PHYSICIAN ASSESSMENT OF STROKE RISK IN HYPERTENSIVE PATIENTS IN THE MIDDLE EAST AND AFRICA: RESULTS OF THE ACTION SURVEY

Kamal F. Badr, MD; Khereddine M. Merad Boudia, MD; Mohamed Alami, MD; Waleed A. Khoja, MD; Ali B. Belhani, MD; Moustafa Nawar, MD; Hany Ragy, MD; Mohammad Ishaq, MD; J. M. Muscat Baron, MD; Ayman J. Hammoudeh, MD; Suzan S. De Mar Youssef, MBA; Reine M. Nakhle, MBA; Amale G. Chalfoun, MD and the ACTION (**A**ssessing and redu**C**ing the risk of s**T**roke in hypertens**ION** Survey Group)

Objectives: In the absence of reliable, contemporary national data, the ACTION survey was designed to: a) provide preliminary data on stroke risk in the MEA (Middle East and Africa); b) describe the contribution of specific cardiovascular risk factors; 3) assess blood pressure (BP) control.

Design and Patients: This was a multi-center observational study in nine countries in the MEA region. From 2003 to 2005, 562 physicians from a variety of specialties recorded observations of cardiovascular risk factors in 4,747 hypertensive patients, aged 54–80 years. The 10-year absolute stroke risk was calculated using a scoring system based on the Framingham Heart Study observations, and comparisons made with an age-matched cohort.

Results: The mean 10-year stroke risk was estimated at 22.7% and was significantly higher for men (25.4%) than for women (19.5%) ($P<.001$) and for diabetics (28.2%) than for non-diabetics (19.4%) ($P< .001$). Compared with an age-matched Framingham cohort, the estimated stroke risk in our population was almost double, and was significantly higher for females (212%) than for males (192%) ($P<.001$). Hypertension, diabetes, left ventricular hypertrophy, and smoking were major contributing risk factors, as were physical inactivity and elevated cholesterol. Blood pressure was controlled in only 18% of the population and in 12% of diabetics.

Conclusion: Physicians of all specialties were willing to participate in stroke risk assessment. The risk of stroke in hypertensive patients in the MEA region is high, and is higher than would be predicted using Framingham data, particularly for females. Hypertension appears to be poorly controlled in more than 80% of hypertensive patients in the MEA region. (*Ethn Dis*. 2007;17:274–279)

Key Words: Stroke, Cardiovascular Risk Factors, Framingham Heart Study, Middle East, Africa

From the Department of Internal Medicine, American University of Beirut, Beirut, Lebanon (KFB); the Cardiology Department, Hospital Mustapha Pacha, Alger, Algeria (KMMB); Cardiologist, Casablanca, Morocco (MA); Riyadh Armed Forces Hospital, Riyadh, Saudi Arabia (WAK); Hospital Charles Nicolle, Tunis, Tunisia (ABB); Alexandria University, Alexandria, Egypt (MN); National Heart Institute, Cairo, Egypt (HR); National Institute of Cardiovascular Diseases, Karachi, Pakistan (MI); Cardiology Department, Dubai Hospital, UAE (JMMB); Al Essra Hospital, Amman, Jordan (AJH); Statistics Department (SSDMY, RMN) and Medical Department (AGC), Merck Sharp & Dohme Representative Office, Lebanon.

Address correspondence and reprint requests to Kamal F. Badr, MD, ASCI, AAP; Professor & Chair, Department of Internal Medicine, American University of Beirut, P.O. Box 11-0236, Riad El Solh 110 72020, Beirut, Lebanon; 961 1 374374 Ext. 5353; +961 1 370814 (fax); kbadr@aub.edu.lb

INTRODUCTION

Globally, stroke is the third most common cause of death and is the earliest and most devastating consequence of uncontrolled hypertension in adults.[1–3] Elevated systolic blood pressure (SBP) is a leading risk factor for stroke; a linear relationship between stroke incidence and SBP has been demonstrated in several epidemiological and clinical studies.[4–6] Most importantly, control of hypertension markedly reduces the incidence of stroke.[7–11] Despite numerous epidemiologic studies on hypertension and stroke, contemporary data from the Middle East and Africa (MEA) remain sparse.[12–14]

Physician assessment of absolute risk of stroke can and should play a central role in counseling and treating individual patients, particularly as they decide on the need and class of pharmacologic therapy. The ACTION survey was centered around the theme of physician involvement in data collection and risk assessment. Its specific objectives were to:

a) provide preliminary data on the risk of stroke in a sample of hypertensive patients from the MEA region;
b) describe the relative contribution of specific cardiovascular risk factors in stroke risk in this part of the world;
c) assess the percentage of patients with controlled blood pressure.

