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Prognosis of acute coronary events is worse in patients living alone: the FINAMI myocardial infarction register

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Abstract

Background: Single living has been associated with a worse prognosis of acute coronary syndrome (ACS). We aimed to study the relation of sociodemographic characteristics to the morbidity, mortality, and case fatality (CF) of ACS in a large population-based ACS register.

Methods: The population-based FINAMI myocardial infarction register recorded 15,330 cases of ACS among persons aged 35–99 years in Finland in 1993–2002. Record linkage with the files of Statistics Finland provided information on sociodemographic characteristics (marital status, household size).

Results: ACS incidence and 28-day mortality rate were higher in unmarried men and women in all age groups. The prehospital CF of incident ACS was higher in single living and/or unmarried 35–64-year-old people. The 28-day CF was 26% (95% confidence interval, CI, 24–29%) in married men, 42% (95% CI 37–47%) in men who had previously been married, and 51% (95% CI 46–57%) in never-married men. Among women, the corresponding figures were 20% (95% CI 15–24%), 32% (95% CI 25–39%), and 43% (95% CI 31–56%). Most of these CF differences were apparent already at the prehospital phase. The only difference in treatment was that middle-aged men living alone or unmarried received thrombolysis less often. The disparities in ACS morbidity and mortality by marital status tended to widen during the study period.

Conclusions: Single living and/or being unmarried increases the risk of having a heart attack and worsens its prognosis both in men and women regardless of age. Most of the excess mortality appears already before the hospital admission and seems not to be related to differences in treatment of ACS.

Keywords

Epidemiology, living arrangements, marital status, myocardial infarction, mortality

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Introduction

Being unmarried or living alone is known to increase total and cardiovascular mortality[1–6] and cardiovascular disease incidence.[7–12] Many of the previous studies[1,2,8] have, however, included only men in their data and data on women and older age groups are missing or results are less consistent. Some studies have indicated that the differences in mortality according to marital status are more pronounced among men.[9] Furthermore, many of the previous Finnish studies originate from the 1970s[3,11,13] and the differences

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in total mortality by marital status seem to have widened thereafter together with the increase in the proportion of unmarried persons.[14]

Our aim was to study the differences in the morbidity and prognosis of incident acute coronary syndromes (ACS) according to sociodemographic characteristics (marital status and household size) among 35–99-year-old men and women in the population-based FINAMI myocardial infarction (MI) register from the years 1993–2002. Secondly, we aimed to assess whether the potential differences have diminished as the social networks have loosened over the decades.

Materials and methods

The FINAMI MI register is a population-based register.[15] It operated in four geographical areas in Finland in 1993–2002. The register study aimed to evaluate all suspected MI events among the 35–99-year-old permanent residents of these areas.

The combined population aged ≥35 of the FINAMI areas remained quite stable during the study period and was about 233,000. The register operated in the town of Turku in southwestern Finland, the town of Kuopio in eastern Finland, the town of Joensuu and some surrounding rural areas in the former province of North Karelia, and in the town of Oulu in northwestern Finland. Oulu has collected data for the years 1993, 1997, 1999, 2001, and 2002. In the other register areas, data were available for the whole 10-year period except for Turku for the year 1999 and Kuopio for the year 1998. Events in persons ≥75 years old were consistently registered from the year 1995 onwards, except for Turku, which from the year 1998 onwards registered the events of men and women aged ≥75 years born on an odd date only. The final number of events in this age group in Turku was obtained by multiplying the registered numbers by two. Earlier data from the years 1988–1992[16] were combined with the current data to be used in the trend estimates. The methods of the FINAMI register have been described earlier in detail.[15]

Trained nurses and register physicians collected the information from hospital documents, death certificates, autopsy reports, and medico-legal documents, using standardized data collection protocols. The collected data were sent to the coordinating centre (at the National Institute for Health and Welfare in Helsinki) to be checked for logical errors. The data were annually further cross-checked for completeness with the National Causes-of-Death Register and the National Hospital Discharge register.

