

Control of hypertension with medication: a comparative analysis of national surveys in 20 countries

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Objective To examine hypertension management across countries and over time using consistent and comparable methods.

Methods A systematic search identified nationally representative health examination surveys from 20 countries containing data from 1980 to 2011 on blood pressure measurements, the diagnosis and treatment of hypertension and its control with antihypertensive drugs. For each country, the prevalence of hypertension (i.e. systolic blood pressure \geq 140 mmHg or antihypertensive use) and the proportion of hypertensive individuals whose condition was diagnosed, treated or controlled with medications (i.e. systolic pressure $<$ 140 mmHg) were estimated.

Findings The age-standardized prevalence of hypertension varied between countries: for individuals aged 35 to 49 years, it ranged from around 12% in Bangladesh, Egypt and Thailand to around 30% in Armenia, Lesotho and Ukraine; for those aged 35 to 84 years, it ranged from 20% in Bangladesh to more than 40% in Germany, the Russian Federation and Turkey. The age-standardized percentage of hypertensive individuals whose condition was diagnosed, treated or controlled was highest in the United States of America: for those aged 35 to 49 years, it was 84%, 77% and 56%, respectively. Percentages were especially low in Albania, Armenia, the Islamic Republic of Iran and Turkey. Although recent trends in prevalence differed in England, Japan and the United States, treatment coverage and hypertension control improved over time, particularly in England.

Conclusion Globally the proportion of hypertensive individuals whose condition is treated or controlled with medication remains low. Greater efforts are needed to improve hypertension control, which would reduce the burden of noncommunicable diseases.

Abstracts in **عربي**, **中文**, **Français**, **Русский** and **Español** at the end of each article.

Introduction

High blood pressure, also known as hypertension, is a major contributor to the global disease burden and was responsible for 7% of all disability-adjusted life years in 2010.¹ Moreover, the number of people with uncontrolled hypertension has increased to around 1 billion worldwide in the past three decades.² As a result, the effective control of hypertension has become a priority for global health policy and, with growing interest in the prevention and control of noncommunicable diseases (NCDs),³ it is vital that health-care systems deliver appropriate interventions for tackling high blood pressure.

The formulation of effective policies for decreasing the burden of uncontrolled hypertension depends on knowledge of the current rate of hypertension control at the population level. Several countries have carried out health examination surveys of nationally representative samples to measure blood pressure and to assess awareness, treatment and control of hypertension in the general population.^{4–11} In addition, trends in indicators of hypertension management have been reported in Canada,¹² England¹³ and the United States of America^{14,15} and coverage of effective treatment for hypertension has been studied in the Islamic Republic of Iran¹¹ and Mexico.^{16,17}

Despite the wealth of data available from national health surveys on the management of hypertension in the general population, it is not always possible to compare published results directly because of differences in survey methods and analytical strategies.^{18,19} Previous studies have reviewed find-

ings from several national surveys on the crude prevalence of hypertension and on awareness, treatment and control of the condition^{20,21} but the issue of comparability was left unresolved. Although one study analysed microdata from national examination surveys, it covered only countries in Europe and North America.^{19,22} Another recent study used regression modelling techniques to aggregate data and improve comparability.² However, awareness, treatment and control of hypertension were not analysed. Thus, comparative information – as is already available for diabetes and hypercholesterolaemia – is needed to benchmark and compare how health systems perform in controlling hypertension.^{23,24}

Our aim was to provide comparable, comprehensive and consistent evidence on the management of hypertension internationally by analysing data from health surveys in 20 countries that included blood pressure measurement.

Methods

Two investigators obtained information on national health examination surveys by systematically searching: (i) published research papers using Medline and Google Scholar; and (ii) health survey databases, such as the Global InfoBase of the World Health Organization (WHO)²⁵ and the STEPwise approach to Surveillance (STEPS) database,²⁶ the European Health Interview and Health Examination Surveys database,²⁷ the Demographic and Health Survey database²⁸ and databases on other web sites identified during the search process. The

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keywords used were *blood pressure, high blood pressure, hypertension, prevalence, treatment, control* and *national health survey* as well as country names. Articles and survey reports were reviewed to determine whether they: (i) involved a random sample of adults in a whole country; (ii) included both sexes; (iii) contained data on blood pressure measurements; and (iv) contained data on the diagnosis of hypertension and on the use of antihypertensive medications.

We identified nationally representative household surveys that met our four criteria for 73 of the 193 WHO Member States: 12 were low-income countries, 38 were middle-income countries and 20 were high-income countries; income was not classified for 3 countries. For these 73 countries, we tried to obtain anonymized individual-level data. We downloaded publicly available data sets for England, the Russian Federation, the United States and 9 countries for which Demographic and Health Survey data were available. For the other 61 countries, we requested data from the institutions that conducted the surveys and we obtained permission to use data from 8 countries. Overall, we obtained individual-level data for 20 countries in which the latest available surveys had been conducted between 1992 and 2011 (Table 1, available at: <http://www.who.int/bulletin/volumes/92/1/13-121954>). All Demographic and Health Surveys, except those for Bangladesh and South Africa, included only women of reproductive age and their husbands. Data from several different years were available for England, Japan and the United States.

Table 1 summarizes the procedures used to measure blood pressure in the surveys included in this study. In most surveys, blood pressure was measured more than twice but only single measurements were recorded in the surveys carried out in Colombia and in Japan in 1980 and between 1986 and 1999. Digital blood pressure metres were used in England and all countries participating in Demographic and Health Surveys except Uzbekistan. All surveys recorded blood pressure in the right arm of seated participants, except those in South Africa and Turkey.

Individuals were regarded as having hypertension if their systolic blood pressure was equal to or greater than 140 mmHg or they reported current use of blood-pressure-lowering medications. We did not include diastolic

blood pressure in our definition of hypertension because prospective studies suggest that systolic pressure is a better predictor of cardiovascular disease risk, particularly in older individuals.^{46,47} Moreover, systolic pressure rises consistently with age, whereas diastolic pressure increases until the age of 50 to 60 years and starts decreasing thereafter.⁴⁸ For each individual, we calculated systolic blood pressure as the average of all measurements taken, excluding the first measurement, when three or more measurements were available; when only one or two measurements were available, we used the single or second measurement, respectively.

