GLOBAL HEART VOL. 7, NO. 4, 2012

ISSN 2211-8160/$36.00
http://dx.doi.org/10.1016/j.gheart.2012.10.001

REVIEW

The Asia Pacific Cohort Studies Collaboration: A Decade of Achievements

Mark Woodward *, Rachel Huxley †, Hirotsugu Ueshima ‡, Xianghua Fang §, Hyeon Chang Kim ||, Tai-Hing Lam ¶

Sydney, Australia; Minneapolis, MN, USA; Otsu, Shiga, Japan; Beijing, China; Seoul, South Korea; and Hong Kong, China

The Asia Pacific Cohort Studies Collaboration (APCSC) was established in the late 1990s when there was a distinct shortfall in evidence of the importance of risk factors for cardiovascular disease in Asia. With few exceptions, most notably from Japan, most of the published reports on cardiovascular disease in the last century were from Western countries, and there was uncertainty how far etiological associations found in the West could be assumed to prevail in the East. Against this background, APCSC was set up as a pooling project, combining individual participant data (about 600,000 subjects) from all available leading cohort studies (36 from Asia and 8 from Australasia) in the region, to fill the knowledge gaps. In the past 10 years, APCSC has published 50 peer-reviewed publications of original epidemiological research, primarily concerned with coronary heart disease, stroke, and cancer. This work has established that Western risk factors generally act similarly in Asia and in Australasia, just as they do in other parts of the world. Consequently, strategies to reduce the prevalence of elevated blood pressure, obesity, and smoking are at least as important in Asia as elsewhere— and possibly more important when the vast size of Asia is considered. This article reviews the achievements of APCSC in the past decade, with an emphasis on coronary heart disease.

The Asia Pacific Cohort Studies Collaboration (APCSC) was established at the end of the last century, when there was a plethora of high-quality evidence of the effects of several risk factors on cardiovascular disease (CVD) from Occidental populations, but scant evidence from Oriental populations [1]. This was despite CVD already being a leading cause of death in Asia. However, the pattern of CVD was, and still is, somewhat different in many Asian countries to European and North American countries. Stroke is often more common than coronary heart disease (CHD) in Asia, but not in the West, and the hemorrhagic—to—ischemic stroke rate ratio is typically higher in Asia. Furthermore, several established "Western" CVD risk factors were known to have very different distributions in Asia—for example, body mass index and cholesterol tend to be lower in Asia. So there were reasons to doubt that etiological associations confirmed, and CVD guidelines developed, in the West could be assumed for Asian populations. With the huge, and aging, populations in Asia, there was a clear need for reliable evidence on the effects of risk factors to inform policy makers in Asian countries and promote primary prevention of CVD and other noncommunicable diseases. However, the studies then completed, or

From the *George Institute, University of Sydney, Sydney, Australia; †Division of Epidemiology and Public Health, University of Minnesota, Minneapolis, MN, USA; ‡Department of Health Science, Shiga University of Medical Science, Otsu, Shiga, Japan; §Department of Epidemiology and Social Medicine, Capital Medical University, Beijing, China; ||Department of Preventive Medicine, Yonsei University College of Medicine, Seoul, South Korea; ¶School of Public Health, The University of Hong Kong, Hong Kong, China. Correspondence: M. Woodward (markw@georgeinstitute.org.au).

GLOBAL HEART, VOL. 7, NO. 4, 2012
December 2012: 343–351

underway, in Asia were not of a size (in terms of numbers of people or numbers of events) to provide the level of certainty required in estimates of association. Even where numbers were of reasonable size overall, they were not large enough to reliably evaluate sex- and age-specific effects.

Hence, APCSC was envisaged as a pooling project of existing studies with the remit to provide reliable evidence of the age-, sex-, and region-specific associations between classical Western risk factors and CHD, stroke, and other leading causes of death in the Asia-Pacific region. At the outset it was realized that a key output from the research would be a comparison of the associations between risk factors and diseases between the Western parts of the region (Australia and New Zealand: ANZ or Australasia) and Asia. In this way, ANZ could act as an exemplar of the West and thus allow East-West comparisons within a single platform.

THE STUDIES

Studies were eligible for inclusion in this project if they: had a study population from the Asia-Pacific region; used a prospective cohort study design; observed at least 5,000 person-years of follow-up; recorded dates of birth (or ages at baseline); recorded sex and blood pressure at baseline; and recorded dates of death (or ages at death), where appropriate. Studies were excluded if they: selected subjects on the basis of a positive disease history or diagnosis; or were judged to be of poor quality, after consultation with local experts.

Using these criteria, studies were identified by electronic searches and personal contacts, and principal investigators were invited to join by sharing their individual participant data on a range of baseline sociodemographic variables and risk factors, as well as events during follow-up. Ultimately this led to the inclusion of 44 studies, 16 from mainland China, 14 from Japan, 8 from Australia, 2 from Taiwan, 2 from Singapore, and 1 each from Hong Kong, New Zealand, South Korea, and Thailand. Unfortunately, no eligible study was found, or was willing to join, from the Indian subcontinent or the Pacific Islands. In addition to the basic requirements of providing data on potential risk factors at baseline and deaths during follow-up, 16 of the 44 studies additionally provided repeat post-baseline measurements of risk factors, 19 reported nonfatal strokes, and 16 reported nonfatal CHD events.