The events were classified on the basis of symptoms, electrocardiograms, biomarker findings, and possible autopsy results as suggested in the American Heart Association Scientific Statement of 2003.[17] Definite, probable, and possible fatal and non-fatal MI events were included in the study. The time period of one event was 28 days, during which the most severe findings were recorded. Information on treatment-seeking time was registered until the year 1998.

The event was considered incident if there was no indication of a previous, clinically recognized MI in the patient's history. Attack rate was defined as the sum of first and recurrent MI events. Information on deaths before reaching hospital and during the first 28 days after the onset of the event (0–27 days) was collected as part of the FINAMI register. Deaths during the rest of the 1-year follow up were identified through the National Causes of Death register.

Individual level data on sociodemographic characteristics (marital status and household size) were obtained by record linkage of the MI register data with the files of Statistics Finland on the basis of the personal identification number. Information on marital status was obtained also for the background population to be used in the denominators. The closest record of the sociodemographic characteristics prior to the first MI event was used. Marital status was divided into two categories: married and unmarried. The latter was further divided into two subcategories: (1) previously married (divorced or widowed) and (2) never married. Moreover, the data were divided into three categories on the basis of household size: (1) >2 people living in the same household, (2) 2 people living in the same household, or (3) living alone.

The FINAMI register has been approved by the Ethical Committee of the National Institute for Health and Welfare.

Statistical methods

The data of all four study areas were pooled for the analyses and divided into three somewhat arbitrary age groups: 35–64 years, 65–74 years, and 75–99 years. Incidence and mortality rates were expressed per 100,000 inhabitants of each marital group per year, calculated for each age group separately and age-standardized to the European standard population.[18] The 95% confidence intervals (CI) for the rates were calculated using normal approximation of the Poisson distribution for the number of events in different age groups.

Case fatality (CF) was determined as the percentage of fatal events of all events within specific time periods (before hospital admission, on the first day, within 28 days, and 1 year after the onset of the event). The CF proportions in the three age groups were age

standardized according to the WHO MONICA Project using the age distribution of the MONICA MI and stroke registers as the standard.[19] CF proportions were analysed according to sociodemographic characteristics. The 95% CIs for the CF proportions were estimated on the basis of normal approximation of the binomial distribution for the number of deaths.

The proportion of patients with a treatment-seeking time of less than 4 hours was assessed from the number of all patients reaching the hospital alive in 1993–1998 and the proportion of patients undergoing revascularization (percutaneous angioplasty or coronary bypass surgery) from the number of patients reaching the hospital alive in 1993–2002. The proportion of patients receiving thrombolysis was assessed from the number of all events in 1993–2002.

The trends in event rates in 1988–2002 by marital status were determined for 35–64-year-old men and women using Poisson regression analysis with the natural logarithm of age-standardized rate as the dependent variable and the year as an independent variable. The regression coefficient of year multiplied by 100 gave the average annual change in percents. The 95% CIs of these trend estimates were calculated from the standard error of the regression coefficient.

The statistical analyses were carried out using SAS version 8 (SAS Institute, Cary, NC, USA).

Results

A total of 15,330 ACS events were recorded in the FINAMI MI register in years 1993–2002. A total of 9646 events were incident and 7703 resulted in death during the first 28 days after the event. Roughly half (53%, $n = 8137$) of all events happened in men and the rest (47%, $n = 7193$) in women. Most of the events in unmarried men (37% of all events in men, $n = 3005$) occurred among those previously married (70%). A quarter ($n = 1783$) of all events in women occurred among married women, 75% ($n = 5410$) among unmarried women and 84% ($n = 4537$) of these among those previously married.

The age-standardized incidences of ACS events were approximately 58–66% higher among unmarried men and 60–65% higher in unmarried women than among married men and women in all age groups (Table 1).