Among people with hypertension, we estimated the fraction that had been diagnosed with the condition, the fraction treated and the fraction whose condition was controlled using antihypertensive medications. We regarded participants as having been diagnosed with hypertension if they answered “yes” when asked whether a doctor or any other health professional had told them they had high blood pressure. The questions used to determine whether a participant had been diagnosed with hypertension were slightly different in some countries: in all surveys in England, except those performed in 2007 and 2008, two questions were asked to determine whether a diagnosis had been made in a clinical setting; in the German survey, “health professionals” were not specifically mentioned; and, in surveys in the Islamic Republic of Iran, Jordan and Thailand, the recall period was limited to the previous 12 months (Table 2, available at: <http://www.who.int/bulletin/volumes/92/1/13-121954>). In addition, the 2007 and 2008 surveys in England and the surveys in Japan in all years except 1980, 1990 and 2000 did not ask about a history of hypertension.

We considered hypertensive patients to be receiving treatment if they reported currently using an antihypertensive medication and we regarded a systolic blood pressure less than 140 mmHg as indicating that the hypertension was controlled. Most surveys employed a single yes–no question to ask respondents about their current use of antihypertensive drugs (Table 2). The German survey and Japanese surveys in 1980 and 1990 to 2002 asked about the frequency of medication use and we considered only those who answered “daily” to be receiving treatment. Most

surveys did not ask about treatment if the respondent answered “no” to a question about being diagnosed with hypertension. In Colombia, only individuals who had been diagnosed with hypertension two or more times were asked about the use of antihypertensive medications. The South African survey asked for the names of the medications to verify that they really were for lowering blood pressure.

We included all individuals aged 35 to 84 years in the analysis to maximize the overlap of age ranges across surveys. We excluded women who were pregnant or breastfeeding and individuals for whom data on any of the following were missing: systolic blood pressure; a history of hypertension (except for some of the English and Japanese surveys, which did not ask about this item); and the use of antihypertensive medications. We could not identify pregnant women in the Jordanian survey because of a lack of data.

Overall, we compiled a data set covering 173 920 individuals from 20 countries for the cross-sectional analysis and, for the trend analysis, we had data on 63 903 individuals from England, 155 212 from Japan and 30 410 from the United States.

We estimated the age-standardized prevalence of hypertension in individuals aged 35 to 49 years in the latest surveys from 20 countries and, in individuals aged 35 to 84 years, in surveys from 11 countries. In these groups, we also estimated the age-standardized proportion of individuals with hypertension whose condition was diagnosed, treated or controlled by means of antihypertensive drugs. In addition, we examined secular trends in these indicators in the population aged 35 to 84 years in England, Japan and the United States. We derived a reference population for the age standardization of prevalence data by calculating an average for the proportion in each 5-year age group in all countries included in the analysis using population estimates for the year 2000.⁴⁹ For the age standardization of the proportion of individuals whose hypertension was diagnosed, treated or controlled, we derived a standard hypertensive population from the reference population by using an average estimate of the prevalence of hypertension in each 5-year age group across all countries. We used Stata version 12 (StataCorp. LP, College Station, USA)

for the analysis and to adjust for complex survey designs that included stratification, clustering and sample weights.

Results

The age-standardized prevalence of hypertension in individuals aged 35 to 49 years ranged from around 12% in Bangladesh, Egypt and Thailand to around 30% in Armenia, Lesotho and Ukraine (Table 3). In those aged 35 to 84 years, it varied from nearly 20% in Bangladesh to more than 40% in Germany, the Russian Federation and Turkey (Table 3).

In individuals with hypertension aged 35 to 49 years, the age-standardized percentage diagnosed with the condition was highest in the United States, at 83.9%, followed by Uzbekistan and Lesotho. It was under 34% in Albania, Armenia, Colombia, the Islamic Republic of Iran and Turkey (Table 4). The age-standardized

percentage whose blood pressure was controlled with medications was 55.7% in the United States, whereas it was less than 10% in Albania, Armenia, Germany, the Islamic Republic of Iran and Turkey (Table 4).

In individuals with hypertension aged 35 to 84 years, the age-standardized percentage whose high blood pressure was diagnosed, treated or controlled was highest in the United States and lowest in Germany, Thailand and Turkey (Table 4). The percentage diagnosed ranged from less than 50% in Thailand and Turkey to 85.3% in the United States (Table 4). The percentage of hypertensive individuals who were diagnosed but not on medication was highest in Turkey, at 20.7%. The percentage whose hypertension was controlled with medications varied from less than 8% in Germany and Turkey to 59.1% in the United States (Table 4).

Our analysis of the secular trend in the age-standardized prevalence of

hypertension in individuals aged 35 to 84 years showed that the prevalence was substantially lower in the United States in the early 1990s than it was in England or Japan, the other two countries in which the trend was analysed (Table 5). However, the prevalence increased in the United States during the 1990s, whereas it decreased in England and Japan. Subsequently, the prevalence became comparable across the three countries in the 2000s. The age-standardized percentage of hypertensive individuals whose hypertension was diagnosed, treated or controlled increased over time in all three countries (Table 6, available at: <http://www.who.int/bulletin/volumes/92/1/13-121954>). The increase was particularly remarkable in England: although the percentage whose hypertension was treated or controlled in England was lower than in Japan in the early 1990s, by the late 2000s, the percentage in England exceeded that in Japan.

Table 3. Age-standardized prevalence of hypertension, by age group, 20 countries, 1992–2011