The study is directed by an executive committee with cross-regional coverage. Day-to-day management is undertaken through a secretariat at the George Institute in Australia.

PUBLICATIONS

To date, APCSC has published 52 peer-reviewed publications [1—52]. Apart from the initial protocol [1], all were published from 2003 to 2012. These can be grouped into papers that report (at least primarily) on the following: single risk factor associations for CVD [2—13,15,18—20,24,28,38,46,47,49,51]; interactions between modifiable risk factor associations for CVD [14,30,31,34,37,40,41,48,50]; the national prevalence of risk factors and attributable risks for CVD [17,23,25,29,35]; risk factor associations for cancer [21,26,27,32,36,42—45,52]; risk factors for other diseases (diabetes [16] and kidney [39]); and smoking and all-cause mortality [33]. This totals 50 primary research papers in the last decade. In addition, a profile of the study was published in 2006 [22].

METHODS

Every study has provided individual participant data, and analyses are performed taking all the data as a single entity (sometimes called a "1-step method" for meta-analysis). Compared with the 2-step method that is necessary when pooling published parameters, individual participant data has the advantage of allowing greater flexibility in model building, especially when interactions are included; conversely, it is less well suited to consideration of heterogeneity between studies. Associations between risk factors and outcomes are estimated using Cox proportional hazards models, stratified [53] by study and sex. All results are at least age-adjusted; most publications show results after adjustment for other risk factors that are potential confounders. Associations of all continuous variables are adjusted for regression dilution using information from repeat measures [53] from those studies within APCSC that have appropriate data. The floating absolute risk technique [53] is used to produce confidence intervals around the point estimates of hazard ratios. Typically, associations are estimated both after grouping the risk factor into ordinal groups, such as its quarters, and when taking the variable in its continuous form. Interactions between risk factors are tested by adding cross-multiplication terms to the Cox models. Results from Asia and ANZ are compared, again, by adding cross-multiplication terms (here, involving region) to Cox models. Attributable risks are estimated, by country, using nationally

Table 1. Summary statistics for APCSC participants aged 20 years or more

	Asia (n = 500,819)	Australia and New Zealand (n = 98,790)
Baseline variables		
Women, %	33.7	45.7
Age, yrs (range)	45.0 ± 9.5 (20–107)	53.2 ± 14.4 (20–104)
Systolic blood pressure, mm Hg	121.3 ± 17.7	136.9 ± 22.1
Diastolic blood pressure, mm Hg	77.7 ± 10.7	79.2 ± 12.7
Total cholesterol (mmol/l)	4.9 ± 0.98	5.6 ± 1.13
HDL cholesterol (mmol/l)	1.35 ± 0.38	1.45 ± 0.38
Triglycerides (mmol/l)	1.44 ± 1.04	1.41 ± 1.07
Body mass index, kg/m^2	22.9 ± 2.9	26.3 ± 4.3
Smoking, %	41.6	17.6
Diabetes, %	3.4	4.2
Number of deaths (median follow-up)	(6.1 yrs)	(8.3 yrs)
Total	17,648	7,897
CHD	1,341	1,855
Stroke*	2,851	613
Hemorrhagic stroke	1,276	114
Ischemic stroke	591	79

Values are mean ± SD unless otherwise indicated. CHD, coronary heart disease; HDL, high-density lipoprotein.
* Many strokes were not classified by subtype.

representative (not APCSC) data for prevalence [17,23,25,29] or distributions [35] and APCSC data for estimated relative risks.

RESULTS

Altogether, APCSC includes 600,443 subjects, of whom almost 600,000 are aged 20 years or over (Table 1). The average levels of risk factors tend to be worse in ANZ than in Asia, except for smoking, which is more common in Asia; although this hides a huge differential between the sexes—smoking is typically common among men, but rare among women, in Asia [17]. As expected, the fatal stroke/CHD ratio is much higher in Asia (around 2:1) than in ANZ (around 1:3) and the fatal hemorrhagic/ischemic stroke ratio is also higher in Asia (around 2:1) than in ANZ (around 3:2).

Primary associations. Figure 1 shows age-adjusted associations for 6 leading risk factors for fatal CHD. Allowing for random error, the associations seen for all 6 risk factors are very similar in Asia and ANZ. Only for systolic blood pressure (SBP) was there evidence of an interaction ($P = 0.002$). For total cholesterol (TC), high- density lipoprotein cholesterol, triglycerides, and SBP, the relationship with fatal CHD was approximately log-linear, with a shallower slope for SBP in ANZ than in Asia. For body mass index (BMI), the shape of the relationship was clearly nonlinear in ANZ; in Asia, the same J-shape was suggested, but not as clearly. There was also a clear dose-response relationship for smoking status in both regions: never smokers having the least and current smokers the most risk of a fatal CHD. The hazard ratio for diabetes compared with no diabetes was, similarly, much the same (around 2) for both subregions (p for interaction = 0.42). Multiple adjusted results showed much the same similarities, with the same exception of a significant difference for SBP between regions [11].

