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Analysis of predicted coronary heart disease risk in England based on Framingham study risk appraisal models published in 1991 and 2000

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In 2000 the UK government launched the national service framework for coronary heart disease, setting national standards for improving prevention, diagnosis, and treatment. In agreement with recent recommendations on preventing coronary heart disease¹ and managing hypertension,² this programme includes use of coronary risk appraisal models from the Framingham study published in 1991³ to help identify patients eligible for drug treatment. These models were updated in 2000,⁴ incorporating further follow up and additional risk factors. We compare the predicted risks calculated using the two models and assess the implications for preventing heart disease.

Methods and results

The health survey for England is an annual, nationwide, household based, cross sectional survey of a representative sample of the population. We used the 1998 survey data for 5518 (62.3% of 8852) participants aged 35-74 with complete information on factors needed for assessment of coronary disease risk, after exclusion of 738 (7.7% of 9590) participants reporting angina, heart attack, or stroke diagnosed by a doctor.⁵ The 2000 models allow calculation of risk over a period of four years,⁴ whereas the 1991 models permit estimation of risk over 4-12 years.³ We estimated the 10 year and four year probabilities of developing heart

disease predicted using the 1991 equations and the four year risk predicted using the 2000 equations.

Summary statistics for four year coronary disease risk per 100 population based on the 1991 and 2000 models within a range of risk categories show that both models generally produce similar distributions (table). Although substantial statistical agreement exists between classification of participants into risk categories based on the two models, participants within each category based on the 1991 models were distributed across a wide range of risk categories based on the 2000 models.

Comment

Although population distributions of coronary risk calculated with the two models are generally similar, a significant number of people meeting criteria for drug treatment on the basis of the 1991 models would not meet the equivalent criteria on the basis of the 2000 models. Current UK guidelines generally recommend offering drug treatment for hypertension or hypercholesterolaemia to patients with a 10 year risk $\geq 15\%$.^{1,2} We used a 5% risk of a coronary event in four years as being equivalent to a 10 year risk of 15%, rather than 6% over four years, because risk increases exponentially rather than linearly with age. Had we used 6%, the discrepancy between the 1991 and 2000 models would have been even greater.

Number of participants and mean (SD) risk in four year predicted risk categories based on coronary heart disease risk appraisal models from the Framingham study published in 1991³ and 2000⁴

| 1991 models | | 2000 models: risk category* | | | | | | | | |
|----------------|-------------|-----------------------------|------------|------------|------------|------------|------------|-------------|------------|------|
| Risk category* | Mean (SD) | <2 | ≥2, <4 | ≥4, <5 | ≥5, <6 | ≥6, <8 | ≥8, <10 | ≥10 | All | % |
| Men | | | | | | | | | | |
| Mean (SD) | N/A | 1.2 (0.43) | 2.9 (0.58) | 4.5 (0.29) | 5.5 (0.30) | 6.9 (0.55) | 8.9 (0.58) | 15.8 (6.57) | 4.4 (4.53) | N/A |
| <2 | 1.0 (0.52) | 812 | 61 | 0 | 0 | 0 | 0 | 0 | 873 | 34.0 |
| ≥2, <4 | 3.0 (0.58) | 74 | 504 | 21 | 1 | 0 | 0 | 0 | 600 | 23.3 |
| ≥4, <5 | 4.5 (0.29) | 0 | 118 | 57 | 12 | 5 | 0 | 0 | 192 | 7.5 |
| ≥5, <6 | 5.5 (0.29) | 0 | 53 | 76 | 53 | 15 | 0 | 0 | 197 | 7.7 |
| ≥6, <8 | 6.9 (0.56) | 0 | 0 | 53 | 77 | 89 | 20 | 2 | 241 | 9.4 |
| ≥8, <10 | 9.0 (0.55) | 0 | 0 | 0 | 14 | 108 | 41 | 14 | 177 | 6.9 |
| ≥10 | 13.9 (3.86) | 0 | 0 | 0 | 0 | 21 | 70 | 200 | 291 | 11.3 |
| All | 4.6 (4.31) | 886 | 736 | 207 | 157 | 238 | 131 | 216 | 2571 | 100 |
| % | N/A | 34.5 | 28.6 | 8.0 | 6.1 | 9.3 | 5.1 | 8.4 | 100 | N/A |
| Women | | | | | | | | | | |
| Mean (SD) | N/A | 0.8 (0.53) | 2.8 (0.57) | 4.5 (0.27) | 5.5 (0.30) | 6.8 (0.57) | 8.9 (0.51) | 13.9 (2.81) | 1.8 (2.01) | N/A |
| <2 | 0.7 (0.56) | 1831 | 125 | 4 | 2 | 2 | 0 | 0 | 1964 | 66.6 |
| ≥2, <4 | 2.8 (0.56) | 228 | 294 | 34 | 10 | 3 | 0 | 0 | 569 | 19.3 |
| ≥4, <5 | 4.5 (0.28) | 9 | 102 | 27 | 12 | 7 | 0 | 1 | 158 | 5.4 |
| ≥5, <6 | 5.4 (0.29) | 2 | 37 | 17 | 13 | 4 | 1 | 0 | 74 | 2.5 |
| ≥6, <8 | 6.8 (0.56) | 1 | 17 | 29 | 23 | 27 | 6 | 2 | 105 | 3.6 |
| ≥8, <10 | 8.8 (0.60) | 0 | 1 | 6 | 7 | 9 | 9 | 6 | 38 | 1.3 |
| ≥10 | 12.3 (1.92) | 0 | 1 | 0 | 3 | 9 | 10 | 16 | 39 | 1.3 |
| All | 1.9 (2.25) | 2071 | 577 | 117 | 70 | 61 | 26 | 25 | 2947 | 100 |
| % | N/A | 70.3 | 19.6 | 4.0 | 2.4 | 2.1 | 0.9 | 0.8 | 100 | N/A |