Country, year of latest available survey	Age group: 35–49 years		Age group: 35–84 years ^a	
	No. of survey participants	Prevalence of hypertension, % (95% CI)	No. of survey participants	Prevalence of hypertension, % (95% CI)
Low-income countries				
Albania, 2008 ²⁹	2 979	23.4 (21.5–25.5)	NA	NA
Armenia, 2005 ³⁰	2 961	28.8 (26.3–31.4)	NA	NA
Azerbaijan, 2006 ³¹	4 311	17.4 (15.9–18.9)	NA	NA
Bangladesh, 2011 ³²	4 086	11.8 (10.6–13.1)	7 686	19.6 (18.5–20.8)
Lesotho, 2009 ³³	939	28.9 (25.4–32.7)	NA	NA
Ukraine, 2007 ³⁴	3 181	30.5 (28.5–32.6)	NA	NA
Uzbekistan, 2002 ³⁵	2 382	13.0 (11.5–14.7)	NA	NA
Middle-income countries				
Colombia, 2007 ³⁶	4 400	18.6 (17.0–20.3)	NA	NA
Egypt, 2008 ³⁷	3 342	12.1 (10.9–13.3)	NA	NA
Islamic Republic of Iran, 2005 ³⁸	24 525	16.2 (15.7–16.6)	NA	NA
Jordan, 2007 ^b	268	12.9 (9.9–16.6)	510	36.5 (34.0–39.1)
Mexico, 2005–2006 ³⁹	11 406	14.8 (13.8–15.9)	21 230	29.5 (28.5–30.5)
Russian Federation, 1992–1993 ⁴⁰	494	27.8 (25.2–30.6)	1 091	43.6 (39.4–47.9)
South Africa, 1998 ⁴¹	3 076	19.5 (17.8–21.2)	6 694	32.7 (31.4–34.1)
Thailand, 2004 ⁸	8 476	11.8 (10.6–13.1)	32 451	24.5 (23.3–25.8)
Turkey, 2003 ⁶	1 534	24.7 (20.9–29.0)	3 027	41.0 (37.4–44.7)
High-income countries				
England, 2010 ⁴²	1 501	14.9 (13.0–17.0)	4 147	31.2 (29.8–32.7)
Germany, 1997–1999 ⁴³	1 969	25.6 (23.5–27.9)	4 696	44.8 (43.2–46.4)
Japan, 2009 ⁴⁴	951	12.9 (10.9–15.1)	3 862	31.8 (30.3–33.2)
United States of America, 2009–2010 ⁴⁵	1 485	17.2 (14.3–20.6)	4 260	34.5 (31.6–37.5)

CI, confidence interval; NA, not available.

^a The upper age limit in Germany was 74 years.

^b Unpublished data, Ministry of Health, Jordan, 2007.

Table 4. Age-standardized percentage of individuals with hypertension whose condition was diagnosed, treated or controlled by medication, by age group, 20 countries, 1992–2011

Country, year of latest available survey	Proportion of individuals with hypertension, % (95% CI)					
	Age group: 35–49 years		Age group: 35–84 years ^a			
	Diagnosed	Treated	Controlled	Diagnosed	Treated	Controlled
Low-income countries						
Albania, 2008 ²⁹	25.9 (22.2–30.0)	13.8 (11.4–16.7)	4.4 (3.0–6.3)	NA	NA	NA
Armenia, 2005 ³⁰	23.0 (20.0–26.2)	18.5 (15.6–21.9)	8.6 (6.6–11.2)	NA	NA	NA
Azerbaijan, 2006 ³¹	60.5 (55.9–64.9)	55.3 (51.0–59.6)	35.6 (30.8–40.6)	NA	NA	NA
Bangladesh, 2011 ³²	67.0 (62.4–71.2)	61.6 (56.8–66.1)	43.2 (38.6–48.1)	62.7 (59.6–65.7)	54.6 (51.3–57.7)	30.2 (27.4–33.2)
Lesotho, 2009 ³³	70.4 (64.6–75.7)	64.2 (57.7–70.1)	39.3 (32.6–46.6)	NA	NA	NA
Ukraine, 2007 ³⁴	61.9 (57.3–66.3)	54.0 (49.3–58.5)	19.7 (16.8–23.1)	NA	NA	NA
Uzbekistan, 2002 ³⁵	75.2 (68.1–81.1)	67.2 (60.4–73.5)	46.8 (40.1–53.6)	NA	NA	NA
Middle-income countries						
Colombia, 2007 ³⁶	31.8 (27.6–36.4)	24.6 (20.8–28.8)	11.7 (8.7–15.4)	NA	NA	NA
Egypt, 2008 ³⁷	64.7 (59.6–69.5)	54.1 (48.8–59.3)	39.5 (34.6–44.7)	NA	NA	NA
Islamic Republic of Iran, 2005 ³⁸	33.4 (32.0–34.9)	21.9 (20.7–23.2)	8.5 (7.7–9.4)	NA	NA	NA
Jordan, 2007 ^b	61.0 (44.5–75.3)	55.5 (39.8–70.2)	34.2 (23.7–46.5)	73.9 (67.5–79.4)	71.0 (64.8–76.4)	38.2 (32.4–44.3)
Mexico, 2005–2006 ³⁹	49.4 (45.8–52.9)	40.9 (37.4–44.4)	27.1 (23.9–30.5)	55.8 (53.8–57.7)	49.5 (47.6–51.5)	28.0 (26.2–29.8)
Russian Federation, 1992–1993 ⁴⁰	63.2 (50.8–74.0)	50.8 (39.0–62.5)	20.2 (13.5–29.1)	74.9 (69.8–79.4)	59.9 (53.2–66.2)	14.2 (11.4–17.6)
South Africa, 1998 ⁴¹	43.1 (38.3–48.0)	30.6 (26.3–35.2)	20.1 (16.4–24.5)	52.8 (50.3–55.3)	37.6 (34.9–40.3)	21.0 (18.8–23.3)
Thailand, 2004 ⁸	36.5 (32.6–40.6)	28.4 (24.9–32.1)	15.7 (12.8–19.1)	46.0 (44.2–47.9)	38.4 (36.6–40.1)	17.7 (16.1–19.6)
Turkey, 2003 ⁶	33.2 (27.3–39.8)	4.4 (2.8–6.8)	0.3 (0.0–2.5)	49.7 (43.4–56.0)	29.0 (24.0–34.6)	6.5 (4.2–9.9)
High-income countries						
England, 2010 ⁴²	42.1 (34.5–50.0)	29.5 (22.9–37.0)	18.9 (13.3–26.0)	62.5 (59.6–65.4)	53.5 (50.6–56.4)	32.3 (29.7–35.1)
Germany, 1997–1999 ⁴³	43.6 (39.2–48.2)	24.4 (20.7–28.5)	6.9 (4.9–9.7)	53.1 (50.8–55.3)	39.2 (36.9–41.5)	7.4 (6.2–8.9)
Japan, 2009 ^{44,c}	NA	29.4 (22.4–37.5)	14.4 (10.0–20.3)	NA	48.9 (46.0–51.7)	22.9 (20.5–25.4)
United States of America, 2009–2010 ⁴⁵	83.9 (78.0–88.5)	76.6 (71.0–81.4)	55.7 (47.1–63.9)	85.3 (81.9–88.1)	80.5 (77.3–83.4)	59.1 (56.0–62.1)

CI, confidence interval; NA, not available.