Our study also hoped to demonstrate the willingness of physicians in the MEA region to become involved in stroke risk assessment and the collection of multinational observational data from the region, which may identify areas of opportunity for improvement as part of an audit cycle.

METHODS

ACTION was an observational multi-center survey performed in nine

Despite numerous epidemiologic studies on hypertension and stroke, contemporary data from the Middle East and Africa (MEA) remain sparse.[12–14]

countries across the Middle East and Africa region (Algeria, Egypt, Jordan, Kingdom of Saudi Arabia [KSA], Lebanon, Morocco, Pakistan, Tunisia and the United Arab Emirates [UAE]). We enrolled patients during January 2003 and January 2005. A total of 562 physicians were asked to recruit a representative sample of patients, diagnosed with hypertension and between the ages of 54 to 85 years.

The study included hypertensive patients, both treated and newly diagnosed. The diagnosis of hypertension was based on current use of antihypertensive drugs or the physician's decision to start antihypertensive therapy. Blood pressure (BP) was measured using a mercury manometer. A minimum systolic BP of 95 mm Hg was needed for the patient to be enrolled in the study in order to exclude patients who were no longer in need of antihypertensive treatment. Patients with a history of stroke or TIA (transient ischemic attacks) were excluded from the study.

Data collected for all recruited patients included age, sex, weight, blood pressure, physical activity, alcohol consumption, total cholesterol, smoking, diabetes, and cardiovascular disease (myocardial infarction, angina pectoris, coronary insufficiency, intermittent claudication or congestive heart failure) and current antihypertensive therapy.

For all patients, an ECG or a TTE (trans-thoracic echocardiography) was performed to determine the presence of LVH (left ventricular hypertrophy). The presence of atrial fibrillation was also recorded.

The recorded data were used in a scoring algorithm for the calculation of the individual patient's 10-year risk of stroke based on the Framingham Heart Study risk scale, with correction necessary to take into account the effect of antihypertensive treatment.[15] The calculation was based on points allocated for the following variables: age, SBP, history of diabetes, current smoking, presence of cardiovascular disease (CVD), history of atrial fibrillation, and presence of LVH. The presence of cardiovascular risk factors such as obesity, physical inactivity and alcohol consumption were reported as per physician judgment. Comparison of stroke risk was made with an age-matched Framingham cohort.

Neither the physicians nor patients who took part were compensated for their participation. Patient data collection sheets were anonymous to preserve patient privacy.

STATISTICS

The primary objective of the study was to estimate the risk of stroke in this hypertensive population, using a scoring system derived from the Framingham study. The prevalence of the individual risk components (systolic blood pressure, age, diabetes, smoking, CVD, atrial fibrillation and LVH) was examined and the contribution of each of these to the overall stroke risk was quantified for each sex. Other known stroke risk factors, not included in the Framingham scoring system, such as elevated cholesterol, obesity, physical inactivity and alcohol consumption, are also presented. The secondary objective was to determine the extent to which blood pressure control was achieved in treated patients.

We used descriptive and summary statistics in our analysis. A sample size of 2000 permits a proportion to be precisely estimated and a 95% confidence interval to be calculated. Where relevant, comparisons were made using Chi-squared tests for proportions and *t* tests for means.

RESULTS

Patients

A total of 4,747 patients were included in the study; 2,515 males and 2,232 females. Data were provided by 562 physicians, of which 360 were cardiologists, 208 general practitioners or internal medicine, and the remainder were mainly nephrologists or endocrinologists. The baseline characteristics of the study population, together with observed risk factors are presented in Table 1.

Stroke Risk

The probability of stroke within 10 years was estimated at a mean of 22.7% and median of 17%. The probability of stroke was significantly higher for men than for women (mean 25.4 vs 19.5%; median 20 vs 13%, respectively, $P<.001$) and among diabetic patients compared with non-diabetics (mean 28.2 vs 19.4%; median: 22 vs 13%, respectively, $P<.001$). The proportional increase in the average risk for stroke, compared to an age-matched Framingham population approximately doubled (195%), and was higher among females than males (212 vs 79%, respectively, $P<0.001$).