Interactions between risk factors. The APCSC papers on interactions between the major modifiable cardiovascular risk factors, published to date, have reported on the joint risks for CHD and stroke for all but one of the 10 2-way combinations of BMI, diabetes, smoking, SBP, and TC. As above, here only results for CHD will be summarized.

In 5 (diabetes and BMI [48], diabetes and smoking [41], diabetes and SBP [31], diabetes and TC [30], SBP and smoking [34]) of the 9 combinations studied, there was no evidence ($P > 0.10$) of (multiplicative) interaction. Hence, when any of these 2-way combinations of risk factors are taken together, the APCSC results suggest that the effect of one risk factor can broadly be assumed to act the same whatever the level of the other risk factor. All the same, having a combination of 2 "bad" levels always appears to be worse than having just a single bad level.

In 2 combinations of risk factors (smoking and BMI [40], smoking and TC [37]), there was

GLOBAL HEART, VOL. 7, NO. 4, 2012
December 2012: 343–351

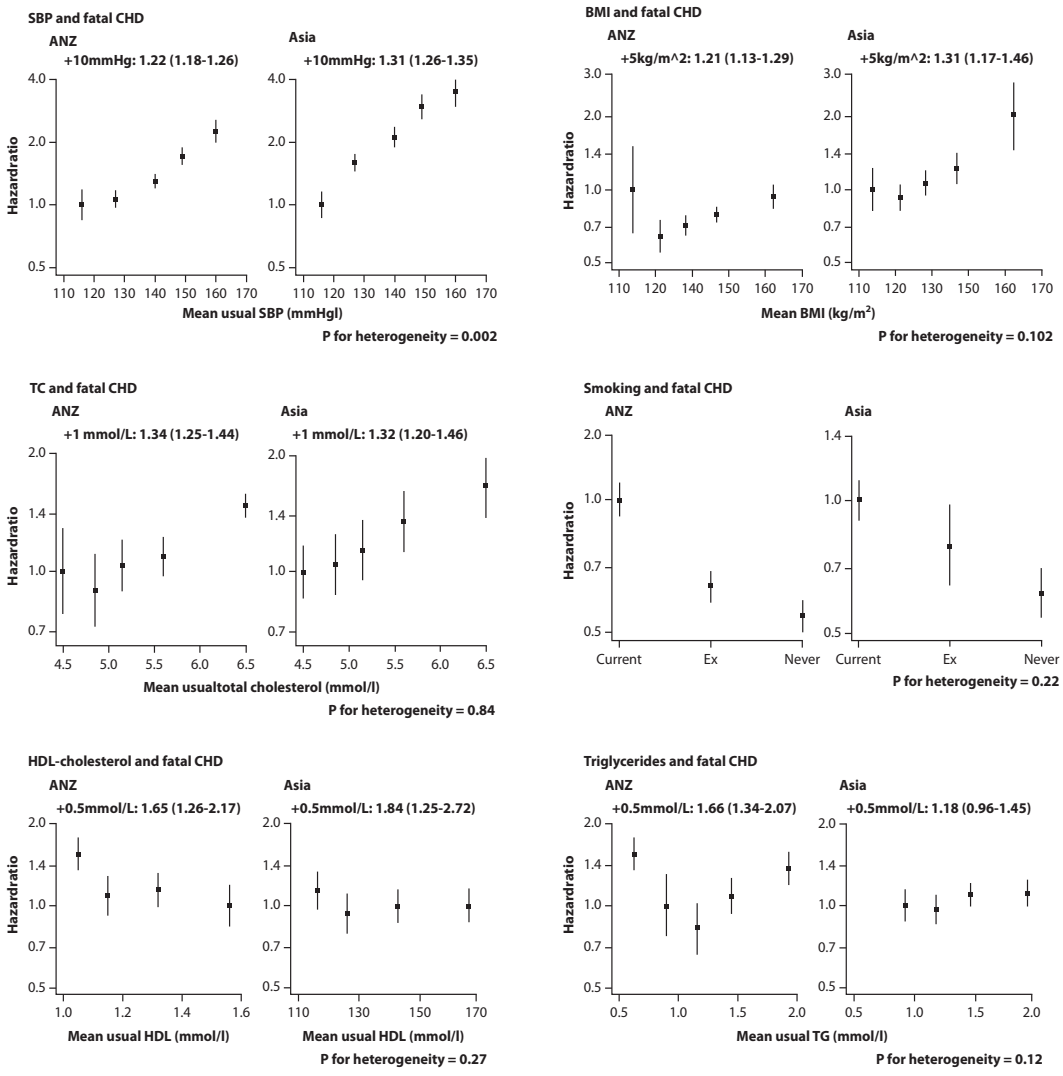

Fig. 1. Hazard ratios (95% confidence intervals) for fatal coronary heart disease (CHD) for 6 major risk factors in Asia Pacific Cohort Studies Collaboration (APCSC) subjects who were domiciled in either Asia or Australia/New Zealand (ANZ). Continuous variables were corrected for regression dilution bias and grouped into fifths or, when data were relatively sparse, quarters. The group with the lowest values was taken as the reference (hazard ratio = 1), except for high-density lipoprotein (HDL) cholesterol, for which the group with the highest values was used. Hazard ratios for a unit difference and p values for a regional interaction between the index risk factor and the hazard for fatal CHD are each shown in text boxes. Note that these results sometimes differ from those in earlier publications because the most recent version of the APCSC database is used here. BMI, body mass index; SBP, systolic blood pressure; HDL, high-density lipoprotein; TG, triglycerides.

evidence of synergism. Among current smokers there was a 13% higher risk of CHD associated with a 2 kg/m^2 higher level of BMI compared with a 9% additional risk amongst nonsmokers ($P = 0.04$ for the interaction). Similarly, among current smokers there was a 54% higher risk of CHD for a 1-SD (1.06 mmol/l) higher level of TC compared with a 38% additional risk for nonsmokers ($P = 0.02$ for the interaction). Hence, concurrent smoking seems to exacerbate the ill effects of high levels of both adiposity and blood cholesterol level. If this is more widely true, it suggests that application of standard cardiovascular risk scores may underestimate risk for smokers. A corollary is that quitting smoking with either lowering of SBP or better control of lipids may have even greater benefit than would be expected from past projections.

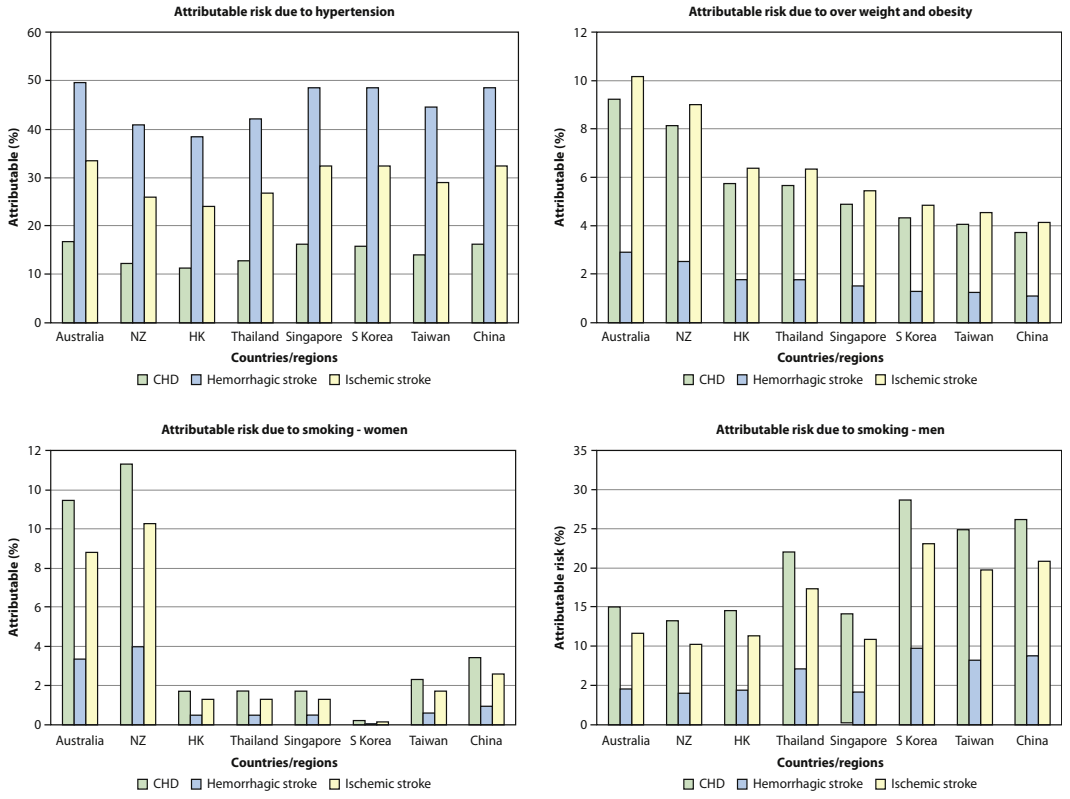

Fig. 2. Fatal coronary heart disease (CHD) and stroke population attributable risks for 3 major risk factors in 8 countries or regions within the Asia-Pacific region. China, mainland China; HK, Hong Kong; NZ, New Zealand.