^a The upper age limit in Germany was 74 years.^b Unpublished data, Ministry of Health, Jordan, 2007.^c No data on diagnosis were available for Japan.

Table 5. Age-standardized prevalence of hypertension in individuals aged 35 to 84 years, England, Japan and the United States of America, 1980–2010

Year	England		Japan		United States	
	No. of survey participants	Prevalence of hypertension, % (95% CI)	No. of survey participants	Prevalence of hypertension, % (95% CI)	No. of survey participants	Prevalence of hypertension, % (95% CI)
1980	NA	NA	9250	48.2 (46.8–49.6)	NA	NA
1986	NA	NA	8647	46.6 (45.3–47.9)	NA	NA
1987	NA	NA	7665	46.5 (45.2–47.7)	NA	NA
1988	NA	NA	7581	48.2 (47.0–49.5)	5091 ^a	32.7 (30.6–34.9) ^a
1989	NA	NA	6982	45.2 (43.7–46.7)	NA	NA
1990	NA	NA	7577	45.5 (44.1–46.9)	NA	NA
1991	1774	50.1 (47.5–52.7)	7589	46.4 (45.2–47.6)	5280 ^b	31.4 (29.0–34.0) ^b
1992	2220	49.1 (46.9–51.3)	7052	46.1 (44.7–47.6)	NA	NA
1993	9315	49.3 (48.3–50.4)	6701	44.8 (43.3–46.2)	NA	NA
1994	8695	45.7 (44.7–46.8)	6187	43.6 (42.1–45.1)	NA	NA
1995	NA	NA	5897	45.5 (44.1–46.8)	NA	NA
1996	NA	NA	5736	45.5 (44.1–46.9)	NA	NA
1997	NA	NA	5647	43.9 (42.4–45.4)	NA	NA
1998	9149	43.8 (42.8–44.8)	5582	43.2 (41.7–44.6)	NA	NA
1999	NA	NA	5986	42.9 (41.2–44.7)	2915 ^c	38.0 (35.4–40.7) ^c
2000	NA	NA	4841	39.7 (38.1–41.3)	NA	NA
2001	NA	NA	5008	39.5 (37.9–41.3)	3188 ^d	37.3 (35.1–39.6) ^d
2002	NA	NA	4843	39.4 (37.9–41.0)	NA	NA
2003	8176	37.8 (36.8–38.9)	4872	35.9 (34.6–37.3)	2830 ^e	39.7 (36.6–42.9) ^e
2004	NA	NA	4673	38.6 (36.9–40.3)	NA	NA
2005	NA	NA	4650	36.2 (34.4–38.0)	2860 ^f	39.4 (36.7–42.1) ^f
2006	6647	36.0 (34.9–37.2)	3456	37.7 (36.1–39.3)	NA	NA
2007	3601	40.0 (38.5–41.5)	3417	38.0 (36.2–39.9)	3986 ^g	39.6 (37.9–41.2) ^g
2008	7753	40.0 (38.9–41.0)	3814	36.6 (35.0–38.4)	NA	NA
2009	2426	35.6 (33.8–37.5)	3637	36.8 (35.4–38.3)	4260 ^h	39.1 (36.2–42.2) ^h
2010	4147	35.5 (34.1–37.0)	NA	NA	NA	NA

CI, confidence interval; NA, not available.

^a Applies to the period from 1988 to 1991.^b Applies to the period from 1991 to 1994.^c Applies to the period from 1999 to 2000.^d Applies to the period from 2001 to 2002.^e Applies to the period from 2003 to 2004.^f Applies to the period from 2005 to 2006.^g Applies to the period from 2007 to 2008.^h Applies to the period from 2009 to 2010.

Discussion

To the best of our knowledge, this is the first study to compare the management of high blood pressure in countries from different regions of the world by using individual-level data from nationally representative health examination surveys. Our results suggest that hypertension is not adequately controlled with medication in many parts of the world. This finding has important implications for medical and public health authorities worldwide and should be considered when formulating and implementing programmes for controlling hypertension.

We found that the prevalence of hypertension was substantial in some low- and middle-income countries, which indicates that the condition is an important contributor to the growing

burden of NCDs in developing countries. Moreover, blood pressure control in hypertensive individuals was particularly poor in Albania, Armenia, the Islamic Republic of Iran and Turkey, as well as in Germany in the late 1990s. Among former socialist states in Europe and central Asia, the proportion of adults aged 35 to 49 years with hypertension whose condition was controlled was much greater in Azerbaijan, Ukraine and Uzbekistan than in Albania and Armenia. Although few studies of changes in the management of hypertension have been carried out in transitional economies, one investigation showed that, in Armenia, inadequate health care utilization was partly due to the high cost for users.⁵⁰ A study in Mexico revealed that health system reform during the early 2000s reduced blood pressure in the population by only around one fifth of the maximum

potential decrease that could have been achieved with antihypertensive drugs.^{16,17} Our results confirmed that there is still considerable room for improvement in Mexico. In Thailand, the prevalence of hypertension was lower than in other countries in our study but hypertension control was relatively poor. This finding supports a previous study's proposal that the screening, treatment and control of hypertension in Thailand should be strengthened.⁸

The fact that the age-adjusted prevalence of hypertension remained between 35 and 40% throughout the 2000s in England, Japan and the United States suggests that there has been little progress in the primary prevention of the condition in these countries. Moreover, previous studies showed that the prevalence of hypertension increased in the United States in the

Table 6. Age-standardized percentage of individuals with hypertension aged 35 to 84 years whose condition was diagnosed, treated or controlled by medication, England, Japan and the United States of America, 1980–2010

