the continued low priority given to these conditions as a development issue (Beaglehole et al, 2011; De Maeseneer et al 2012). Consequently, there is a clear need to strengthen the evidence base to challenge this framing. The next sections of this paper review evidence for overall rates of hypertension in six LMICs, paying particular attention to social gradients and rural/urban disparities. As well as the prevalence of hypertension, they consider levels of awareness, control and treatment effectiveness.

Data and methods.

We used new data from the World Health Organization Study on Global Aging and Adult Health (SAGE). This comprises nationally representative household surveys in six countries, China, Ghana, India, Mexico, South Africa and the Russian Federation. Sampling methods were based on the design developed for the World Health Survey (WHS, 2003) where a probability sampling design was employed using multi-stage, stratified, random cluster samples. The primary sampling units were stratified by region and location (urban/rural) and, within each stratum, enumeration areas were selected. Details are available at Kowal et al (2012) and the SAGE website (www.who.int/healthinfo/systems/sage). The six countries comprise a total study population of 35,125 people aged 50 and over. Table 1 shows the distribution of characteristics for the SAGE sample as a whole and by country and response rates. With the exception of Mexico, individual response rates ranged from 92.3 per cent in India to 77.7 per cent in South Africa. The response rate for Mexico was only 52.4 per cent, calling into question the robustness of the data for this country.

TABLE 1 ABOUT HERE

The SAGE data analysis was weighted, reflecting the inverse of the probability of selection for each individual, trimmed and post-stratified, based on the UN Population Standards data. The SAGE protocol required three objective blood pressure measurements; a self-reported question (have you ever been diagnosed with high blood pressure?); and two treatment question (have you been taking any medications or other treatment during the last two weeks?; have you been taking any medications or other treatment during the last 12 months?).[ii] The period of data collection varied by country, ranging from 2007 to 2010.

We used a multivariable logistic regression to examine the association of a range of characteristics with the following outcomes: hypertension, awareness of diagnosis and use of anti-hypertensives. This was applied to each country sample individually, and to the total pooled sample. All characteristics were retained in the final "forced" multivariable model, with complete data on all variables. Hypertension was defined if the mean of the last two measurements was ≥140 (Systolic blood pressure) or ≥90 (Diastolic blood pressure), or by currently taking anti-hypertensives. Control of hypertension was defined as being on treatment during the previous two weeks and a mean blood pressure below 140/90 over the previous two measurements. A person was defined as aware if he/she was hypertensive and self-reported the condition. Thus, the proportion of controlled hypertension included those who self-reported being hypertensive and on treatment among all those who were hypertensive or normotensive on treatment. The proportion of effective treatment included those who were on treatment and were normotensive among all hypertensives on treatment.

Independent variables were chosen from characteristics previously associated with hypertension in the literature. For the hypertension analysis, the adjusted model included: age, sex, education, wealth quintiles at the household level, location (rural/urban), body mass index (BMI, kg/m2), smoking, alcohol consumption and physical exercise. Body Mass Index (BMI) was classified as follows: underweight: BMI<18.5; normal: 18.5≤BMI<25; overweight: 25 ≤BMI<30; obese: BMI≥30. Wealth quintiles were derived from the household ownership of durable goods, dwelling characteristics (type of floors, walls and cooking stove), and access to services (improved water, sanitation and cooking fuel) for a total of 21 assets. Household economic status was determined using a dichotomous hierarchical ordered probit model, based on ownership of these selected assets and access to certain services (Ferguson et al, 2003; Gakidou et al, 2007; Hosseinpoor et al, 2005). This model returns a summary index between 0 (low ownership/access) and 1 (high), whose quintiles are entered into the logistic regression as a covariate. Goodness-of-fit was assessed through the global chi-square, the Hosmer-Lemeshow statistics, the area under the ROC, the Pearson residual and the variance residual, and by plotting the estimated values versus residuals. Assessment of collinearity was checked by computing the tolerance and variance inflation factor produced by the linear regression analysis.

We applied similar models to participants observed to have hypertension or anti-hypertensive treatment to determine the factors associated with awareness, control and treatment efficacy. The adjusted model included: age, sex, education, location (rural/urban) and household wealth quintiles.

Social gradients of hypertension prevalence, awareness and control.

