Original article

# Education, household wealth and blood pressure in Albania, Armenia, Azerbaijan and Ukraine: Findings from the Demographic Health Surveys, 2005-2009 ${ }^{\text {NT }}$ 

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#### Abstract

Background: While socioeconomic gradients in cardiovascular disease have been well established in high-income countries, this relationship is not well understood in middle-income countries. Methods: Data from Demographic Health Surveys collected in Albania (2008-09), Armenia (2005), Azerbaijan (2006) and Ukraine (2007) were used to estimate age-adjusted differences in systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse pressure (PP), hypertension (HTN), elevated blood pressure, and optimal blood pressure across a standardized wealth index, level of educational attainment, and urban versus rural residence. Results: The wealthiest Albanian females had lower average SBP, DBP, PP (all p<0.01) and HTN status (odds ratio $[\mathrm{OR}]=0.3, \mathrm{CI}: 0.2-0.5, \mathrm{p}<0.001$ ) compared to the poorest; similar education gradients were also found. Such disparities also existed for Albanian men. Among Armenian women, urban ( $\mathrm{OR}=1.4,1.1-1.8, \mathrm{p}<0.01$ ), more educated ( $\mathrm{OR}=0.7, \mathrm{CI}: 0.6-0.9, \mathrm{p}<0.01$ ), and wealthier ( $\mathrm{OR}=1.8,1.4-2.4, \mathrm{p}<0.001$ ) women were more likely to have optimal blood pressure. Urban Armenian men were also more likely to have optimal blood pressure ( $\mathrm{OR}=1.8,1.2-2.9, \mathrm{p}<0.01$ ). Wealthier and urban Azerbaijani had lower risk of elevated blood pressure and Azerbaijani women displayed strong wealth gradients with higher quintiles of wealth associated with lower continuous blood pressure measures. There were no socioeconomic gradients for Ukrainian males or females. Conclusions: There is compelling evidence that wealth and education gradients affect the probability of HTN for women in Albania, Armenia, and Azerbaijan, and for men in Albania.


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## 1. Introduction

Since the middle of the 19th century, countries in Northern Europe have experienced approximately a $50 \%$ increase in adult life expectancy, with a concomitant $90 \%$ decline in childhood mortality [1]. The epidemiologic transitions in these countries occurred as a result of economic development, improvements in sanitation, access to nutrition, and advances in medical technology [2,3]. As a result, populations survived long enough to develop cardiovascular disease (CVD), currently the number one cause of death and disability worldwide [2-6]. Wealthier countries in Northern and Western Europe, as well as the United States, Japan, and Australia were the first to experience increases in CVD, whereas similar trends have only more recently occurred in low- and middle-income countries [5-11]. However, a particular focus on CVD risk factors in low-and middle-income countries is of high

[^0]importance, as the consequences of CVD disproportionately impact mortality in these populations. Indeed, while chronic diseases such as CVD, cancer, chronic respiratory diseases, and diabetes accounted for $60 \%$ ( 35 million) of all deaths worldwide in $2005,80 \%$ of these deaths occurred in low- and middle-income countries [7].

Historically, the largest and lasting burden of CVD has fallen on the poorest and least educated citizens of countries that have undergone the epidemiological transition, as the wealthier and more educated had the advantage of increased access to medical care and pharmaceuticals that successfully modify the known risk factors for CVD [12-14]. Elevated blood pressure is one of these CVD risk factors (other examples include elevated blood glucose, cholesterol, and abdominal obesity). The relationship of blood pressure to CVD is independent of other CVD risk factors and while previous guidelines have identified stage I hypertension (HTN) as SBP/DBP of $\geq 140 / 90$ millimeters of mercury ( mm Hg ) [15], many experts advocate lower blood pressure goals given evidence that above blood pressures of $115 / 75 \mathrm{~mm} \mathrm{Hg}$, CVD mortality doubles with each 20 mm Hg increment in SBP and 10 mm Hg increment in DBP for persons aged 40-49 [16]. Studies carried out in wealthy countries have consistently found a higher mean blood pressure and greater frequency of HTN among people of lower socioeconomic position (SEP) [17-19]. However, the empirical
literature that exists on SEP and CVD in middle-income countries is sparse and conflicting on the link between SEP and CVD risk factors [9,17]. Given these uncertainties, there is a growing interest in country-specific research to identify patterns of CVD risk factors such as high blood pressure [20,21], particularly in low- and middle-income countries [10,22-24]. Therefore, understanding patterns of blood pressure in low- and middle-income countries, where mortality from chronic disease is particularly high, is the goal of this manuscript. We seek to contribute to the knowledge of the relationship between SEP and blood pressure by examining nationally representative survey data from Albania, Armenia, Azerbaijan and Ukraine [25]. These four middle-income countries (as defined by the World Bank) have not been included in other regional socioeconomic and health analyses [25-32]. We hypothesized, as described in high-income countries, that high blood pressure, an important modifiable CVD risk factor, exhibits an inverse gradient with SEP [12-14,17]. We also hypothesized, based on prior evidence, that lower SEP more strongly and adversely impacts women and urban inhabitants [4,8,12,13,17,33].