Year	Proportion of individuals with hypertension, % (95% CI)											
	England				Japan				United States of America			
	Diagnosed	Treated	Controlled	Diagnosed	Treated	Controlled	Diagnosed	Treated	Controlled	Diagnosed	Treated	Controlled
1980	NA	NA	NA	47.0 (45.1–49.0)	25.3 (23.6–27.0)	3.5 (3.0–4.2)	NA	NA	NA	NA	NA	NA
1986	NA	NA	NA	NA	34.2 (32.4–36.0)	7.3 (6.4–8.3)	NA	NA	NA	NA	NA	NA
1987	NA	NA	NA	NA	35.8 (33.8–37.9)	8.0 (7.0–9.2)	NA	NA	NA	NA	NA	NA
1988	NA	NA	NA	NA	35.6 (33.4–38.0)	7.5 (6.4–8.8)	74.7 (72.1–77.2) ^a	59.8 (56.6–62.9) ^a	34.8 (31.5–38.1) ^b	NA	NA	NA
1989	NA	NA	NA	NA	36.1 (33.9–38.3)	7.3 (6.2–8.6)	NA	NA	NA	NA	NA	NA
1990	NA	NA	NA	47.9 (45.9–49.8)	35.2 (33.2–37.2)	6.0 (5.1–6.9)	NA	NA	NA	NA	NA	NA
1991	37.1 (33.5–40.9)	23.1 (20.3–26.1)	4.3 (3.1–6.1)	NA	35.2 (33.4–37.0)	8.0 (6.8–9.3)	74.6 (71.9–77.1) ^b	63.2 (60.0–66.3) ^b	34.5 (31.4–37.7) ^b	NA	NA	NA
1992	36.8 (33.5–40.2)	22.1 (19.4–25.0)	3.8 (2.8–5.2)	NA	37.1 (35.4–38.9)	8.0 (6.9–9.2)	NA	NA	NA	NA	NA	NA
1993	38.6 (37.1–40.0)	23.8 (22.5–25.1)	5.3 (4.6–6.0)	NA	38.2 (35.9–40.5)	9.3 (8.0–10.8)	NA	NA	NA	NA	NA	NA
1994	39.3 (37.7–40.8)	24.9 (23.6–26.3)	5.6 (4.9–6.4)	NA	37.4 (35.4–39.3)	9.5 (8.4–10.8)	NA	NA	NA	NA	NA	NA
1995	NA	NA	NA	NA	38.2 (35.9–40.6)	8.7 (7.4–10.1)	NA	NA	NA	NA	NA	NA
1996	NA	NA	NA	NA	38.1 (36.2–40.1)	8.4 (7.2–9.7)	NA	NA	NA	NA	NA	NA
1997	NA	NA	NA	NA	38.5 (36.5–40.6)	9.3 (8.0–10.8)	NA	NA	NA	NA	NA	NA
1998	47.1 (45.5–48.6)	32.6 (31.1–34.1)	9.6 (8.7–10.6)	NA	41.2 (39.3–43.1)	10.3 (9.1–11.6)	NA	NA	NA	NA	NA	NA
1999	NA	NA	NA	NA	40.0 (38.0–42.0)	9.0 (7.8–10.5)	73.3 (69.4–76.9) ^c	65.4 (59.5–70.9) ^c	37.1 (31.2–43.5) ^c	NA	NA	NA
2000	NA	NA	NA	54.0 (51.7–56.3)	46.1 (43.7–48.6)	11.9 (10.5–13.5)	NA	NA	NA	NA	NA	NA
2001	NA	NA	NA	NA	43.7 (41.5–45.9)	14.6 (12.9–16.5)	76.8 (72.9–80.2) ^d	67.9 (63.3–72.1) ^d	41.5 (38.2–44.8) ^d	NA	NA	NA
2002	NA	NA	NA	NA	46.6 (44.3–48.8)	14.0 (12.4–15.8)	NA	NA	NA	NA	NA	NA
2003	62.4 (60.6–64.2)	48.2 (46.4–50.0)	23.5 (22.0–25.1)	NA	48.2 (45.7–50.8)	17.9 (16.0–20.1)	82.0 (78.9–84.8) ^e	73.0 (68.8–76.9) ^e	46.0 (43.1–49.0) ^e	NA	NA	NA
2004	NA	NA	NA	NA	47.4 (44.9–49.9)	16.7 (14.6–19.0)	NA	NA	NA	NA	NA	NA
2005	NA	NA	NA	NA	49.7 (46.8–52.6)	17.9 (15.8–20.2)	82.6 (79.3–85.5) ^f	73.8 (70.5–76.8) ^f	50.0 (46.1–54.0) ^f	NA	NA	NA
2006	68.5 (66.3–70.7)	56.5 (54.1–58.9)	31.3 (28.9–33.8)	NA	49.3 (47.0–51.7)	19.2 (17.3–21.4)	NA	NA	NA	NA	NA	NA
2007	NA	61.6 (59.0–64.1)	37.9 (35.4–40.5)	NA	51.1 (48.5–53.6)	21.8 (19.5–24.3)	84.5 (82.9–85.9) ^g	78.3 (76.0–80.4) ^g	55.7 (53.0–58.3) ^g	NA	NA	NA
2008	NA	63.2 (61.4–64.9)	38.7 (36.9–40.6)	NA	54.4 (52.1–56.7)	27.0 (24.8–29.3)	NA	NA	NA	NA	NA	NA
2009	64.2 (61.3–67.1)	56.2 (53.3–59.1)	32.0 (28.9–35.3)	NA	53.7 (51.1–56.2)	24.8 (22.6–27.3)	85.6 (82.3–88.4) ^h	81.3 (78.3–84.0) ^h	59.1 (56.0–62.0) ^h	NA	NA	NA

CI, confidence interval; NA, not available.
^a Applies to the period from 1988 to 1991.
^b Applies to the period from 1991 to 1994.
^c Applies to the period from 1999 to 2000.
^d Applies to the period from 2001 to 2002.
^e Applies to the period from 2003 to 2004.
^f Applies to the period from 2005 to 2006.
^g Applies to the period from 2007 to 2008.
^h Applies to the period from 2009 to 2010.

1990s,^{14,15} perhaps partly on account of the increasing number of overweight and obese individuals.¹⁴ In England, the substantial decrease in the prevalence of hypertension observed in the 1990s and early 2000s¹³ seemed to have ceased by the late 2000s. It is a challenge for these highly industrialized countries to resume progress in reducing the prevalence of hypertension, particularly in older individuals.

Of all the countries included in our analysis, the United States showed the highest rates of diagnosis, treatment and control of hypertension. Since the late 1990s, England has been rapidly catching up with the United States. The improvement may partly be explained by the influence of a series of guidelines on the management of hypertension disseminated by the British Hypertension Society and by a pay-for-performance system introduced in the new General Medical Services contract that gives general practitioners an incentive to lower patients' blood pressure.¹³ In contrast, progress in controlling hypertension with medications has been relatively slow in Japan. Although substantial efforts have been made in the country to improve the management of hypertension, many physicians may be cautious about aggressively treating the condition, particularly in elderly patients. A fundamental change in physicians' attitudes may be needed to achieve the same level of hypertension control as has been achieved in England and the United States.