In the final 2 cases (SBP and BMI [50], SBP and TC [14]), there was evidence of antagonism. The effects of SBP on CHD, although always substantial and log-linear, tended to diminish as BMI increased ($P = 0.01$ for the interaction). For example, a 10-mm Hg higher SBP was associated with a 27% higher risk among people with "healthy" BMI (18.5 to 22.9 kg/m^2) compared with a 17% higher risk among overweight people (BMI: 25 to 29.9 kg/m^2). Similarly, the log-linear effects of SBP diminished systematically as TC level increased ($P < 0.001$ for the interaction). For example, a 10-mm Hg higher SBP was associated with a 34% higher risk among those with TC <4.75 mmol/l compared with 21% among those with TC >6.25 mmol/l. Thus, though not undermining the importance of these risk factors, this suggests that when the effects of SBP are considered along with either BMI or TC, some allowance should be made for mutual attenuation of effects.

Comparison of these contrasting results should take account of the relatively low power when tests are performed on dichotomous variables, such as diabetes and smoking. More generally, although APCSC has a large sample, which allows us to reliably examine the effect modification of one risk factor on another, it is still not large enough for more detailed analyses of interactions involving more than two risk factors or to reliably compare the interaction effects of modifiable risk factors across region, age, or sex groups. Furthermore, unlike in Figure 1, fatal and nonfatal events were combined in the analyses testing interactions to increase the available power. With more data, reliable conclusions for 2-way interactions would be possible for fatal CHD, and fatal stroke, alone.

Attributable risk. Figure 2 shows estimates of attributable risks (AR) for CHD, hemorrhagic and ischemic stroke mortality for 8 selected countries in the Asia-Pacific region, and 3 selected risk factors, using the most recent national data available when the APCSC papers were published (2006/2007). Blood pressure is an especially strong determinant of both the major stroke subtypes, but most particularly

GLOBAL HEART, VOL. 7, NO. 4, 2012
December 2012: 343–351

hemorrhagic stroke, which has AR approaching 50% in some countries. Differences between countries were not great, reflecting the widespread importance of high blood pressure for all CVD across the entire Asia-Pacific region. For overweight or obesity (BMI of 30 kg/m^2 or more), ARs were smaller for hemorrhagic stroke than for either CHD or ischemic stroke, and both Australia and New Zealand had much higher ARs than any Asian country for which data were available. As already noted, the prevalence of smoking for men is much higher than for women in many Asian countries; hence, ARs are presented here separately for women and men. Due to these differences in prevalence in Asia, and the contrasting situation in ANZ where the prevalence of smoking is very similar between sexes, the pattern of AR by country goes in opposite directions by sex. For women, ARs are higher in ANZ than in Asia, but for men they are lower. Hemorrhagic stroke has lower ARs due to smoking than those for CHD or ischemic stroke; the AR for the latter pair are broadly similar.

DISCUSSION

This synopsis has reviewed some of the previously published results from APCSC, with a particular focus on CHD. Further details are available from the published papers. After a decade of research, APCSC has a considerable portfolio of results and recommendations that have been influential in setting national guidelines and have contributed results to international forums, such as the World Health Organization's Global Burden of Disease study [54] and the Institute of Medicine's initiative to improve global cardiovascular health [55]. The research has not only greatly extended knowledge of chronic disease risk factors in Asia, but also has produced more precise estimates of the effects of some risk factors than had previously been available, for example, on triglycerides [7]. Due to the relatively low incidence in Western populations, risk factors for stroke, and particularly hemorrhagic stroke, have not been studied as thoroughly as CHD has been. The Asian studies in APCSC had a high frequency of stroke events; thus, APCSC has contributed importantly to epidemiological knowledge about stroke and its risk factors.

Moreover, in addition to producing valuable region-specific estimates of associations between risk factors and chronic disease, the large number of women (well over 200,000) included in the collaboration has enabled us to reliably explore sex differences in the relationships between risk factors and outcomes. For example, several papers have shown higher relative risks associated with diabetes and cigarette smoking for CHD and other chronic conditions in women than in men. The APCSC findings have contributed to the growing body of evidence suggesting that there are fundamental sex-differences in how certain risk factors exert their effects on subsequent chronic disease risk [56,57].

APCSC has, undoubtedly, been a trendsetting project. APCSC researchers are based in 9 countries or regions, speak at least 5 major primary languages, and are from several professions—predominantly clinical, statistical, and epidemiological. It is a tribute to all concerned that such a disparate group of researchers has collaborated so successfully and achieved so much in a comparatively short space of time. Perhaps most importantly, the APCSC has been an important focus for the training of Asian researchers. APCSC workshops have been held in China, South Korea, and Hong Kong and have been attended by students and healthcare professionals from the region that sought to benefit from an intensive course in cardiovascular epidemiology. These courses focused on the innovative statistical methods used in APCSC, including modern methods in meta-analysis. Furthermore, APCSC still has valuable, yet-untapped, resources with extensive data on risk factors, such as alcohol consumption and socioeconomic status, yet to be analyzed. An extensive program of future research has been mapped out to include greater use of the data as a practical basis for the evaluation of contemporary methodology in biostatistics, for example, continuing the use of these data to compare methods for missing value imputation [58].