Table 1. The age-standardized incidence and 28-day mortality of 35–99-year-old men and women by marital status in the FINAMI register in 1993–2002

	35–64 years	65–74 years	75–99 years
Men			
Incidence			
Married	269 (254–284)	1140 (1071–1209)	2661 (2471–2851)
Unmarried	442 (411–473)	1888 (1725–2051)	4196 (3846–4546)
Previously married	472 (427–517)	1914 (1712–2116)	4324 (3934–4714)
Never married	437 (389–485)	1838 (1562–2114)	3503 (2652–4354)
Mortality			
Married	109 (99–119)	866 (806–926)	3049 (2841–3257)
Unmarried	292 (266–318)	1792 (1633–1951)	4843 (4467–5219)
Previously married	297 (262–332)	1772 (1578–1966)	4891 (4478–5304)
Never married	291 (251–331)	1816 (1542–2090)	4353 (3413–5293)
Women			
Incidence			
Married	55 (48–62)	478 (435–521)	1654 (1476–1832)
Unmarried	90 (78–102)	765 (706–824)	2733 (2624–2842)
Previously married	103 (87–119)	807 (736–878)	2821 (2698–2944)
Never married	69 (51–87)	648 (540–756)	2342 (2108–2576)
Mortality			
Married	16 (12–20)	247 (216–278)	1577 (1397–1757)
Unmarried	44 (36–52)	493 (446–540)	2667 (2561–2773)
Previously married	47 (36–58)	520 (464–576)	2759 (2639–2879)
Never married	39 (25–53)	415 (329–501)	2261 (2034–2488)

Rates are expressed per 100,000 persons per year (95% CI).

The differences in 28-day mortality were even larger. The 28-day mortality rates of all ACS events were 60–168% higher in unmarried men and 71–175% higher in unmarried women. The rates of the previously married and never married did not statistically significantly differ, but the rates of the never married tended to be lower.

The CFs of incident ACS events among 35–64-year-old unmarried men and women were higher before hospital admission, on the first day, and 28 days after the onset of the event than the CFs of married men and women (Table 2). In line with this finding, the CF of 35–64-year-old single men and women was higher at all time points than the CF of those living with one or more people. The 1-year prognosis of never-married men was significantly worse (55%, 95% CI 50–60%) than the prognosis of previously married men (44%, 95% CI 40–49%).

The CFs of 65–74-year-old men and women did not differ much from the CFs of the younger age group (see supplementary file, available online). Among women, the prehospital CF of those living with one person was lower than the CF of the others. No significant differences were seen at other time points according to household size among women. The CFs of 75–99-year-old men and women differed somewhat from the CFs of the younger age groups (see supplementary file). The CF of married men was lower than the CF of never-married men before hospital, on the first day and 28 days after the onset of the event. The CF of unmarried 75–99-year-old women was higher on the first day after the event than the CF of previously married women but no other significant differences according to marital status could be seen in the CFs of women in this oldest age group. The CF of 75–99-year-old men living with one person was lower on the first day and the CF of single men was lower 28-days after the onset of the event than the CF of those living with two or more people. Among 75–99-year-old women the CFs of those living alone or with one person were, in turn, lower at all time points than the CFs of those living with two or more people.

Married men were treated with thrombolysis more often than unmarried men, and men living alone received thrombolysis less often than men living with one or more people, but in women there were no such differences in the use of reperfusion therapies (Table 3).

The attack rates, incidences and 28-day mortality rates showed mainly a declining trend during the 15-year period (Table 4). The only exceptions was the rising trend in attack rate and incidence of never-married women (Table 4). The 95% CIs of the trend estimates were mainly wide and overlapping but the attack rate of married women declined while the attack rate of never married women had a rising trend. The 28-day mortality rates of married men also declined significantly more than in never married men.