Our study had several limitations. First, although we used the latest available surveys, those of Germany, the Russian Federation and South Africa all dated from the 1990s and were too old for us to draw conclusions about the current state of hypertension management in those countries. Second, although systolic blood pressure is a better predictor of cardiovascular risk, the exclusion of diastolic blood pressure from our definition of hypertension may have led us to underestimate the prevalence of the condition in individuals younger than 50 years. Third, information about diagnosis and treatment was obtained from survey respondents' answers to questions and may have been affected by recall bias and variations in the wording of questions. Fourth, most surveys employed a question with a yes–no answer

to record the use of antihypertensive medications and did not ask about frequency of use. Consequently, our estimates of the proportion of hypertensive individuals being treated may have included those taking medications less than daily and this may have resulted in underestimates of the proportion whose hypertension was under control. Fifth, in this study, we focused on treatment with antihypertensive medications. The prevalence of hypertension and the proportions of hypertensive individuals whose high blood pressure is treated or controlled would be different in countries in which nonpharmacological interventions, such as dietary modification and physical activity, are common. Sixth, although it was a nationally representative sample, the survey sample in Jordan was small. Consequently, the figures for the percentage of hypertensive individuals, particularly older individuals, whose condition was diagnosed, treated or controlled by medication should be interpreted with caution.

The strength of our study is that the use of individual-level data enabled us to apply consistent definitions and analytical methods when comparing estimates of the prevalence, awareness, treatment and control of hypertension across countries and over time. The use of consistent analytical methods is crucial for assessing how well individual health systems are responding to the health needs of the population. Therefore, we believe our study is important as a first attempt at providing consistent and comparable information on the management of hypertension globally.

Considerably more national health examination surveys on high blood pressure have been conducted around the world than on high blood glucose or cholesterol concentrations.^{23,24} Nevertheless, largely owing to financial constraints, most countries have not carried out surveys that involve blood pressure measurement and very few have established continuous surveys. In our study, we were able to obtain access to individual-level data for only 20 of 73 countries identified. Consequently, our final survey selection was somewhat opportunistic, which may have limited the representativeness of our data and its generalizability to other countries. In addition, opportunities to assess, bench-

mark and compare the performance of health policies and programmes internationally may have been missed. As has been proposed for the assessment of hypercholesterolaemia,²⁴ there is a clear need for a standardized protocol for implementing blood pressure surveys. Those we identified adopted different ways of measuring blood pressure and many asked respondents themselves to report their history of hypertension and current treatment status. Errors that result from the heterogeneity in survey methods are difficult to correct. In resource-poor settings, the user-friendly techniques employed by Demographic and Health Surveys would be helpful for gathering biomarker data. Use of these techniques should be promoted by the global campaigns on the prevention and control of NCDs planned for coming years.

In conclusion, globally the proportion of hypertensive patients whose disease is treated effectively with medications remains low, especially in some low- and middle-income countries. Since hypertension is the leading risk factor associated with morbidity and mortality from NCDs worldwide, greater efforts should be devoted to improving hypertension control. Countries and different clinical disciplines should work together to adopt a comprehensive approach to the prevention and control of high blood pressure. Effective and affordable drugs are available. It is time to act, since the alternative is expensive and a large portion of the population is affected. ■

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ملخص

مكافحة فرط ضغط الدم بالأدوية: تحليل مقارنة للمسوح الوطنية في 20 بلداً

الذين تراوحت أعمارهم من 35 إلى 84 عاماً، تراوح من 20٪ في بنغلاديش إلى أكثر من 40٪ في ألمانيا والاتحاد الروسي وتركيا. وكانت أعلى النسب المئوية الموحدة حسب الأعمار للأشخاص المصابين بفرط ضغط الدم الذين تم تشخيص حالتهم أو علاجها أو مكافحتها في الولايات المتحدة الأمريكية: وبالنسبة للأشخاص الذين تراوحت أعمارهم من 35 إلى 49 عاماً، كانت النسبة المئوية 84٪، و77٪، و56٪ على التوالي. وكانت النسب المئوية منخفضة ولاسيما في ألبانيا وأرمينيا وجمهورية إيران الإسلامية وتركيا. وعلى الرغم من اختلاف الاتجاهات الحديثة في الانتشار في إنجلترا واليابان والولايات المتحدة، تحسنت تغطية العلاج ومكافحة فرط ضغط الدم بمرور الوقت، ولاسيما في إنجلترا. الاستنتاج على الصعيد العالمي، تظل نسبة الأشخاص المصابين بفرط ضغط الدم الذين يتم علاج حالتهم أو مكافحتها بالأدوية منخفضة. ويتعين بذل جهود أكبر لتحسين مكافحة فرط ضغط الدم، الأمر الذي سيقبل عبء الأمراض غير السارية.

الغرض دراسة تديبر فرط ضغط الدم عبر البلدان وبمرور الوقت باستخدام طرق متسقة وقابلة للمقارنة. الطريقة حدد بحث منهجي مسح الفحص الصحي المثلثة على الصعيد الوطني من 20 بلداً تحتوي على بيانات من عام 1980 إلى 2011 حول قياسات ضغط الدم وتشخيص فرط ضغط الدم وعلاجه ومكافحته بالأدوية الخافضة لضغط الدم. وبالنسبة لكل بلد، تم تقدير انتشار فرط ضغط الدم (ضغط الدم الانقباضي أكبر من أو يساوي 140 ملليمتر زئبق أو استخدام الأدوية الخافضة لضغط الدم) ونسبة الأفراد المصابين بفرط ضغط الدم الذين تم تشخيص حالتهم أو علاجها أو مكافحتها بالأدوية (ضغط الدم الانقباضي أقل من 140 ملليمتر زئبق). النتائج اختلف الانتشار الموحد حسب الأعمار لفرط ضغط الدم بين البلدان: بالنسبة للأشخاص الذين تراوحت أعمارهم من 35 إلى 49 عاماً، تراوح من 12٪ تقريباً في بنغلاديش ومصر وتايلند إلى حوالي 30٪ في أرمينيا وليسوتو وأوكرانيا؛ وبالنسبة للأشخاص

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Résumé

Contrôle de l'hypertension sous médication: une analyse comparative des enquêtes nationales dans 20 pays

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Резюме

Медикаментозный контроль гипертензии: сравнительный анализ национальных обследований в 20 странах

Цель Исследовать методы терапии гипертензии в разных странах в разные периоды времени с использованием устойчивых и поддающихся сравнению методов.