APCSC is not, however, without its drawbacks, most of which stem from the use of existing datasets. First, many of the cohorts began in the 1980s; CVD treatment and risk factor profiles have changed considerably in the many Asian countries that are undergoing economic and epidemiological transitions. Second, reporting of risk factors is not always consistent, both in terms of coverage (high-density lipoprotein cholesterol, for example, is only recorded in 25 of the 44 cohorts) and methodology. This is a particular problem when analyzing nonclinical variables, such as alcohol and social class, which are recorded differently in different geo-ethnic populations. Third, repeat measurements are only available from a minority of cohorts; even then, the frequency of remeasurement is not consistent, so that only limited longitudinal analyses are possible. Fourth,

only one study had a biobank available for use by the collaboration, so we have been unable to reliably analyze novel biomarkers, such as C-reactive protein. Fifth, outcomes were recorded in several different ways, including by contacting subjects, or their relatives, and record linkage. Lack of information on nonfatal outcomes from many cohorts lowered statistical power and could have introduced bias when all events were pooled in some analyses. The level of disaggregation in cause of death also varies. Most studies used International Classification of Diseases (ICD) codes, but without consistency in which version was used, and although we were able to harmonize all coding to ICD-9, this could also have introduced a degree of bias in estimation. Differential diagnoses are a particular problem for subtyping stroke; for instance, not all studies had access to imaging.

To solve some of these problems, a new Asian collaboration in CVD, LIFECARE (Life Course Study in Cardiovascular Disease Epidemiology) [59], has been formed, involving longitudinal studies in 4 countries. This has a common set of questions and scheduled repeat recording of risk factor levels, as well as a biobank. However, it remains to be seen whether funding will allow hard outcomes to be collected, and, if so, whether follow-up will be long enough to obtain precise estimates. Perhaps the future lies more in using routinely collected health system data to draw epidemiological inferences. In this respect, Asia could lead the world with the existing huge medical insurance databases in South Korea that have already been used for epidemiological analyses (the Korean Heart Study; paper submitted) and Taiwan (the Taiwan MJ Health study) [60].

ACKNOWLEDGMENTS

The authors are grateful to all members of the APCSC: investigators and subjects alike. Special thanks to the group at the University of Auckland, who did much of the early study recruitment, data management, and statistical work, and Federica Barzi, who did the statistical analyses for many of the publications and produced the figures included here. A full list of collaborators appears elsewhere [22].

REFERENCES

1. Zhang XH, MacMahon S, Rodgers A, Neal B. Determinants of cardiovascular disease in the Asia Pacific region: protocol for a collaborative overview of cohort studies. CVD Prevention 1999;4:1–9.
2. Woodward M, Zhang X, Barzi F, et al. The effects of diabetes on the risks of major cardiovascular diseases and death in the Asia-Pacific region. Diabetes Care 2003;26:360–6.
3. Lawes C, Rodgers A, Bennett D, et al. Blood pressure and cardiovascular disease in the Asia Pacific region. J Hypertens 2003;21:707–16.
4. Zhang X, Patel A, Horibe H, et al. Cholesterol, coronary heart disease, and stroke in the Asia Pacific region. Int J Epidemiol 2003;32:563–72.
5. Lawes CM, Bennett DA, Parag V, et al. Blood pressure indices and cardiovascular disease in the Asia Pacific region: a pooled analysis. Hypertension 2003;42:69–75.
6. Lawes CMM, Parag V, Bennett DA, et al. Blood glucose and risk of cardiovascular disease in the Asia Pacific region. Diabetes Care 2004;27:2836–42.
7. Patel A, Barzi F, Jamrozik K, et al. Serum triglycerides as a risk factor for cardiovascular diseases in the Asia-Pacific region. Circulation 2004;110:2678–86.
8. Ni Mhurchu C, Rodgers A, Pan WH, Gu DF, Woodward M. Body mass index and cardiovascular disease in the Asia-Pacific Region: an overview of 33 cohorts involving 310,000 participants. Int J Epidemiol 2004;33:751–8.
9. Barzi F, Patel A, Woodward M, et al. A comparison of lipid variables as predictors of cardiovascular disease in the Asia Pacific region. Ann Epidemiol 2005;15:405–13.
10. Woodward M, Lam TH, Barzi F, et al. Smoking, quitting and the risk of cardiovascular disease among women and men in the Asia-Pacific region. Int J Epidemiol 2005;34:1036–45.
11. Woodward M, Huxley H, Lam TH, et al. A comparison of the associations between risk factors and cardiovascular disease in Asia and Australasia. Eur J Cardiovasc Prev Rehabil 2005;12:484–91.
12. Feigin V, Parag V, Lawes CM, et al. Smoking and elevated blood pressure are the most important risk factors for subarachnoid hemorrhage in the Asia-Pacific region: an overview of 26 cohorts involving 306,620 participants. Stroke 2005;36:1360–5.
13. Huxley R, Woodward M, Barzi F, et al. Does sex matter in the associations between classical risk factors and fatal coronary heart disease in populations from the Asia-Pacific region? J Womens Health (Larchmt) 2005;14:820–8.
14. Asia Pacific Cohort Studies Collaboration. Joint effects of systolic blood pressure and serum cholesterol on cardiovascular disease in the Asia Pacific Region. Circulation 2005;112:3384–90.
15. Asia Pacific Cohort Studies Collaboration. Coronary risk prediction for those with and without diabetes. Eur J Cardiovasc Prev Rehabil 2006;13:30–6.
16. Ni Mhurchu C, Prasad V, Nakamura M, et al. Body mass index and the risk of diabetes mellitus in the Asia-Pacific region. Asia Pac J Clin Nutr 2006;15:127–33.
17. Martiniuk AL, Lee CM, Lam TH, et al. The fraction of ischaemic heart disease and stroke attributable to smoking in the WHO Western Pacific and South-East Asian regions. Tob Control 2006;15:181–8.
18. Asia Pacific Cohort Studies Collaboration. Central obesity and risk of cardiovascular disease in the Asia