TABLE 2 ABOUT HERE

Table 2 shows the prevalence of hypertension across the six SAGE countries, as well as by wealth quintile, rural/urban location and level of education. Although there are variations between wealth and education categories, the cross-national differences are much larger. Overall prevalence ranged from 33 per cent in India to 78 per cent in South Africa; comparable to rates reported for high income countries (Egan et al, 2010). The prevalence of hypertension in South Africa is the highest that has ever been recorded by a nationally representative study for any country in the world. South Africa is the only country in southern Africa for which these data are available, raising the question whether neighbouring countries may have similar or even higher rates of prevalence. There is no apparent relationship between levels of national economic development and prevalence, with similar rates reported for Ghana, Mexico and China.

Table 2 does not show consistent patterns of social gradients by wealth quintile. In the case of India and Ghana, there is higher prevalence among wealthier groups, while in China and the Russian Federation, there are below average rates of prevalence for the wealthiest quintile. In South Africa there is no indication of a gradient either way. Mexico displays an unusual pattern, with particularly high rates for quintile 2, although this may be an artefact of low response rates and so should be treated with some caution. Comparisons across education groups need to take into account that the numbers in some categories are very small: for example, only 10.5 per cent of older people in Mexico had higher education and only 0.7 per cent of older Russians had no education. India and Ghana show a slight gradient towards higher prevalence among more educated groups. Conversely, China, the Russian Federation, South Africa and Mexico show lower rates for more educated groups. Taken together, the data on wealth quintiles and education suggest that India and Ghana have yet to pass any tipping point in the NCD social gradient, whereas China and the Russian Federation have done so. That said, rates of prevalence among the poorest and least educated in Ghana and India are only marginally below national averages, and so the significance of social gradients should not be over-stated. Relative rates of hypertension between rural and urban populations varied across the SAGE countries, with higher rates among rural older people in three cases (Mexico, China and South Africa).

TABLE 3 ABOUT HERE

Table 3 presents adjusted individual-level multivariable analysis of socio-economic characteristics potentially associated with hypertension.[iii] In India, prevalence was associated with the wealthiest quintile, as well as for quintile 4, but there were no significant associations for education. In Ghana, there were significant associations for quintiles three, four and five and for no education. This supports the hypothesis that India and Ghana have yet to pass any social gradient tipping point. South Africa presents a more varied scenario: there was a significant positive association with the wealthiest quintile, but there was a negative association with having a higher education. In China there were no significant associations by either wealth quintile or education. In Mexico there was a significant positive association with quintile two and in Russia for quintile four. Rural location was positively associated in China, but negatively in Ghana. Female sex was positively associated in Ghana, India and South Africa. Being in older age groups was consistently associated with hypertension across the SAGE countries, with the exception of Ghana where it was only significant for people aged 65 to 69.

Taken together, the results in Table 3 indicate that India and Ghana have clear social gradients, with higher rates of hypertension among wealthier groups. The findings for the other four countries provide less persuasive evidence of a social gradient. In the case of South Africa, and to some extent Russia, this is probably in part because the rates of hypertension prevalence are very high for the population in general. It is also possible that these countries, along with China, have reached a social gradient tipping point, leading to less linear sets of associations.

TABLE 4 ABOUT HERE

Separate epidemiological analysis of non-socio-economic risk factors for hypertension in the same populations reports a very strong, significant and consistent association with higher body mass index (BMI) (Lloyd-Sherlock et al, 2014). Given this strong association, it is of interest to assess the socio-economic patterning of high BMI. Table 4 shows data on the prevalence of overweight/obesity for the SAGE countries and again reveals much larger variations between countries than across social groups. Overall rates of overweight/obesity ranged from 12.9 per cent in India to 78.0 per cent in Mexico. Rates of obesity were higher for wealthier quintiles in five countries; in the case of the Russian Federation, there was less evidence of a social gradient. In three countries (Mexico, South Africa and the Russian Federation) obesity was a generalised condition and, although rates were higher for the wealthy, over 60 per cent of the poorest quintile was overweight/obese. In the other three (India, Ghana and China) overall rates were much lower and there was a much more notable social gradient. In the case of India, rates for the wealthiest quintile (25.5 per cent) were more than eight times those for the poorest (3.2 per cent). In India, Ghana and China, the social gradient for obesity was more pronounced than the one for hypertension, indicating that the relationship between high BMI, as well as other risk factors and hypertension may vary across socio-economic groups. The differences in overall rates and social gradients between these two sets of countries largely reflect their current positions in the nutritional transition (Prentice, 2006).