Методы Проведение систематического поиска репрезентативных национальных медицинских осмотров из 20 стран, содержащих данные с 1980 по 2011 г. по измерениям артериального давления, диагностике и лечению гипертензии и ее контроль антигипертензивными препаратами. Для каждой страны оценивалась распространенность гипертензии (т.е. систолическое артериальное давление ≥ 140 мм.рт.ст. или применение антигипертензивных препаратов) и доля страдающих гипертензией лиц, чье заболевание диагностировалось, подвергалось лечению или контролю медицинскими препаратами (т.е. систолическое давление доводилось до уровня < 140 мм.рт.ст.).

Результаты Стандартизированная по возрасту распространенность гипертензии варьировалась между странами: для лиц в возрасте от 35 до 49 лет она составляла

от приблизительно 12% в Бангладеш, Египте и Таиланде до приблизительно 30% в Армении, Лесото и Украине; для возрастной группы от 35 до 84 лет она варьировалась от 20% в Бангладеш до более 40% в Германии, Российской Федерации и Турции. Приведенные к возрасту процентные доли лиц с гипертензией, чье состояние было диагностировано, подвергнуто лечению или контролю, были наивысшими в Соединенных Штатах Америки: для группы от 35 до 49 лет они составляли 84%, 77% и 56%, соответственно. Особенно низкий процент был зафиксирован в Албании, Армении, Исламской республике Иран и Турции. Хотя последние тенденции по распространенности в Англии, Японии и США различаются, охват лечением и контроль гипертензии с течением времени улучшился, особенно в Англии.

Вывод Во всемирном масштабе доля лиц с гипертензией, чье состояние контролируется медицинскими препаратами, остается низкой. Необходимы дальнейшие усилия для улучшения контроля гипертензии, что потенциально снизит бремя болезни и развитие осложнений в виде неинфекционных заболеваний.

Resumen

El control de la hipertensión con medicamentos: un análisis comparativo de las encuestas nacionales en 20 países

Objetivo Examinar la gestión de la hipertensión entre países y a lo largo del tiempo con métodos consistentes y comparables.

Métodos Se realizó una búsqueda sistemática a fin de identificar encuestas de salud por examen representativas a nivel nacional de 20 países con datos recogidos de 1980 a 2011 sobre las mediciones de la presión arterial, el diagnóstico y el tratamiento de la hipertensión, así como su control con fármacos antihipertensivos. Se estimó la prevalencia de la hipertensión arterial en cada país (es decir, la presión arterial sistólica ≥ 140 mmHg o el uso de antihipertensivos) y la proporción de hipertensos que fueron diagnosticados, tratados o controlados con medicamentos para su condición (es decir, presión sistólica < 140 mmHg).

Resultados La prevalencia estandarizada por edad de la hipertensión varió entre países: en las personas de entre 35 y 49 años osciló entre el 12 % en Bangladesh, Egipto y Tailandia, y cerca del 30 % en Armenia, Lesoto y Ucrania. En las personas entre 35 y 84 años varió entre el 20 %

en Bangladesh, y más del 40 % en Alemania, la Federación Rusa y Turquía. El porcentaje estandarizado por edad de las personas hipertensas que recibieron un diagnóstico, tratamiento o control con medicamentos para su condición fue mayor en los Estados Unidos de América. En concreto, fue del 84 %, 77 % y 56 %, respectivamente, en las personas entre 35 y 49 años. Los porcentajes fueron particularmente bajos en Albania, Armenia, la República Islámica del Irán y Turquía. Aunque las tendencias recientes en la prevalencia difirieron en Inglaterra, Japón y Estados Unidos, la cobertura del tratamiento y el control de la hipertensión han mejorado con el tiempo, sobre todo en Inglaterra.

Conclusión A nivel mundial, la proporción de hipertensos que recibe tratamiento y control con medicamentos sigue siendo baja. Deben realizarse mayores esfuerzos para mejorar el control de la hipertensión, lo que reduciría la carga de enfermedades no transmisibles.

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Table 1. Procedure for measuring blood pressure in surveys in 20 countries, 1980–2011

Country, year of survey ^a	Investigator	Type of blood pressure measuring device	Arm used	No. of measurements	Rest period before first measurement (minutes)	Rest period between measurements (minutes)
Low-income countries						
Albania, 2008 ²⁹	Trained interviewer	Digital	ND	3	ND	10
Armenia, 2005 ³⁰	Physician	Digital	ND	3	ND	5
Azerbaijan, 2006 ³¹	Trained interviewer	Digital	Right	3	ND	10
Bangladesh, 2011 ³²	Trained interviewer	Digital	ND	3	ND	10
Lesotho, 2009 ³³	Trained interviewer	Digital	ND	3	Duration of interview	10
Ukraine, 2007 ³⁴	Trained interviewer	Digital	Right	3	Duration of interview	10
Uzbekistan, 2002 ³⁵	Physician or nurse	Standard mercury sphygmomanometer	Right	2	Duration of interview	10
Middle-income countries						
Colombia, 2007 ³⁶	ND	ND	ND	1	ND	NA
Egypt, 2008 ³⁷	Trained interviewer	Digital	ND	3	Duration of interview	10
Islamic Republic of Iran, 2005 ³⁸	Trained interviewer	Standard mercury sphygmomanometer	Right	2	10	1
Jordan, 2007 ^b	Physician	Standard mercury sphygmomanometer	Right	2	5	0.5
Mexico, 2005–2006 ³⁹	ND	ND	ND	2	ND	5
Russian Federation, 1992–1993 ⁴⁰	Trained interviewer	Random-zero sphygmomanometer	Right	3	5	0.5
South Africa, 1998 ⁴¹	Trained interviewer	Digital	Left	3	5	ND
Thailand, 2004 ⁸	Nurse	Standard mercury sphygmomanometer	Right	3	5	1
Turkey, 2003 ⁶	Physician	Random-zero sphygmomanometer	Both ^c	2–3	30 (duration of interview)	10
High-income countries						
England, 1991–1993, 1998, 2003 and 2006–2010 ⁴²	Nurse	Digital	Right	3	5	1
Germany, 1997–1999 ⁴³	Physician	Standard mercury sphygmomanometer	Right	3	5	3
Japan ⁴⁴						
1980 and 1986–1999	Trained interviewer	Standard mercury sphygmomanometer	Right	1	5	NA
2000–2009	Trained interviewer	Standard mercury sphygmomanometer	Right	2	5	1–2
United States of America ⁴⁵						
1988–1994	Trained interviewer or physician	Standard mercury sphygmomanometer	Right	6 ^d	5	0.5
1999–2010	Physician	Standard mercury sphygmomanometer	Right	3	5	0.5

NA, not applicable; ND, not determined.