## 2. Methods

### 2.1. Data sources

Nationally representative surveys known as Demographic Health Surveys (DHS) conducted in Albania (2008-09) [34], Armenia (2005) [35], Azerbaijan (2006) [36] and Ukraine (2007) [37] were used for this analysis. ICF International conducts these surveys in many low- and middle-income countries in collaboration with national partners. Survey households are chosen using a 2 -stage sampling process in which representative clusters are selected from a national sampling frame and a random sample of households is selected within each cluster. In each household, women between 15 and 49 years of age who consent are interviewed. Though women are the primary focus of these surveys, DHS also collects data on males (15-49 years) in consented households. The informed consent process
typically involves verbal consent from the participants, presumably because literacy rates are low in many of the regions in which the DHS are conducted. Response rates were greater than $90 \%$ in all surveys in this analysis (Table 1). This study was based on anonymous public use data with no identifiable information on the survey participants.

### 2.2. Measurement of the outcome variables

We examined hemodynamic indices found to have independent associations with CVD outcomes [38,39]. In each country, trained interviewers (including physicians and nurses) took blood pressure readings using a fully automatic, digital oscillometric blood pressure measuring device (Table 1). Three measurements of SBP and DBP were taken during the survey interview, with an interval of at least 10 minutes between measurements. The average of the three measurements was used to estimate the following outcomes: (1) continuous central hemodynamics: [a] SBP, [b] DBP, and [c] pulse pressure (PP) $=$ SBP - DBP [40]; (2) pre-specified blood pressure cut-offs: [a] HTN (defined as $\mathrm{SBP} \geq 140 \mathrm{~mm} \mathrm{Hg}, \mathrm{DBP} \geq 90 \mathrm{~mm} \mathrm{Hg}$, or both) [15] and [b] elevated blood pressure (defined as $S B P \geq 130 \mathrm{~mm} \mathrm{Hg}$, DBP $\geq 85 \mathrm{~mm} \mathrm{Hg}$, or both ), a level identified in the most recent harmonized definition of the Metabolic Syndrome as a CVD risk factor [41]; and (3) optimal blood pressure (defined as $\leq 120 / 80 \mathrm{~mm} \mathrm{Hg}$ ) [15].

### 2.3. Measurement of socioeconomic indicators

Conceptually, an individual's SEP indicates their prestige and access to material or social resources [12,42,43]. No single measure of SEP is ideal for all studies and contexts [17,44]. Adult SEP is typically measured using educational attainment (years of schooling or highest level of school completed), income, occupation, residence (urban or rural) or marital status [45,46]. The key exposure variables in this study are: (1) three levels indicating the highest level of schooling the individual completed at the time of the survey: [a] no education or primary school only, [b] secondary/professional/or technical, and

Table 1
Survey characteristics.

|  | Albania | Armenia | Azerbaijan | Ukraine |
| :---: | :---: | :---: | :---: | :---: |
| World Bank classification | Upper middle-income | Lower middle-income | Upper middle-income | Lower middle-income |
| Male cardiovascular disease mortality rate (2008) ${ }^{\text {a }}$ | 469 | 709 | 655 | 772 |
| Female cardiovascular disease | 417 | 388 | 583 | 441 |

mortality rate (2008) ${ }^{\text {a }}$
Sample characteristics

| Year | 2008-09 |  |  | 2005 |  |  | 2006 |  |  | 2007 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Citation | [32] |  |  | [33] |  |  | [34] |  |  | [35] |  |  |
| Sampling plan | 2-stage cluster, not self-weighting |  |  | 2-stage cluster |  |  | 2-stage cluster, not self-weighting, autonomous Republic of Nakhichevan excluded |  |  | 2-stage cluster |  |  |
| Response rate ( $\max =100 \%$ ) | 96.0\% |  |  | 92.8\% |  |  | 95.5\% |  |  | 95.1\% |  |  |
| Blood pressure device used | Omron HEM-711ac |  |  | Samsung model HD-503 |  |  | Riester Model richampion, No. 1715 |  |  | LifeSource UA-787EJ |  |  |
|  | N | Mean or \% | SD | N | Mean or \% | SD | N | Mean or \% | SD | N | Mean or \% | SD |
| Age | 6472 | 31.9 | 11.0 | 7552 | 31.3 | 10.6 | 10958 | 31.7 | 10.8 | 10802 | 32.3 | 10.0 |
| \% female |  | 56\% |  |  | 84\% |  |  | 77\% |  |  | 53\% |  |
| Years of education (avg) |  | 5.3 | 2.4 |  | 3.8 | 1.4 |  | 6.1 | 1.9 |  | 5.2 | 1.7 |
| SBP (avg) |  | 129.1 | 12.4 |  | 127.4 | 16.7 |  | 121.2 | 13.5 |  | 125.8 | 15.0 |
| DBP (avg) |  | 82.5 | 8.3 |  | 78.7 | 12.2 |  | 76.3 | 11.2 |  | 82.0 | 11.6 |
| Pulse pressure |  | 46.6 | 9.8 |  | 48.7 | 11.6 |  | 44.9 | 9.7 |  | 43.7 | 9.3 |
| \% hypertensive (females) ${ }^{\text {b }}$ |  | 20.0\% |  |  | 21.7\% |  |  | 16.4\% |  |  | 24.5\% |  |
| \% hypertensive (males) ${ }^{\text {b }}$ |  | 27.6\% |  |  | 27.3\% |  |  | 16.6\% |  |  | 31.9\% |  |

[^1]
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[^1]:    Notes: SBP = systolic blood pressure; DBP = diastolic blood pressure; pulse pressure $=$ SBP -DBP .
    ${ }^{\text {a }}$ Mortality rate per 100,000 .
    ${ }^{\text {b }}$ Published DHS prevalence using $\mathrm{SBP} \geq 140$ and $\mathrm{DBP} \geq 90$ or reported use of anti-hypertensive medication in Albania [34], Armenia [35], Azerbaijan [36] and Ukraine [37].