TABLE 5 ABOUT HERE

Table 5 shows the proportion of people with hypertension who were aware of their condition. As with prevalence, there are large national variations with awareness ranging from 72 per cent in the Russian Federation to 23 per cent in Ghana. There are clear social gradients by wealth quintile for all countries other than Mexico, where awareness is particularly low for quintile 2. For education, there are gradients for India and Ghana and less consistent patterns for the other countries. The effects of rural/urban location varied by country. In China, Ghana, India and South Africa, rural populations had lower awareness, whereas in Mexico and Russia they were higher.

TABLE 6 ABOUT HERE

Table 6 presents the findings of the multivariable analysis of socio-economic effects on awareness. Being in wealth quintiles two, three, four and five was positively associated with awareness in China and in India. For Ghana, there were significant associations for quintiles three four and five and in Russia just for quintile five. There were fewer significant results for education. In Ghana having no education was negatively associated with awareness and higher education was positively associated. In India higher education was also associated with awareness. In Russia there was a negative association for no education, but the number in this category was very small. Female sex was positively associated in every country other than Mexico. Rural location was negatively associated with awareness in all countries other than Mexico and Russia. Taken together, the results presented in Table 6 demonstrate clear social gradients for awareness in China, Ghana and India, whereby being less wealthy and living in rural locations was associated with lower levels of awareness.

TABLE 7 ABOUT HERE

Table 7 shows the proportion of people who were hypertensive but who had their condition under control due to effective treatment. National rates of control are low, ranging from 4.1 per cent in Ghana to 14.1 per cent in India. All countries other than Mexico demonstrate pronounced social gradients, with lower rates of control among the poor. There are clear gradients for education groups in India, China and the Russian Federation, but less consistent patterns for the other three countries. Control rates are lower in rural locations for all countries other than Mexico, where they are higher.

TABLE 8 ABOUT HERE

Table 8 presents the multivariate analysis for determinants of hypertension control. Being in wealth quintiles four and five was positively associated with control in India and Russia, as was being in quintile five in Ghana. Having secondary or higher education was associated with control in China, and higher education was also significant in India. By contrast, having no education was associated with lower rates of control in Russia. In all countries other than Mexico and South Africa rural location was negatively associated with control. In India and South Africa, female sex was associated with higher rates.

Taken together, the descriptive and multivariate analyses in Tables 2 to 8 show considerable variation in national experience. Ghana and India present a clear prevalence gradient with higher rates of hypertension among wealthier groups. However, these effects are to some extent off-set by higher rates of awareness and control among these groups. There were less consistent results for the other SAGE countries, or for educational categories.

Conclusions.

This paper demonstrates a strong perception in the international development community that NCDs are conditions associated with affluence and therefore are inherently less important than health conditions supposedly associated with poverty. Whilst not always expressed explicitly, this view is manifested in the almost complete neglect of NCDs by the main academic journals related to international development. This paper contributes to the growing evidence that this perception is almost entirely unfounded. While it is true that the prevalence of hypertension is higher for wealthier groups in Ghana and India, this does not mean it is uncommon among the poor. In the case of Ghana, nearly half the poorest quintile were found to be hypertensive. Moreover, it is essential to go beyond prevalence data to consider the extent to which individuals are able to effectively manage these conditions. With the exception of Mexico, the SAGE data show that poorer, less educated groups and those in rural areas are less likely to be aware they have hypertension or to be effectively controlling their condition. This indicates the need for tailored interventions to meet the needs of these groups in low and middle income countries, drawing on wider experiences of extending basic health services to excluded groups.