Table 2. Case fatalities of incident events among 35–64-year-old men and women at different time points according to marital status and household size in the FINAMI register during 1993–2002

	Before hospital	≤1 day	0–27 days	0–364 days
Men				
Marital status				
Married	19 (17–21)	21 (19–23)	26 (24–29)	29 (27–32)
Never married	41 (36–47)	45 (39–50)	51 (46–57)	55 (50–60)
Previously married	34 (29–38)	36 (31–40)	42 (37–47)	44 (40–49)
Household size				
>2 people	23 (20–27)	25 (22–29)	31 (28–35)	33 (29–37)
2 people	23 (20–26)	25 (22–28)	31 (28–34)	34 (31–37)
Living alone	41 (36–45)	43 (39–48)	49 (44–54)	52 (48–57)
Women				
Marital status				
Married	9 (6–12)	11 (8–15)	20 (15–24)	23 (18–27)
Never married	35 (22–47)	36 (24–49)	43 (31–56)	45 (32–58)
Previously married	19 (13–25)	23 (16–29)	32 (25–39)	34 (27–41)
Household size				
>2 people	10 (5–16)	10 (5–16)	21 (14–28)	24 (16–32)
2 people	14 (9–18)	17 (11–22)	25 (19–31)	28 (21–34)
Living alone	32 (24–39)	37 (29–44)	43 (35–51)	45 (37–53)

Values are % (95% CI).

Discussion

According to this study, being unmarried increases the risk of ACS and ACS death in both genders at all ages. In contrast to some previous studies,[2,8,13] the results were similar in both men and women. The disparities in ACS morbidity and mortality by marital status tended to widen during the study period.

Single living and being unmarried were associated with higher CF of incident ACS. Most of this difference seems to be due to a greater susceptibility to sudden prehospital coronary deaths among people living alone and the difference in mortality remained significant at least 1 year after the attack. As in the recent results of the REACH Register study indicating a higher 4-year cardiovascular mortality among middle-aged people living alone but not among the oldest old,[20] advancing age modified the associations of household size and CF also in our study, possibly due to the higher proportion of people no longer living

Table 3. Treatment-seeking times and proportions of ACS patients receiving thrombolysis or revascularization among 35–64-year-old men and women according to marital status and household size in the FINAMI register during 1993–2002

	Delay <4 hours	Thrombolysis	Revascularization
Men			
Marital status			
Married	63 (59–66)	30 (28–33)	20 (18–22)
Never married	51 (43–59)	21 (17–25)	14 (10–18)
Previously married	58 (52–65)	19 (16–22)	18 (14–21)
Household size			
>2 people	62 (58–67)	29 (26–32)	18 (15–21)
2 people	62 (58–67)	28 (25–30)	20 (17–22)
Living alone	54 (47–61)	17 (14–20)	17 (13–21)
Women			
Marital status			
Married	52 (44–61)	25 (20–30)	15 (11–20)
Never married	51 (34–69)	13 (6–20)	22 (11–33)
Previously married	63 (54–72)	22 (16–27)	11 (6–16)
Household size			
>2 people	24 (17–31)	53 (41–65)	17 (10–24)
2 people	23 (18–28)	57 (48–66)	16 (12–20)
Living alone	18 (12–24)	55 (43–68)	19 (12–26)

Values are % (95% CI).

Table 4. Trends in age-standardized incidence attack rate and 28-day mortality rate (per 100,000 inhabitants) by marital status among 35–64-year-old men and women in the FINAMI register during 1988–2002

	Incidence	Attack rate	28-day mortality rate
Men			
Married	−3.5 (−4.6 to −2.5)	−5.6 (−6.4 to −4.7)	−8.1 (−9.7 to −6.5)
Never married	−3.1 (−4.9 to −1.2)	−3.0 (−4.7 to −1.4)	−2.2 (−4.7 to 0.2)
Previously married	−3.1 (−4.8 to −1.4)	−4.3 (−5.7 to −2.8)	−6.0 (−8.1 to −4.0)
Women			
Married	−4.3 (−6.5 to −2.0)	−6.1 (−8.1 to −4.2)	−8.6 (−12.6 to −4.6)
Never married	2.7 (−2.3 to 7.8)	3.6 (−0.9 to 8.0)	−2.0 (−8.5 to 4.6)
Previously married	−1.3 (−4.0 to 1.3)	−2.7 (−5.0 to −0.4)	−2.9 (−6.8 to 1.0)

Values are % per year (95% CI).

at home (e.g. living in a nursing home) and therefore classified as living with two or more people.