Contribution of Individual Risk Factors

Most patients had three or four of the seven risk factors (SBP, age, diabetes, smoking, CVD, atrial fibrillation and LVH), which constitute the basis for Framingham risk score calculations. Table 1 includes the most common risk factors that are not included in the Framingham risk score. Figure 1 shows the contribution of each Framingham risk factor to the overall predicted probability of stroke. The total population was segmented into tertiles: one third with the lowest probability of stroke (3%–13% for males and 1%–8% for females), one third with medium probability of stroke (15%–26% for males and 9%–16% for females), and one third with the highest probability of stroke (29%–88% for males and 19%–88% for females). Hypertension was the most prominent risk factor, but its contribution to total risk was progressively diminished among higher risk groups, as other factors (CVD, atrial

Table 1. Baseline characteristics of study population

	Males	*n*	Females	*n*	All	*N*
Age (years)	63.4 (7.1)	2515	63.9 (7.1)	2232	63.6 (7.1)	4747
Weight (kg)	79.9 (24.8)	1839	75.2 (13.2)	1638	77.7 (20.3)	3477
Treated patients SBP (mmHg)	154.4 (22.4)	2035	155.7 (22.9)	1888	155.0 (22.6)	3923
Treated patients DBP (mmHg)	93.7 (12.3)	1557	91.6 (11.8)	1484	92.7 (12.1)	3041
Non-treated patients SBP (mmHg)	170.0 (20.5)	480	168.6 (23.3)	344	167.7 (21.7)	824
Non-treated patients DBP (mmHg)	99.1 (11.3)	349	96.5 (12.1)	231	98.1 (11.7)	580
Stroke risk factors that constitute part of Framingham calculations						
SBP ≥ 106 mmHg for males and SBP ≥ 95 mmHg for females (%)	98	2515	100	2232	99.4	4747
Age ≥ 57 yrs (%)	80	2515	82	2232	81	4747
Diabetes (%)	37.1	2515	37.5	2232	37.3	4747
Smoking (%)	48.4	2515	12.4	2232	31.5	4747
History of CVD (%)	33.8	2515	27.2	2232	30.7	4747
Atrial fibrillation (%)	7.5	2515	8.1	2232	7.8	4747
LVH (%)	35.9	2515	36	2232	35.9	4747
Other cardiovascular risk factors						
Elevated TC (%)	48.4	1978	45.3	1765	46.9	3743
Physical inactivity (%)	54.6	1978	64.8	1765	59.4	3743
Obesity (%)	36.3	1978	47.9	1765	41.8	3743
Alcohol consumption (%)	8.1	1978	1.2	1765	4.9	3743

SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; LVH, left ventricular hypertrophy; CVD, cardiovascular disease. Data are shown as mean (SD, standard deviation) or percentage.

fibrillation, age, and LVH) increasingly contributed to risk.

Control of BP

Of 4,747 evaluated patients, 3,923 (83%) were patients with an established diagnosis of hypertension; 824 were newly diagnosed. Half the treated patients were receiving beta blockers. The level of blood pressure control of treated patients based on European Society of Hypertension/European Society of Cardiology guidelines (non-diabetic ≤140/90 mm Hg, diabetic: ≤130/85 mm Hg) is shown in Figure 2. Only 18% of patients had both systolic and diastolic BP controlled; this was similar in males and females. The percentage of controlled patients is even lower among the diabetic population where only 12% had both the SBP and DBP controlled.

DISCUSSION

The ACTION survey highlights a number of relevant issues that affect the approach to the management of hypertension in the MEA region. First, by looking at the number of participating physicians, it demonstrates the willingness and compliance of physicians in the region to undertake systematic assessment of stroke risk in their hypertensive patients. Physicians who participated in ACTION were from all