There is a tendency to frame the growing prevalence of NCDs as an almost inevitable epidemic of wider global trends such as population ageing, urbanisation and modernisation. However, the SAGE data show an inconsistent association between urban location and prevalence, coupled with high rates of awareness and control in urban locations. Better access to healthcare among the urban population has a positive effect on controlling hypertension and may be a benefit of urbanisation. Similarly, the data show large variations in prevalence between countries for the same age groups, indicating that the effect of population ageing on NCDs is far from inevitable and inelastic. This calls into question a tendency to exclude older people from NCD interventions (Lloyd-Sherlock et al, 2015).

The evidence that NCDs matter for poor people in poor countries is increasingly abundant. However, this evidence alone may not be enough to overcome the powerful institutional forces and discourses that continue to frame NCDs as something else. There are signs that global NCD networks are starting to gain influence, reflected in the inclusion of an NCD target in the Sustainable Development Goals. For now, rather than prove that NCDs affect the poor, the key challenge for researchers is to identify what works best in tackling these conditions among rural, uneducated and disadvantaged populations. Here the evidence remains minimal.

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Table 1: Distribution (%) of characteristics, overall and by country.

		China (n=13349)	Ghana (n=4725)	India (n=7150)	Mexico (n=2315)	Russian Federation (n=3763)	South Africa (n=3839)
Age (years)	[50-54)	21.8	21.0	23.6	26.3	23.1	28.3
	[55-59)	23.3	19.4	25.3	21.8	22.1	21.5
	[60-64)	17.2	14.8	16.5	14.3	11.5	16.9
	[65-69)	14.6	12.5	14.0	11.2	13.1	13.7
	[70-74)	11.1	14.3	10.6	7.8	10.4	8.4
	[75+	12.1	18.0	10.0	18.6	19.8	11.2
Sex	Males	49.8	49.7	51.1	46.8	38.9	44.0
	Females	50.2	50.3	48.9	53.2	61.1	56.0

Education	None	23.8	54.0	51.2	17.2	0.7	25.2
	Primary	39.5	21.3	24.9	62.4	6.8	46.4
	Secondary	19.7	4.0	10.2	9.9	20.2	14.2
	Higher	17.0	20.7	13.7	10.5	72.3	14.2
BMI	Normal	60.5	55.3	48.3	21.4	23.8	24.7
	Underweight	4.3	15.3	39.0	0.6	1.1	3.3
	Overweight	29.5	19.7	10.6	49.4	40.8	26.9
	Obese	5.7	9.7	2.1	28.6	34.3	45.1
Location	Urban	47.6	40.6	29.4	78.8	72.7	64.9
	Rural	52.4	59.4	70.6	21.2	27.3	35.1
Wealth quintile	Poorest	16.3	18.4	17.9	15.3	16.2	20.7
	Q2	18.2	19.4	19.3	24.7	19.6	19.9

	Q3	20.5	20.7	18.8	16.8	19.1	18.2
	Q4	23.3	20.0	19.5	16.6	20.5	19.8
	Richest	21.7	21.5	24.5	26.6	24.6	21.4
Response rate		92.3	78.4	87.3	52.4	82.3	77.7

Table 2. Prevalence of hypertension by wealth quintile, education and living area (% of total population aged 50 and over).

	China	Ghana	India	Mexico	Russia	S Africa
Overall	59.5	57.1	32.6	58.2	71.1	77.9
Poorest quintile	62.7	47.1	25.9	63.8	72.3	76.0
Quintile 2	58.6	52.8	30.2	71.3	74.7	76.8
Quintile 3	59.8	56.6	30.1	46.9	74.0	78.5
Quintile 4	60.0	61.7	34.0	53.9	75.3	78.3
Wealthiest quintile	56.7	65.6	40.4	51.9	61.4	79.2
No education	64.4	54.3	31.1	75.6	81.3	80.7
Primary	60.1	60.6	33.3	57.4	87.8	79.4
Secondary	57.0	58.0	33.4	41.9	76.5	78.7

Higher	53.9	61.2	35.9	49.9	67.9	72.7
Urban	57.0	65.7	37.0	57.5	71.1	77.7
Rural	61.6	51.2	30.8	60.9	71.0	78.2

Table 3. Odds ratios (95% CI) for hypertension (adjusted for all the other variables in the table).