A Danish study has previously reported that living alone is associated with a greater risk of incident ACS[12] and death during the first year after the onset of ACS.[5] Danish researchers have also shown that living alone is an independent risk factor for all-cause long-term mortality after MI.[21] Consistent with our results, being unmarried has previously been associated also with a higher risk of out-of-hospital sudden cardiac death[4] and death during the first day after coronary event.[8] In our study, these differences remained significant also at later time points. Furthermore, marriage seems to protect women even more than men from out-of-hospital ACS death.

One possible explanation for the observed differences in ACS morbidity and mortality by marital status could be differences in the prevalence of traditional cardiovascular risk factors. The risk profiles have mainly favored married men compared to unmarried men, but the results have varied.[1,4,10,22] We cannot exclude the possibility that persons with poor health status may be more prone to staying unmarried or getting divorced, but the lower cardiac risks of married persons may also result from a protective effect of marriage. For example, the married persons may have a better financial status, better health habits, and higher levels of social support compared to the unmarried, thereby promoting their overall health. Lack of social support has previously been associated with increased risk of cardiac morbidity and mortality.[23,24] Furthermore, unmarried people have been found to be more likely depressed.[25] Depression seems to have an adverse effect on cardiovascular mortality rates after MI[26] and very high levels of social support have been considered to buffer the impact of post-MI depression on mortality after MI.[27]

Another potential mechanism suggested to be mediating the effects of psychosocial factors and coronary heart disease is disturbed autonomic balance. Decreased heart rate variability, as a sign of autonomic imbalance, has been associated not only with depressive symptoms after an acute coronary event,[28] but also both with the risk of nonfatal and fatal coronary heart disease[29] and with being unmarried.[30]

In this study, most of the difference in prognosis – between both the married and the unmarried and those living with someone or alone – arose already in the prehospital phase. It may be assumed that resuscitation or calling for help was initiated faster and more often among those married or cohabiting.

To our knowledge, no previous research has evaluated potential differences in access to invasive coronary operations according to marital status. Living alone[31] or being unmarried[32] has been associated with a longer treatment-seeking time after MI, which may increase the likelihood of prehospital death. In our study, we did not find significant differences by sociodemographic characteristics in the proportion of patients reaching the hospital in less than 4 hours. However, we found that a larger proportion of married and cohabiting men received reperfusion therapy at acute stage which may contribute to their better survival after hospitalization. Lower adherence to secondary preventive medications (aspirin, statins, beta-blockers, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers) among the unmarried may have an adverse effect on long-term prognosis after MI.[33]

There are some limitations in our study that need to be taken into consideration. Troponins were adopted in Finnish hospitals in the latter half of our study period. They increase the numbers of nonfatal ACS events[34] and therefore may have slightly decreased the attack rate and incidence rate differences and decreased the CF differences between married and unmarried people. We were not able to study differences in the rates of ACS events according to household size because we lacked information on this characteristic in the background population. We, unfortunately, had no information on the prevalence of cardiovascular risk factors or comorbidities in the FINAMI population possibly affecting the ACS risk and marital status. Our study had no information on possible marital transitions allowing more accurate analyses. It has been studied earlier, that remarried men have a higher total mortality risk than those in a consistent marriage but lower mortality risks than the divorced or widowed.[35] Furthermore, we do not know the proportion of unmarried cohabiting couples in our data.

The strengths of this study are the nation-wide population-based design and the large size of the FINAMI MI register data. Furthermore, a major strength was the possibility of record linkage with the files of Statistics Finland providing us with individual-level data on the sociodemographic characteristics of the study population before the ACS event.

In conclusion, our study suggests that marriage reduces the risk of ACS and death due to ACS in both men and women and at all ages. Furthermore, especially among middle-aged men and women, being married and cohabiting are associated with considerably better prognosis of incident ACS events both before hospitalization and after reaching the hospital alive. Marriage seems to protect women even more than men from out-of-hospital death. The differences in prognosis cannot fully be explained by differences in treatment-seeking time or access to thrombolysis or revascularization. These sociodemographic differences in the morbidity, mortality, and prognosis of ACS are considerable population health problems.