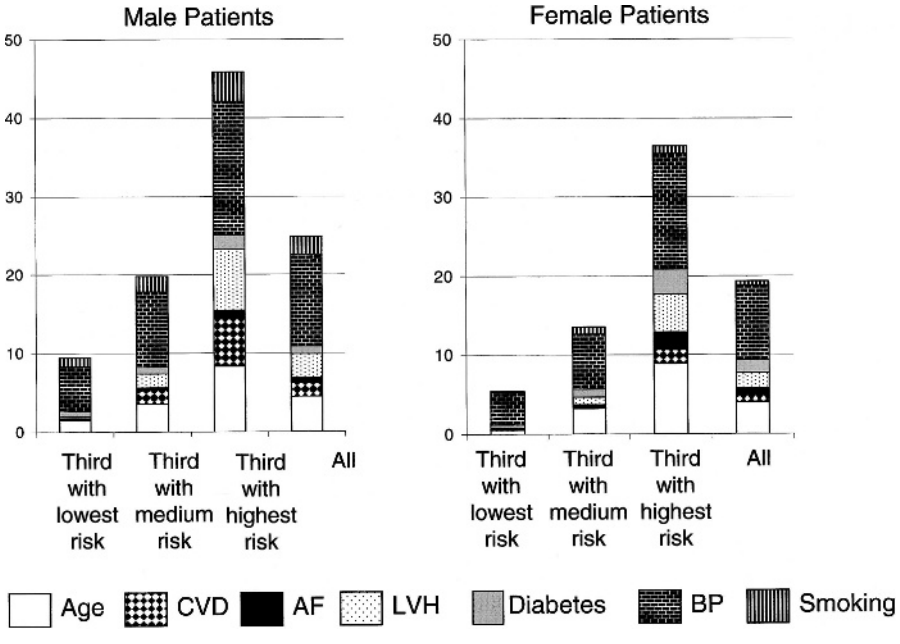

Fig 1. Contribution of each cardiovascular stroke risk to the total probability of stroke in all and each tertile.The percentage of points each risk factor contributed to the total points was calculated as per the Framingham model. The percentages were scaled to the probability of stroke for each tertile

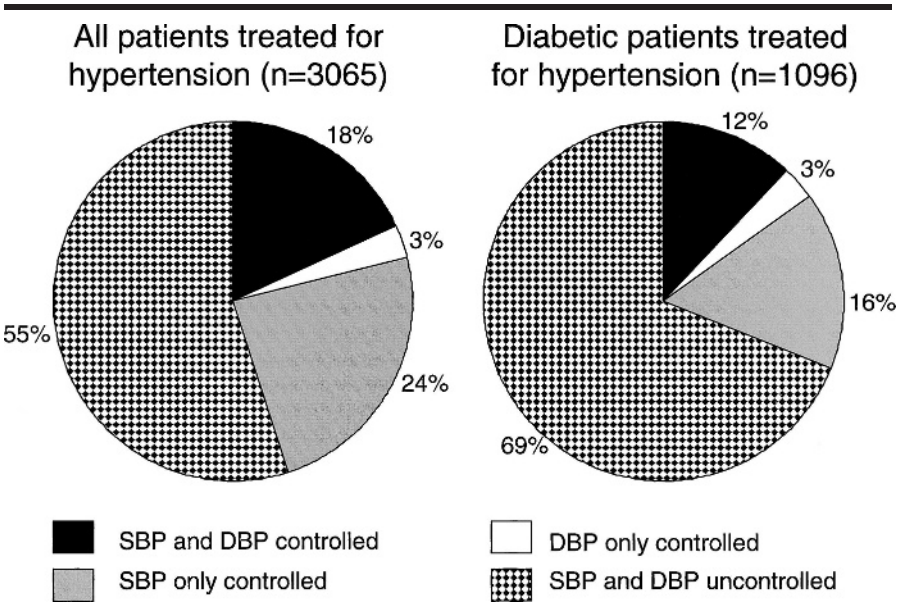

Fig 2. Proportion of treated patients with controlled and uncontrolled systolic blood pressure, diastolic blood pressure or systolic blood pressure and diastolic blood pressure according to European Society of Hypertension/European Society of Cardiology guidelines SBP/DBP level ≤140/90 mm Hg and diabetic patients are controlled at an SBP/DBP level ≤130/85 mm Hg

specialties responsible for treating hypertension in this region. They participated without reward, and were willing to collect all the data, perform the necessary calculations, and report their findings in a timely manner. Their cooperation and enthusiasm for the study highlights the potential usefulness of this approach in increasing physician, as well as patient, awareness of the risk of stroke, and the need for the treatment of high blood pressure.

Our comparison with data derived from the Framingham Heart Study deserves discussion. Clearly, the relevance of an American population to many parts of the MEA region is limited, not only because of differences in standards of living and treatment opportunities but also because of the ethnic differences. Nonetheless, our use of the Framingham data as a 'control' seems to bare scrutiny. We found a doubling of estimated 10-year stroke risk compared with Framingham. WHO statistics[1] estimate the morbidity of stroke in our region to be between 4 and 9 disability-adjusted life years (DALYs) lost per 1000 population, compared with between 3 and 4 DALYs for the US and major European countries and is consistent with our estimate of a doubling of risk.