		China (n=11980)	**Ghana** (n=3931)	**India** (n=4420)	**Mexico** (n=2060)	**Russian Federation** (n=3200)	**South Africa** (n=2610)
Age (years)	[50-54)	1	1	1	1	1	1
	[55-59)	1.32 (1.19-1.48)	1.08 (0.85-1.38)	1.31 (0.99-1.74)	1.83 (0.82-4.10)	1.42 (0.81-2.48)	1.36 (0.93-1.98)
	[60-64)	1.78 (1.59-2.00)	1.19 (0.91-1.54)	1.16 (0.88-1.52)	2.74 (1.21-6.24)	2.20 (1.27-3.83)	1.58 (0.99-2.54)
	[65-69)	2.22 (1.86-2.64)	1.36 (1.04-1.78)	1.78 (1.30-2.44)	5.21 (2.45-11.09)	1.88 (0.80-4.41)	1.52 (1.03-2.26)
	[70-74)	2.73 (2.24-3.34)	1.20 (0.92-1.58)	1.83 (1.37-2.46)	5.17 (2.65-10.06)	3.08 (1.69-5.61)	1.38 (0.79-2.41)
	[75+	3.23 (2.68-3.89)	1.09 (0.84-1.40)	1.89 (1.43-2.51)	4.80 (2.30-10.05)	4.60 (2.51-8.44)	1.62 (1.09-2.40)
Sex	Males	1	1	1	1	1	1
	Females	1.05 (0.97-1.13)	1.31 (1.12-1.54)	1.38 (1.16-1.63)	1.22 (0.71-2.12)	1.31 (0.86-2.00)	1.42 (1.09-1.85)
Education	Primary	1	1	1	1	1	1
	None	0.95 (0.80-1.13)	0.80 (0.66-0.98)	0.90 (0.73-1.10)	2.12 (0.98-4.60)	0.55 (0.19-1.60)	1.09 (0.81-1.48)
	Secondary	1.07 (0.96-1.19)	0.77 (0.51-1.16)	1.07 (0.83-1.38)	0.61 (0.26-1.44)	0.65 (0.33-1.27)	0.86 (0.57-1.28)

	Higher	0.90 (0.75-1.07)	0.94 (0.74-1.19)	1.10 (0.85-1.43)	0.73 (0.32-1.66)	0.65 (0.38-1.12)	0.59 (0.39-0.90)
Location	Urban	1	1	1	1	1	1
	Rural	1.38 (1.19-1.61)	0.64 (0.52-0.79)	0.87 (0.68-1.11)	0.95 (0.45-1.99)	1.12 (0.71-1.76)	1.00 (0.71-1.40)
Wealth quintile	Poorest	1	1	1	1	1	1
	Q2	0.94 (0.80-1.09)	1.20 (0.99-1.46)	1.25 (0.89-1.76)	2.65 (1.07-6.56)	1.16 (0.81-1.67)	1.00 (0.62-1.62)
	Q3	1.06 (0.92-1.22)	1.36 (1.06-1.74)	1.22 (0.94-1.56)	0.92 (0.44-1.95)	1.07 (0.60-1.90)	1.24 (0.76-2.04)
	Q4	1.17 (0.99-1.37)	1.55 (1.19-2.01)	1.47 (1.15-1.86)	1.29 (0.67-2.46)	1.58 (1.05-2.39)	1.43 (0.88-2.33)
	Richest	1.14 (0.94-1.37)	1.68 (1.28-2.21)	1.78 (1.38-2.29)	1.52 (0.79-2.92)	0.86 (0.53-1.39)	1.80 (1.04-3.12)

Table 4. Prevalence of overweight/obese by wealth quintile, education and living area (% of total population aged 50 and over).

	China	Ghana	India	Mexico	Russia	S Africa
Overall	35.2	29.5	12.8	78.0	75.1	72.1
Poorest quintile	23.8	12.2	2.9	69.3	72.4	60.2
Quintile 2	30.1	19.5	8.8	76.8	72.8	64.6
Quintile 3	36.0	22.8	10.7	79.1	70.3	74.0
Quintile 4	39.9	37.6	12.0	82.0	82.1	81.1
Wealthiest quintile	42.0	51.1	25.7	80.9	76.2	80.6
No education	31.9	24.3	8.2	72.3	94.9	60.9
Primary	34.9	32.2	14.3	79.9	60.4	70.9
Secondary	37.0	44.3	17.8	75.0	75.2	83.5

Higher	38.4	36.9	22.9	82.3	76.2	80.8
Urban	39.4	44.1	22.0	79.5	74.8	76.5
Rural	31.6	19.3	9.1	72.9	75.8	64.1

Table 5. Prevalence of hypertension awareness by wealth quintile, education and living area (% of people with hypertension).