Further research should be done to reveal the reasons for these differences in Finland.

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Presentation

The results have been presented in part as a poster at the ESC 2011 Congress.

Conflict of interest

The authors declare that there is no conflict of interest.

References

1. Ben-Shlomo Y, Smith GD, Shipley M, et al. Magnitude and causes of mortality differences between married and unmarried men. *J Epidemiol Community Health* 1993; 47: 200–205.
2. Malyutina S, Bobak M, Simonova G, et al. Education, marital status, and total and cardiovascular mortality in Novosibirsk, Russia: a prospective cohort study. *Ann Epidemiol* 2004; 14: 244–249.
3. Salonen JT. Socioeconomic status and risk of cancer, cerebral stroke, and death due to coronary heart disease and any disease: a longitudinal study in eastern Finland. *J Epidemiol Community Health* 1982; 36: 294–297.
4. Empana JP, Jouven X, Lemaitre R, et al. Marital status and risk of out-of-hospital sudden cardiac arrest in the population. *Eur J Cardiovasc Prev Rehabil* 2008; 15: 577–582.
5. Nielsen KM, Larsen ML, Foldspang A, et al. Living alone and atypical clinical presentation are associated with higher mortality in patients with all components of the acute coronary syndrome. *Eur J Cardiovasc Prev Rehabil* 2007; 14: 152–154.
6. Koskinen S, Joutsenniemi K, Martelin T, et al. Mortality differences according to living arrangements. *Int J Epidemiol* 2007; 36: 1255–1264.
7. Engström G, Hedblad B, Rosvall M, et al. Occupation, marital status, and low-grade inflammation: mutual confounding or independent cardiovascular risk factors? *Arterioscler Thromb Vasc Biol* 2006; 26: 643–648.
8. Gerward S, Tydén P, Engström G, et al. Marital status and occupation in relation to short-term case fatality after a first coronary event – a population based cohort. *BMC Public Health* 2010 10; 10: 235–242.
9. Nilsson PM, Nilsson JA, Ostergren PO, et al. Social mobility, marital status, and mortality risk in an adult life course perspective: the Malmö Preventive Project. *Scand J Public Health* 2005; 33: 412–423.
10. Venters M, Jacobs DR Jr, Pirie P, et al. Marital status and cardiovascular risk: the Minnesota Heart Survey and the Minnesota Heart Health Program. *Prev Med* 1986; 15: 591–605.
11. Koskenvuo M, Kaprio J, Romo M, et al. Incidence and prognosis of ischaemic heart disease with respect to marital status and social class. A national record linkage study. *J Epidemiol Community Health* 1981; 35: 192–196.
12. Nielsen KM, Faergeman O, Larsen ML, et al. Danish singles have a twofold risk of acute coronary syndrome: data from a cohort of 138 290 persons. *J Epidemiol Community Health* 2006; 60: 721–728.
13. Koskenvuo M, Kaprio J, Lönnqvist J, et al. Social factors and the gender difference in mortality. *Soc Sci Med* 1986; 23: 605–609.
14. Martikainen P, Martelin T, Nihtilä E, et al. Differences in mortality by marital status in Finland from 1976 to 2000: analyses of changes in marital-status distributions, socio-demographic and household composition, and cause of death. *Popul Stud (Camb)* 2005; 59: 99–115.
15. Salomaa V, Ketonen M, Koukkunen H, et al. Trends in coronary events in Finland during 1983–1997. The FINAMI study. *Eur Heart J* 2003; 24: 311–319.
16. Salomaa V, Niemelä M, Miettinen H, et al. Relationship of socioeconomic status to the incidence and prehospital, 28-day, and 1-year mortality rates of acute coronary events in the FINMONICA myocardial infarction register study. *Circulation* 2000; 101: 1913–1918.
17. Luepker RV, Apple FS, Christensen RH, et al. Case definitions for acute coronary heart disease in epidemiology and clinical research studies. *Circulation* 2003; 108: 2543–2549.
18. Waterhouse J, Muir C and Correa P. *Cancer incidence in five continents*, vol III. Lyon, France: International Agency for Research on Cancer, 1976. IARC Scientific Publication no. 15.
19. Tunstall-Pedoe H, Kuulasmaa K, Mähönen M, et al. Contribution of trends in survival and coronary-event rates to changes in coronary heart disease mortality: 10-year results from 37 WHO MONICA Project populations. *Lancet* 1999; 353: 1547–1957.
20. Udell JA, Steg PG, Scirica BM, et al. for the REduction of Atherothrombosis for Continued Health (REACH) Registry Investigators. Living alone and cardiovascular risk in outpatients at risk of or with atherothrombosis. *Arch Intern Med* 2012; 172: 1086–1095.
21. Nielsen FE and Mard S. Single-living is associated with increased risk of long-term mortality among employed patients with acute myocardial infarction. *Clin Epidemiol* 2010; 2: 91–98.
22. Molloy GJ, Stamatakis E, Randall G, et al. Marital status, gender and cardiovascular mortality: behavioural, psychological distress and metabolic explanations. *Soc Sci Med* 2009; 69: 223–228.
23. Rosengren A, Wilhelmsen L and Orth-Gomér K. Coronary disease in relation to social support and social class in Swedish men. A 15 year follow-up in the study of men born in 1933. *Eur Heart J* 2004; 25: 56–63.
24. Horsten M, Mittleman MA, Wamala SP, et al. Depressive symptoms and lack of social integration in relation to prognosis of CHD in middle-aged women. The Stockholm Female Coronary Risk Study. *Eur Heart J* 2000; 21: 1072–1080.
25. Inaba A, Thoits PA, Ueno K, et al. Depression in the United States and Japan: gender, marital status, and SES patterns. *Soc Sci Med* 2005; 61: 2280–2292.