One limitation of our survey needs to be acknowledged. This was not a statistically derived representative sample; it was based on physicians' positive responses to an invitation to participate. We have no way of knowing whether the cohort is truly representative of the population of these countries but the large number of patients, sampled from many different healthcare settings should minimize bias caused by individual sites selecting patients.

The results are disturbing. We, and others, have shown that the MEA region has a substantial problem in the magnitude of stroke risk, and its potential impact on the health, the social and the economic status of the population.[16–17] The combined effects of sedentary lifestyle, smoking, untreated or undertreated hypertension, obesity, and cardiovascular disease contribute to the excess risk compared with the West.[18–19] Obesity and dyslipidemia have accompanied a near-epidemic increase in the incidence of diabetes. Poor BP control is a significant risk factor in our population, especially among diabetics, and the high incidence of LVH is an expected consequence.

…the results of the ACTION survey have shown that the risk of stroke in the MEA region is significantly higher than expected …

In conclusion, the results of the ACTION survey have shown that the risk of stroke in the MEA region is significantly higher than expected, compared with Western populations, and is especially increased among females. Physicians of all specialties in the region are willing to participate in stroke risk assessment for their patients. Hypertension appears to be poorly controlled in the majority of patients in the MEA region. These findings should prompt a widespread effort to engage physicians in stroke risk evaluation of hypertensive patients and to more effectively control BP in this high-risk population.

ACKNOWLEDGMENTS

The authors wish to thank Helen Tate and Paul Robinson for their guidance in writing and in the editorial support. The ACTION survey was sponsored by Merck, Sharp and Dohme (MSD), Middle East and Africa.

Conflict of interest: Amale G. Chalfoun, Suzan S. De Mar Youssef, and Reine M. Nakhle are employees of MSD who make antihypertensive medication. Kamal F. Badr has received honoraria as advisor and speaker for MSD.

Also the authors would like to acknowledge all the participating physicians:

Algeria (704 Patients): M. Ait Athmane, N. Aliane, Y. Allioua, N. Amamra, S. Aou-

chiche, B. Aouiche, M. Azzouz, W. Beguiret, Z. Belhadj-Mostafa, A. Belkacemi, C. Benabdallah, M. Benameur, L. Bendaoud, M.L. Benghezel, D. Benhacine, M. Benkhettab, H. Benzaoui, A. Bouaziz, R. Bouchair, D. Bouchenak, R. Chaabane, K.F. Chachoua, L. Chentir, M. Chibane, L. Chouarfia, A. Daib, A. Dali Youcef, K. Drebine, B. Drici, C. El Bekri, A. Ferdas, K. Grid, N. Hamdache, N. Hamedache, D. Hamizi, L. Hamou Jamous, R. Hassine, A. Hellal, N. Jamous, A. Kachenoura, F. Z. Kaddour Benkada, K. Kadri, F. Z. Kahoul, L. Kara, Z. Kara Nebia, R. Kouadria, T. Lassal, M. Mabrouki, M. Mansouri, T. Mebarak, A. Mennai, A. Meziane, Y. Moualek, D. Nasri, F. Othmani, B. Ouddai, S. Ounnas, A. Rahouati, K. Sahtout, A. Salah Mansour, B. Sedkaoui, D. Si Ahmed, R. Tabet Aoul, K. Tahraoui, T. Taileb, C. Taouti, S. Teguiche, A. Yahia Berrouiguet, H. Zidani, N. Zourdani

Egypt (421 Patients): A. Abdel Hakeem, M. Abdel Maaboud, H. Abdel Rahman, E. Affify, H. Ahmed Hamed, M. Badry, A. Bahriz, E. Barakat, Y. Bohdady, I. Daoud, S. El Amin, M. El Far, H. El Gayar, H. El Khatib, A. El Kousy, M. El Refaee, A. El Sadek, W. El Saied, H. El Sayad, A. El Sebaei, A. El Wahsh, A. Fouad, S. Ghait, T. Gouda, B. Hanna, A. Ibrahim, M. Iskander, S. Kamal, A. Khashaba, S. Louis, Y. Mahmoud, M. Makhloof, A. Mohammed, Y. Radwan, W. Rafla, N. Salama, A. Sallouma, F. Samy, K. Wahby, T. Youssef