^a The year of the latest available survey is given for most countries. For England, Japan and the United States of America, years are given for several surveys because time trends were analysed.

^b Unpublished data, Ministry of Health, Jordan, 2007.

^c The first measurement was made on both arms and the second and third measurements were made on the arm with the higher first measurement.

^d Measured three times each at home and at a mobile examination centre.

Table 2. Survey questions on the diagnosis and treatment of hypertension, 20 countries, 1992–2011

Country, year of latest available survey	Diagnosis questions and choice of answers	Medication questions and choice of answers
Albania, 2008; ²⁹ Armenia, 2005; ³⁰ Azerbaijan, 2006; ³¹ Bangladesh, 2011; ³² Egypt, 2008; ³⁷ Lesotho, 2009; ³³ Ukraine, 2007 ³⁴ Colombia, 2007 ³⁶	Question: Have you ever been told by a doctor or other health professional or nurse that you had hypertension or high blood pressure? Answer: Yes/no/don't know	Question: ^a To lower your hypertension or high blood pressure, are you now: taking a prescribed medicine? Answer: Yes/no/don't know
	Question 1: Have you been told by a doctor or health professional that you had high blood pressure? Answer 1: Yes/no Question 2: Have you been told at least twice by a doctor or health professional that you had high blood pressure? Answer 2: Yes/no	Question: ^a Are you now taking any medicine for high blood pressure? Answer: Yes/no
England, 2010 ⁴²	Question 1: Do you now have, or have you ever had high blood pressure (sometimes called hypertension)? Answer 1: Yes/no Question 2: ^b You mentioned that you have had high blood pressure. Were you told by a doctor or nurse that you had high blood pressure? Answer 2: Yes/no	Question: ^a Are you currently taking any medicines, tablets or pills for high blood pressure? Answer: Yes/no
Germany, 1997–1999 ⁴³	Question: Which of the following illnesses have you ever had? 1. High blood pressure, hypertension. Answer: Yes/no/don't know	Question: How often have you used the following drugs in the last 12 months? 1. Blood pressure-lowering agents. Answer: Daily/several times per week/1–2 times per week/1–3 times per month/rarely/never
Islamic Republic of Iran, 2005 ³⁸	Question 1: Did a physician or health worker check your blood pressure in the previous year? Answer 1: Yes/no. Question 2: ^b Did the physician or health worker tell you that your blood pressure is high? Answer 2: Yes/no	Question: Do you take a drug to control high blood pressure now? Answer: Yes/no
Jordan, 2007 ^c	Question: During the past 12 months have you been told by a doctor or other health worker that you have elevated blood pressure or hypertension? Answer: Yes/no	Question: ^a Are you currently receiving any of the following treatments for high blood pressure prescribed by a doctor or other health worker? Drugs (medication) that you have taken in the last 2 weeks. Answer: Yes/no Question: Are you currently receiving any of the following treatments? 1. Blood pressure-lowering drugs. Answer: Yes/no
Japan, 2009 ⁴⁴	Not available	
Mexico, 2005–2006 ³⁹	Question: Have you ever been told by a doctor that you have high blood pressure? Answer: Yes/no	Question: ^a Are you currently taking any medications to control your blood pressure? Answer: Yes/no/don't know
Russian Federation, 1992–1993 ⁴⁰	Question: Have you (he/she) ever been told by a doctor that you have (he/she has) high blood pressure? Answer: Yes/no/don't know/refused to answer	Question: ^a Do you (he/she) currently take any medicine to reduce high blood pressure? Answer: Yes/no/don't know/refused to answer
South Africa, 1998 ⁴¹	Question: Has a doctor or nurse or staff member at a clinic or at a hospital told you that you had or have any of the following conditions: a. High blood pressure? Answer: Yes/no/don't know	Question 1: Do you use any medicine regularly that has been prescribed by a doctor or nurse? Answer 1: Yes/no/don't know Question 2: ^b Do you know what the medication is for? Answer 2: Yes/no Question 3: ^b Is it for high blood pressure? Answer 3: Yes/no Question 4: ^b Can you name the medication? Answer 4: Yes/no Question 5: ^b Can you write down the name of the medication. Answer 5: Yes/no
Thailand, 2004 ⁸	Question: During the past 12 months, have you ever been told by the health personnel that you had hypertension? Answer: Yes/no	Question: ^a At present, do you receive any of the following treatments for hypertension from the health personnel? Answer: Yes/no
Turkey, 2003 ⁶	Question: Have you been told that you have hypertension by a doctor? Answer: Yes/no	Question: Are you on antihypertensive medication now? Answer: Yes/no

(continues. . .)

... continued

Country, year of latest available survey	Diagnosis questions and choice of answers	Medication questions and choice of answers
United States of America, 2009 and 2010 ⁴⁵	Question: Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure? Answer: Yes/no/don't know/refused to answer	Question 1: ^a Because of your high blood pressure/hypertension, have you ever been told to take a prescribed medicine? Answer 1: Yes/no/don't know/refused to answer Question 2: Are you now taking a prescribed medicine? Answer 2: Yes/no/don't know/refused to answer
Uzbekistan, 2002 ³⁵	Question: Have you ever been told by a doctor or other health professional that you had hypertension or high blood pressure? Answer: Yes/no/don't know	Question 1: ^a Did a doctor or other health professional tell you what to do about your hypertension or high blood pressure? Answer: Yes/no Question 2: ^b To lower your hypertension or high blood pressure, are you now: taking a prescribed medicine? Answer: Yes/no/don't know

^a This question was asked if the interviewee answered yes to the question or questions on diagnosis.

^b This question was asked if the interviewee answered yes to the previous question.

^c Unpublished data, Ministry of Health, Jordan, 2007.