26. Frasure-Smith N, Lespérance F and Talajic M. Depression and 18-month prognosis after myocardial infarction. *Circulation* 1995; 91: 999–1005.
27. Frasure-Smith N, Lespérance F, Gravel G, et al. Social support, depression, and mortality during the first year after myocardial infarction. *Circulation* 2000; 101: 1919–1924.
28. Zimmermann-Viehoff F, Orth-Gomer K, Wang HX, et al. Depressive symptoms and heart rate variability in younger women after an acute coronary event. *Eur J Cardiovasc Rehabil* 2010; 17: 509–513.
29. Liao D, Cai J, Rosamond WD, et al. Cardiac autonomic function and incident coronary heart disease: a population-based case-cohort study. The ARIC Study. Atherosclerosis Risk in Communities Study. *Am J Epidemiol* 1997; 145: 696–706.
30. Randall G, Bhattacharyya MR and Steptoe A. Marital status and heart rate variability in patients with suspected coronary artery disease. *Ann Behav Med* 2009; 38: 115–123.
31. Bouma J, Broer J, Bleeker J, et al. Longer pre-hospital delay in acute myocardial infarction in women because of longer doctor decision time. *J Epidemiol Community Health* 1999; 53: 459–464.
32. Atzema CL, Austin PC, Huynh T, et al. Effect of marriage on duration of chest pain associated with acute myocardial infarction before seeking care. *CMAJ* 2011; 183: 1482–1491.
33. Kulkarni SP, Alexander KP, Lytle B, et al. Long-term adherence with cardiovascular drug regimens. *Am Heart J* 2006; 151: 185–191.
34. Salomaa V, Koukkunen H, Ketonen M, et al. A new definition for myocardial infarction: what difference does it make? *Eur Heart J* 2005; 26: 1719–1725.
35. Blomgren J, Martikainen P, Grundy E, et al. Marital history 1971–91 and mortality 1991–2004 in England & Wales and Finland. *J Epidemiol Community Health* 2012; 66: 30–36.