Jordan (142 Patients): R. Ali, N. Asa'ad, Z. Atyieh, K. Hamati, B. Jbour, B. Kadri, H. Kana'an, M. Mazahreh, H. Rashid, S. Sbeitan, A. Shihab, M. Shugair, M. Suleiman, M. Suwi

Lebanon (1,171 Patients): C. Abdel Ahad, A. Abdel Masih, N. Abdel Samad, L. Abdel Sater, N. Abi Rached, B. Abou Hamdan, S. Abou Jaoudeh, A. Abou Khalil, H. Abou Zeinab, A. Adhami, M. Akel, M. Al-Ali, A. Alameddine, E. Andary, S. Arnaout, P. Awad, R. Azar, G. Badaoui, F. Barakeh, N. Bassil, M. Beaini, A. Berbari, G. Chaer, I. Chahine, E. Chammas, D. Chlela, I. Dgheim, H. Dib, E. Eid, G. Elias, A. Fadel, H. Fatfat, M. Feghaleh, G. Ghanem, A. Gibaii, J. Haddad, M. Hamadeh, C. Hennawi, A. Ibrahim, T. Ibrahim, F. Irani, M. Ismaeel, M. Jaber, A. Jaffal, S. Jurdi, I. Kalash, A. Kambar, R. Kassab, M. Kassis, H. Kazma, J.C. Khairallah, Y. Khodr, B. Khoury, W. Khoury, M. Kleit, E. Kourdahi, A. Koweyess, S. Mallat, A. Mansour, W. Mouawad, G. Moukarzel, E. Nasr, M. Nassar, G. Obeid, G. Ojaimy, H. Ramadan, A. Saab, N. Saab, S. Saad, E. Salameh, N. Saliba, A. Shim, A. Simonan, S. Succar, F. Tabaja, K. Taki, A. Toutaunji, F. Turquieh, S. Wakim, D. Wazni, A. Wehbe, R. Yassine, N. Youakim, R. Zalloum, A. Zgheib, M. Zoghbi

Morocco (656 Patients): A. Aadou, A. Abadi, A. Abbadi, K. Adnan, J. Agoumy, M. Alami, S. Amrioui, M. Atlab, N. Atmani, B. Babou, A. Benabdeslam, B. Benazzouz, D. Benchekroun, D. Benchekroun, C. Benchekroun, M. Benjelloun, H. Benjelloun, S. Bennouna, M. Benomar, S. Benomar, S. Bensafiddine, W. Bensouda, F. Bentayeb, A. Benyahia, M. Berbich, M. Berrada Gouzi, A. Bidani, A. Boukili, A. Boulaich, A. Chaib, M. Chami, N. Chemaou, D. Cherkaoui, K. Cherkaoui, A. Chouladi, F. El Ali, M. El Assali, H. El Beqali, N. El Haitem, M. El Khatabi, A. El Koutbi, N. El Malki Berrada, B. El Younassi, N. Errafii, D. Ezzayadi, S. Guedira, A. Haytoumi, J. Ibnattya Andaloussi, S. Jamai, C. Joundy, N. Karim, M. Kassioui, M. Kendoussi, A. Khatouri, Z. Lakhal, A. Lakhssassi, M. Lamghari Moulay, M. Lamtai, M. Lebbar, S. Liamani, I. Louah, B. Menebhi, H. Mir, A. Najab, A. Naji, M. Nazzi, A. Oujjari, M. Ouzry, A. Rami, M. Sadeli, M. Scadi , H. Sefrioui, R. Serghouchni, A. Tazi Mezalek, M. Zahraoui, M. Zbir, M. Zizi, F. Zoheir, A. Zouaki

Pakistan (363 Patients): N. Aara, Z. Abbas, F. Akbani, M.A. Akhter, R. Ali, K. Amin, P. Asgher, M. Ashfaq, T. Ashraf, H.M. Ayoub, A. Bhatti, H. Bikya, A. Bilal, A. Farooqui, I. Fazal, P. Hafeez, A. Haider, I. Haq, A. Hussain, M. Hussain, A. Islam, M.N. Khan, N. Khursheed, M.I. Malik, F. R. Memon, F. Memon, D. Muhammed, T. Naheed, N. Naqi, A. M. Paracha, S. Rafiq, M. Rauf, M. Raza, F. Rehman, F.H. Rizvi, S. Sanghi, H. Shafique, W. Sharif, A. A. Sheikh, F. Sheikh, B. Somroo, A.I. Syed, H. ul Banna, H. Ullah Jan, N. Un Nasir, E. Vohra, M. Zafar