	China	Ghana	India	Mexico	Russia	S Africa
Overall	42.7	23.3	37.8	44.6	72.1	38.0
Poorest quintile	34.1	11.0	18.6	52.5	63.6	28.2
Quintile 2	38.1	13.5	32.8	29.1	72.5	34.1
Quintile 3	42.7	18.0	34.5	51.2	72.9	39.8
Quintile 4	45.0	28.9	38.1	51.7	68.5	42.6
Wealthiest quintile	51.9	37.5	52.5	51.3	81.7	44.0
No education	40.8	17.9	30.4	42.7	90.0	34.8
Primary	38.2	23.7	35.8	43.6	67.6	40.5
Secondary	45.1	32.7	44.9	38.3	76.7	39.8

Higher	56.1	33.7	60.0	61.0	70.8	33.7
Urban	57.0	32.7	51.5	42.8	71.7	40.8
Rural	31.4	15.0	31.4	50.6	73.2	32.9

Table 6. Adjusted model for being aware of the presence of hypertension by country (Odds Ratios with 95% Confidence Intervals).

		China (n=3565)	**Ghana (n=1510)**	**India (n=1798)**	**Mexico (n=454)**	**Russian Federation (n=1495)**	**South Africa (n=1165)**
Wealth quintile	Poorest	1	1	1	1	1	1
	Q2	1.20 (1.03-1.40)	1.16 (0.71-1.88)	2.02 (1.20-3.40)	0.44 (0.17-1.13)	1.66 (0.97-2.82)	1.12 (0.66-1.88)
	Q3	1.30 (1.07-1.58)	1.55 (0.99-2.42)	1.92 (1.10-3.36)	1.00 (0.51-1.97)	1.70 (0.96-3.03)	1.37 (0.82-2.27)
	Q4	1.39 (1.20-1.60)	2.49 (1.64-3.80)	2.14 (1.32-3.47)	1.13 (0.54-2.37)	1.57 (0.80-3.07)	1.42 (0.82-2.46)
	Richest	1.42 (1.14-1.76)	3.22 (2.03-5.08)	2.67 (1.61-4.44)	1.16 (0.53-2.57)	3.54 (1.49-8.41)	1.71 (0.96-3.03)
Age (years)		1.03 (1.02-1.04)	1.03 (1.01-1.04)	1.02 (1.01-1.03)	1.04 (1.01-1.06)	1.02 (0.99-1.04)	1.03 (1.02-1.05)
sex	Males	1	1	1	1	1	1
	Females	1.47 (1.34-1.61)	2.27 (1.74-2.97)	1.96 (1.43-2.68)	1.68 (0.97-2.89)	2.44 (1.60-3.72)	1.58 (1.16-2.14)
Location	Urban	1	1	1	1	1	1
	Rural	0.44 (0.38-0.51)	0.54 (0.40-0.74)	0.61 (0.46-0.83)	1.37 (0.73-2.57)	1.03 (0.53-2.00)	0.68 (0.49-0.94)
Education	Primary	1	1	1	1	1	1
	None	0.97 (0.85-1.13)	0.66 (0.46-0.93)	0.79 (0.55-1.13)	0.96 (0.44-2.07)	3.85 (1.07-13.89)	0.84 (0.62-1.14)
	Secondary	1.18 (0.99-1.42)	1.31 (0.68-2.53)	1.64 (0.99-2.69)	0.89 (0.39-2.06)	1.70 (0.74-3.95)	0.88 (0.58-1.33)
	Higher	1.43 (1.20-1.70)	1.53 (1.05-2.23)	2.87 (1.67-4.96)	2.02 (0.68-6.03)	1.40 (0.55-3.55)	0.69 (0.41-1.15)

Table 7. Prevalence of hypertension control by wealth quintile, education and living area (% of people with hypertension).