Pacific Region. Asia Pac J Clin Nutr 2006;15:287–92.
19. Asia Pacific Cohort Studies Collaboration. The impact of cardiovascular risk factors on the age-related excess risk of coronary heart disease. Int J Epidemiol 2006;35:1025–33.
20. Patel A, Barzi F, Woodward M, et al. An evaluation of metabolic risks for coronary death in the Asia Pacific region. Diabetes Res Clin Pract 2006;74:274–81.
21. Ansary-Moghaddam A, Huxley R, Barzi F, et al. The effect of modifiable risk factors on pancreatic cancer mortality in populations of the Asia-Pacific region. Cancer Epidemiol Biomarkers Prev 2006;15:2435–40.
22. Woodward M, Barzi F, Martiniuk A, et al. Cohort profile: the Asia Pacific Cohort Studies Collaboration. Int J Epidemiol 2006;35:1412–6.
23. Lee CMY, Huxley R, Lam TH, et al. Prevalence of diabetes mellitus and population attributable fractions for coronary heart disease and stroke mortality in the WHO South-East Asia and Western Pacific regions. Asia Pac J Clin Nutr 2007;16:187–92.
24. Barzi F, Patel A, Gu D, et al. Cardiovascular risk prediction tools for populations in Asia. J Epidemiol Community Health 2007;61:115–21.
25. Martiniuk AL, Lee CM, Lawes CM, et al. Hypertension: its prevalence and population attributable fraction for mortality from cardiovascular disease in the Asia-Pacific region. J Hypertens 2007;25:73–9.
26. Ansary-Moghaddam A, Huxley R, Lam TH, et al. The role of lifestyle risk factors on mortality from colorectal cancer in populations of the Asia-Pacific region. Asian Pacific J Cancer Prev 2007;8:191–8.
27. Ansary-Moghaddam A, Huxley R, Lam TH, et al. The impact of modifiable risk factors on mortality from prostate cancer in populations of the Asia-Pacific region. Asian Pacific J Cancer Prev 2007;8:199–205.
28. Woodward M, Barzi F, Feigin V, et al. Associations between high-density lipoprotein cholesterol and both stroke and coronary heart disease in the Asia Pacific region. Eur Heart J 2007;28:2653–60.
29. Asia Pacific Cohort Studies Collaboration. The burden of overweight and obesity in the Asia-Pacific region. Obes Rev 2007;8:191–6.
30. Asia Pacific Cohort Studies Collaboration. Cholesterol, diabetes and major cardiovascular diseases in the Asia Pacific region. Diabetologia 2007;50:2289–97.
31. Kengne AP, Patel A, Barzi F, et al. Systolic blood pressure, diabetes and the risk of cardiovascular diseases in the Asia-Pacific region. J Hypertens 2007;25:1205–13.
32. Huxley R, Jamrozik K, Lam TH, et al. Impact of smoking and smoking cessation on lung cancer mortality in the Asia-Pacific region. Am J Epidemiol 2007;165:1280–6.
33. Barzi F, Huxley R, Jamrozik K, et al. Association of smoking and smoking cessation with major causes of mortality in the Asia Pacific Region: the Asia Pacific Cohort Studies Collaboration. Tob Control 2008;17:166–72.
34. Nakamura K, Barzi F, Lam TH, et al. Cigarette smoking, systolic blood pressure, and cardiovascular diseases in the Asia-Pacific region. Stroke 2008;39:1694–702.
35. Woodward M, Martiniuk A, Lee CM, et al. Elevated total cholesterol: its prevalence and population attributable fraction for mortality from coronary heart disease and ischaemic stroke in the Asia-Pacific region. Eur J Cardiovasc Prev Rehabil 2008;15:397–401.
36. Ansary-Moghaddam A, Martiniuk A, Lam TH, et al. Smoking and the risk of upper aero digestive tract cancers for men and women in the Asia-Pacific region. Int J Environ Res Public Health 2009;6:1358–70.
37. Nakamura K, Barzi F, Huxley R, et al. Does cigarette smoking exacerbate the effect of total cholesterol and high-density lipoprotein cholesterol on the risk of cardiovascular diseases? Heart 2009;95:909–16.
38. Lee CM, Barzi F, Woodward M, et al. Adult height and the risks of cardiovascular disease and major causes of death in the Asia-Pacific region: 21,000 deaths in 510,000 men and women. Int J Epidemiol 2009;38:1060–71.
39. O'Seaghdha CM, Perkovic V, Lam TH, et al. Blood pressure is a major risk factor for renal death: an analysis of 560,352 participants from the Asia-Pacific region. Hypertension 2009;54:509–15.