Saudi Arabia (511 Patients): M. Abbas, K. Abbas, A. Abd Rabo, R. Abu Khader, N. Ahmed Abu Newair, M. Abu Talib, N. Abul Khair, O.M. Ahmed, Y. Al Abraq, A.M. Al Ajlani, M.F. Al Deeb, M. Al Fakry, A. Al Gamal, M. Al Gazzar, M. Al Motaafy, M. Al Omar, H. Al Remah, A. Alagan, A. Alasfar, M. Ali Koseibi, M. Anwar, S. Atef, A. Atta, M. Bader, M. Badr, M. Bou Khatra, B. Dahha, Z. Dallo, A. Dervez, F. El Bably, M. El Baradee, M.S. El Baz, N. El Naggar, M. El Nazer, H. El Sayed, O. El Shahrani, M. El Hakamy, M. Essawy, M.R. Ezzat, M. Fakr Al Din, T. Fauzy, A.Y. Gad, M.S. Ghani, R. Ghazal, F. Ghazy, N. Hamdi, M. Hamid, S. Hamza, M. Haran, T. Hassan, M. Hassan, M. Helal, M. Helmy, Z. Hussain, I. Hyder, A. Ibrahim, S. M. Ibrahim, M. Inam, M. Kader, A. Kamal, M.A. Karim, E. Karima, S.M. Khalek, T. Khalil, J. Khan, G. Khattab, G. Korayem, P. Kumar, M. Kunhi, P. Madathil, M. Mahdy, W. Mahfooz, M. Mahmoud, M.K. Mahmoud, I. Mansoor Bakshi, D. Mansour Ewais, S. Marwish, A.H. Mohamed, M. Mohammed, A. Mohd, K. Mohi Eldin, A. Mostaba, E. Mostafa, M. Moustafa, A.A. Muhamad, M.K. Moh Nada, M. Nour Al Din, A. Nourin, O. Obidate, M.H. Odeh, A.K. Omer, S. Omran, E. Ramadan, H. Raslan, M. Rawi, V. Rezaicek, N. Saad, K. Said, M. Salah Moselhy, T. R. Samaan, A. Ali Samy, M. Sayoufi, A. Shaarawy, A. Shalaby, S. El Din Shams, R. Sheker, P. Shridar, S. Sobhy, F. Soker, S.M. Abdulla Sulieman, S. Tawfeek, M. Thamadail, S. Yagen, F. Younes, T.M. Yousef, R. Yousef, M.A. Zahir, M.M. Zaki, S. Zazoa, T. ZoI Faqar

Tunisa (477 Patients): H. Drissa, A. Hdiji, S. Laabidi

United Arab Emirates (302 Patients): A.Z. Abdel Rahman, Z.M. Aboulfotouh, J. Ailaboni, U.S. Ajai Kumar, M. Al Ghorouri, A.M. Al Ruwaih, M. Alapatt, T. Alhassan, A.M. Ali, M.L. Antoon, I. Awad, K.R. Barua, H. Darouei, H. Delshad, D. Dharmarajan, A. Fuad, R. Gupta, H. Habibi, H. Hanafi, S. Hashemipour, S. Hgde, N. Jamkhou, S. Jazrawi, A. Khalaf, T. Khatab, S. Kumar, C. Lang, V. Lenin, S. Menon, S. Menon, N. Mohmaed, A. Muslim, A.K. Nasr, H. Por, H. Risik, M.T. Saeed, V. Sasikumar, V.J. Sebashau, H. Soberjani, C. Wehbe Chidiac