	China	Ghana	India	Mexico	Russia	S Africa
Overall	8.3	4.1	14.1	11.8	10.5	7.8
Poorest quintile	4.9	1.7	5.4	15.7	5.8	3.0
Quintile 2	6.5	1.4	7.6	5.4	9.2	6.8
Quintile 3	8.7	2.0	9.3	14.2	10.1	6.5
Quintile 4	9.7	3.7	17.0	17.0	11.9	11.6
Wealthiest quintile	11.0	9.9	23.5	12.6	14.4	10.6
No education	5.6	3.0	11.2	15.0	1.6	8.1
Primary	6.2	4.0	13.1	10.4	10.7	6.8
Secondary	10.2	9.4	17.8	11.2	10.3	10.1

Higher	16.5	5.8	22.8	13.3	10.6	7.2
Urban	15.6	7.1	21.0	10.1	11.9	9.4
Rural	2.5	1.5	10.9	17.3	6.7	4.8

Table 8. Adjusted model for effective control of hypertension in hypertensive participants (Odds Ratios with 95% Confidence Intervals).

		China (n=3575)	**Ghana (n=1510)**	**India (n=1802)**	**Mexico (n=454)**	**Russian Federation (n=1495)**	**South Africa (n=1165)**
Wealth quintile	Poorest	1	1	1	1	1	1
	Q2	1.18 (0.74-1.86)	0.71 (0.22-2.25)	1.44 (0.60-3.43)	0.45 (0.15-1.36)	1.55 (0.77-3.11)	2.29 (0.66-8.03)
	Q3	1.18 (0.77-1.82)	0.96 (0.28-3.34)	1.65 (0.76-3.58)	1.23 (0.48-3.16)	1.87 (0.98-3.56)	1.74 (0.58-5.17)
	Q4	1.20 (0.78-1.83)	1.44 (0.57-3.61)	3.27 (1.55-6.90)	1.85 (0.67-5.06)	2.63 (1.45-4.76)	2.60 (0.84-8.04)
	Richest	0.93 (0.54-1.57)	3.44 (1.44-8.17)	3.98 (1.87-8.46)	1.45 (0.38-5.55)	3.34 (1.85-6.06)	3.22 (0.98-10.56)
Age (years)		1.01 (1.00-1.02)	1.03 (1.01-1.05)	1.02 (1.00-1.04)	1.02 (0.99-1.06)	1.01 (0.99-1.04)	1.02 (1.00-1.04)
sex	Males	1	1	1	1	1	1
	Females	0.99 (0.83-1.19)	1.38 (0.78-2.47)	1.59 (1.13-2.22)	3.06 (1.58-5.94)	1.44 (0.92-2.27)	1.74 (1.03-2.94)
Location	Urban	1	1	1	1	1	1
	Rural	0.16 (0.11-0.23)	0.33 (0.16-0.68)	0.67 (0.42-1.06)	1.84 (0.81-4.19)	0.49 (0.24-0.99)	0.64 (0.36-1.14)
Education	Primary	1	1	1	1	1	1
	None	0.98 (0.68-1.41)	0.78 (0.36-1.71)	1.01 (0.69-1.48)	1.59 (0.75-3.38)	0.12 (0.02-0.72)	1.41 (0.76-2.60)
	Secondary	1.26 (0.99-1.59)	1.58 (0.59-4.18)	1.45 (0.84-2.51)	1.40 (0.56-3.48)	0.99 (0.52-1.91)	1.30 (0.72-2.36)

	Higher	1.62 (1.20-2.19)	1.05 (0.51-2.18)	1.77 (1.04-3.01)	1.44 (0.53-3.93)	0.99 (0.51-1.92)	0.87 (0.47-1.62)

[i] Attempts to isolate this a racial effect in comparative studies have been hampered by associations between race and socio-economic status (Ferdinand and Townsend, 2012).

[ii] Some studies indicate that the use of a single measurement occasion for defining hypertension may reduce the reliability of prevalence data, but it unlikely to affect the social gradients or associations with different population groups (Chiolero et al, 2007).

[iii] Table 3 does not include other risk factors, such as weight or diet, since it is primarily concerned with social gradients and not a comprehensive analysis of potential risk factors. See Lloyd-Sherlock et al (2014) for a comprehensive, epidemiological analysis.