40. Asia Pacific Cohort Studies Collaboration. Impact of cigarette smoking on the relationship between body mass index and coronary heart disease: a pooled analysis of 3264 stroke and 2706 CHD events in 378579 individuals in the Asia Pacific region. BMC Public Health 2009;9:294.
41. Kengne AP, Nakamura K, Barzi F, et al. Smoking, diabetes and cardiovascular disease in men in the Asia Pacific region. J Diabetes 2009;1:173–81.
42. Batty GD, Barzi F, Huxley R, et al, the APCSC Writing Committee. Obesity and liver cancer mortality in Asia: the Asia Pacific Cohort Study Collaboration. Cancer Epidemiol 2009;33:469–72.
43. Batty GD, Barzi F, Woodward M, et al. Adult height and cancer mortality in Asia: the Asia Pacific Cohort Studies Collaboration. Ann Oncol 2010;21:646–54.
44. Parr CL, Batty GD, Lam TH, et al. Body-mass index and cancer mortality in the Asia-Pacific Cohort Studies Collaboration: pooled analyses of 424,519 participants. Lancet Oncol 2010;11:741–52.
45. Lam EK, Batty GD, Huxley RR, et al. Associations of diabetes mellitus with site-specific cancer mortality in the Asia-Pacific region. Ann Oncol 2011;22:730–8.
46. Woodward M, Tsukinoki-Murakami R, Murakami Y, et al. The epidemiology of stroke amongst women in the Asia-Pacific region. Women's Health (Lond Engl) 2011;7:305–17.
47. Huxley RR, Barzi F, Lam TH, et al, for the Asia Pacific Cohort Studies Collaboration and the Obesity in Asia Collaboration. Isolated low levels of high-density lipoprotein cholesterol are associated with an increased risk of coronary heart disease: an individual participant data meta-analysis of 23 studies in the Asia-Pacific region. Circulation 2011;124:2056–64.
48. Murakami Y, Huxley RR, Lam TH, et al. Diabetes, body mass index and the excess risk of coronary heart disease, ischemic and hemorrhagic stroke in the Asia Pacific Cohort Studies Collaboration. Prev Med 2012;54:38–41.
49. Arima H, Murakami Y, Lam TH, et al. Effects of prehypertension and hypertension subtype on cardiovascular disease in the Asia-Pacific region. Hypertension 2012;59:1118–23.
50. Tsukinoki R, Murakami Y, Huxley R, et al. Does body mass index impact on the relationship between systolic blood pressure and cardiovascular disease? Meta-analysis of 419,488 individuals from the Asia Pacific Cohort Studies Collaboration. Stroke 2012;43:1478–83.
51. Woodward M, Webster R, Murakami Y, et al. The association between resting heart rate, cardiovascular disease and mortality: evidence from 112,680 men and women in 12 cohorts. Eur J Prev Cardiol 2012 Jun 20 [E-pub ahead of print].
52. Morrison DS, Parr CL, Lam TH, et al. Behavioural and metabolic risk factors for mortality from colon and rectum cancer: an analysis of data from the Asia-Pacific Cohort Studies Collaboration. Asian Pac J Cancer Prev 2012. In press.
53. Woodward M. Epidemiology: Study Design and Data Analysis. 2nd edition. Boca Raton, FL: Chapman and Hall/CRC Press; 2005.
54. Murray CJL, Lopez AD. Alternative projections of mortality and disability

by cause 1990—2020: Global Burden of Disease Study. Lancet 1997;349: 1498–504.
55. Institute of Medicine. Promoting Cardiovascular Health in the Developing World: A Critical Challenge To Achieve Global Health. Washington, DC: The National Academies Press, 2010.
56. Huxley R, Barzi F, Woodward M. Excess risk of fatal coronary heart disease associated with diabetes in men and women: meta-analysis of 37 prospective cohort studies. BMJ 2006;332:73–8.
57. Huxley RR, Woodward M. Cigarette smoking as a risk factor for coronary heart disease in women compared with men: a systematic review and meta-analysis of prospective cohort studies. Lancet 2011;378:1297–305.
58. Barzi F, Woodward M. Imputations of missing values in practice: results from imputations of serum cholesterol in 28 cohort studies. Am J Epidemiol 2004;160:34–45.
59. Tai ES, Poulton R, Thumboo J, et al. An update on cardiovascular disease epidemiology in South East Asia. Rationale and design of the LIFE course study in CARdiovascular disease Epidemiology (LIFECARE). CVD Prev Control 2009;4:93–102.
60. Wen CP, Wai JP, Tsai MK, et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. Lancet 2011;378:1244–53.