REFERENCES

1. Mackay J, Mensah GA. The atlas of heart disease and stroke. Available at: http://www.who.int/cardiovascular_diseases/en/cvd_atlas_16_death_from_stroke.pdf. Last accessed 9/1/06.
2. Mancia G. Prevention and treatment of stroke in patients with hypertension. *Clinical Therapeutics.* 2004;26:631–648.
3. Goldstein L, Adams R, Becker K, et al. Primary prevention of ischemic stroke. *Stroke.* 2001;32:280–299.
4. Lawes C, Bennett D, Feigin V, Rodgers A. Blood pressure and stroke. An overview of published reviews. *Stroke*. 2004;35:1024–1033.
5. Collins R, Peto R, MacMahon S, et al. Blood pressure, stroke, and coronary heart disease. Part 2, short-term reductions in blood pres-

sure: overview of randomized drug trials in their epidemiological context. *Lancet*. 1990; 335:827–838.
6. Li C, Engström G, Hedblad B, Berglund G, Janzon L. Blood pressure control and risk of stroke. A population-based prospective cohort study. *Stroke*. 2005;36:725–730.
7. Mancia G, Ambrosioni E, Rosei EA, Leonetti G, Trimarco B, Volpe M. Blood pressure control and risk of stroke in untreated and treated hypertensive patients screened from clinical practice: results of the ForLife study. *J Hypertens*. 2005;23:1575–1581.
8. MacMahon S, Peto R, Cutler J, et al. Blood pressure, stroke and coronary heart disease. Part 1, prolonged differences in blood pressure: prospective observational studies corrected for the regression dilution bias. *Lancet*. 1990;335:765–774.
9. Neal B, MacMahon S, Chapman N. Effects of ACE inhibitors, calcium antagonist and other blood pressure lowering drugs: results of prospectively designed overviews of randomized trials. Blood Pressure Lowering Trialists' Collaboration. *Lancet*. 2000;356:1955–1964.
10. Hansson L, Lindholm L, Ekbom T, et al. Randomised trial of old and new antihypertensive drugs in elderly patients: cardiovascular morality and morbidity the Swedish Trial in Old Patients with Hypertension-2 study. *Lancet*. 1999;354:1751–1756.
11. Dahlöf B, Devereux R, Kjeldsen S, et al. Cardiovascular morbidity and morality in Losartan intervention for endpoint reduction in hypertension study (LIFE): a randomized trial against atenolol. *Lancet*. 2002;359: 995–1003.
12. Al-Rajeh S, Larbi E, Bademosi O, Awada A, Ismail H, Al-Freihi H. Pattern and ethnic variations in stroke in Saudi Arabia. *J Neurol Sci*. 1991;102:112–118.
13. Radhakrishnan K, Ashok PP, Sridharan R, Mousa ME. Stroke in the young: incidence and pattern in Benghazi, Libya. *Acta Neurol Scand*. 1986;73:434–438.
14. Thorvaldsen P, Asplund K, Kuulasmaa K, Rajakangas AM, Schroll M. Stroke incidence, case fatality, and mortality in the WHO MONICA project. World Health Organization Monitoring Trends and Determinants in Cardiovascular Disease. *Stroke*. 1995;26: 361–367.
15. Straus SE, Majumdar SR, McAlister FA. New evidence for stroke prevention. *JAMA*. 2002;288:1388–1395.
16. Staessen J, Kuznetsova T, Stolarz K. Hypertension prevalence and stroke mortality across populations. *JAMA*. 2003;289: 2420–2422.
17. Giroud M, Beuriat P, Vion P, D'Athis P.H, Dusserre L, Dumas R. Stroke in a French prospective population study. *Neuroepidemiology*. 1989;8:97–104.
18. Sudlow CL, Warlow CP. Comparable Studies of the incidence of stroke and its pathological types: results from an international collaboration. International Stroke Incidence Collaboration. *Stroke*. 1997;28:491–499.
19. Bastuji-Garin S, Deverly A, Moyse D, et al. The Framingham prediction rule is not valid in a European population of treated hypertensive patients. *J Hypertens*. 2002;20:1973–1980.

AUTHOR CONTRIBUTIONS

Design concept of study: Badr, Nawar, Ragy, Haqmmoudeh, Chalfoun

Acquisition of data: Merad Boudia, Alami, Belhani, Nawar, Ragy, Ishaq, Baron, Haqmmoudeh

Data analysis and interpretation: Badr, Alami, Khoja, Belhani, Ishaq, De Mar Youssef, Nakhle

Manuscript draft: Badr, Merad Boudia, Khoja, Ishaq, Baron, De Mar Youssef, Chalfoun

Statistical expertise: Nakhle

Administrative, technical, or material assistance: Merad Boudia, Alami, Ishaq, Chalfoun

Supervision: Badr, Merad Boudia, Khoja, Nawar, Ishaq, Baron, Haqmmoudeh, Chalfoun