Weighted \times (95% CI): men 0.83 (0.82 to 0.84); women 0.67 (0.65 to 0.69). N/A=not applicable. *Number of coronary heart disease events per 100 population.

Our study confirms that risk of coronary disease in Britain is high. On the basis of the 1991 risk appraisal models, approximately 32% of men and 7% of women aged 35-74 in England are at $\geq 15\%$ risk of developing heart disease in the next 10 years. The 2000 models give figures for a four year risk $\geq 5\%$ of 29% for men and 6% for women. Although only 1-2% of men and women ineligible for drug treatment under current criteria would be eligible if the 2000 models were used, 20% of men and 43% of women currently recommended drug treatment would not be eligible if their four year risk based on the updated models was used. Sensitivity and specificity for the 1991 risk appraisal models would be 97.6% and 90.0% for men and 79.7% and 96.0% for women, considering the updated models to provide the most up to date assessment of coronary disease risk for asymptomatic men and women. Although thresholds for drug treatment are somewhat arbitrary and depend to a large degree on the resources available, we recommend that these findings are taken into account when guidelines for coronary heart disease prevention are updated in accordance with emerging scientific evidence for statin treatment and management of mild hypertension.

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Contributors: KN devised this study and drafted the manuscript of the paper, JD undertook the statistical analyses, and all authors contributed to writing the paper. KN will act as guarantor.

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Corrections and clarifications

Minerva

A keyboard slip seems to have accounted for Minerva attributing a study to a US rather than UK hospital (20 April, p 986). The study was about physical illness in patients referred to psychiatric clinics and was reported in *Acta Psychiatrica Scandinavica*.

Science, medicine, and the future: New vaccine development

Because of an editorial oversight (mistaking one competing interest form for another), this article by Gregory A Poland and colleagues (1 June, pp 1315-9) did not include Dr Poland's declaration that he had performed a trial of a DNA vaccine funded by Powderject Vaccines.

Unexplained differences in sex ratios at birth in Europe and North America

In the table accompanying this Research Pointer by Victor Grech and colleagues (27 April, pp 1010-1), readers may have been surprised to see that Denmark and Finland seemed to have exactly the same numbers of female and total live births. This was in fact an error, which arose during editing and was not picked up on the proofs. The figures for Finland were correct, but for Denmark the number of female live births are 1 588 490 and total live births 3 269 412.

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