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Dietary fat intake and risk of stroke in male US healthcare professionals: 14 year prospective cohort study

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Abstract

Objective To examine the association between intake of total fat, specific types of fat, and cholesterol and risk of stroke in men.

Design and setting Health professional follow up study with 14 year follow up.

Participants 43 732 men aged 40-75 years who were free from cardiovascular diseases and diabetes in 1986.

Main outcome measure Relative risk of ischaemic and haemorrhagic stroke according to intake of total fat, cholesterol, and specific types of fat.

Results During the 14 year follow up 725 cases of stroke occurred, including 455 ischaemic strokes, 125 haemorrhagic strokes, and 145 strokes of unknown type. After adjustment for age, smoking, and other potential confounders, no evidence was found that the amount or type of dietary fat affects the risk of developing ischaemic or haemorrhagic stroke. Comparing the highest fifth of intake with the lowest fifth, the multivariate relative risk of ischaemic stroke was 0.91 (95% confidence interval 0.65 to 1.28; P for trend = 0.77) for total fat, 1.20 (0.84 to 1.70; P = 0.47) for animal fat, 1.07 (0.77 to 1.47; P = 0.66) for vegetable fat, 1.16 (0.81 to 1.65; P = 0.59) for saturated fat, 0.91 (0.65 to 1.28; P = 0.83) for monounsaturated fat, 0.88 (0.64 to 1.21; P = 0.25) for polyunsaturated fat, 0.87 (0.62 to 1.22; P = 0.42) for *trans* unsaturated fat, and 1.02 (0.75 to 1.39; P = 0.99) for dietary cholesterol. Intakes of red meats, high fat dairy products, nuts, and eggs were also not appreciably related to risk of stroke.

Conclusions These findings do not support associations between intake of total fat, cholesterol, or specific types of fat and risk of stroke in men.

Introduction

Strong evidence indicates that type of dietary fat is more important than total fat intake in predicting risk

of coronary heart disease. Monounsaturated and polyunsaturated fats seem to have beneficial effects, but saturated fat and *trans* unsaturated fatty acids increase risk of coronary heart disease.¹ However, these associations do not seem to apply to stroke. Previous studies have even suggested an inverse relation between saturated fat or *trans* unsaturated fat intake and risk of stroke,^{2,3} but the mechanisms remain unclear. We prospectively examined the associations between intakes of total fat and specific types of fat and the risk of subtypes of stroke in the health professional follow up study.

Methods

Study population

The health professional follow up study is a cohort of 51 529 male US healthcare professionals, aged 40-75 years in 1986, who responded to a mailed questionnaire including a comprehensive survey of diet, lifestyle characteristics, and medical history. Non-dietary variables are updated every other year and dietary information every four years. For this analysis, we followed participants from 1986 to 2000. We excluded men who at baseline reported a previous diagnosis of cardiovascular diseases or diabetes mellitus. We also excluded men who had incomplete information or implausible total daily energy intake. A total of 43 732 men remained in the analyses.

Dietary and outcome assessment

We assessed dietary intake by using validated semiquantitative food frequency questionnaires in 1986, 1990, and 1994.⁴ We considered as endpoints all incident fatal and non-fatal strokes occurring between the return of the baseline questionnaire and 31 January 2000. A physician blinded to risk factor status reviewed participants' medical records, for which permission was obtained, when incident strokes were reported on a follow up questionnaire. Fatal stroke was reported by next of kin or colleagues or obtained from

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postal authorities or the national death index. We classified cases into ischaemic (embolism or thrombosis), haemorrhagic (subarachnoid and intracerebral), or unknown type of stroke.⁵

Statistical analyses

We calculated follow up time for each participant from the date of return of the first questionnaire to the date of the first stroke, death, or end of the follow up. We divided participants into fifths according to their intake of each type of fat. To estimate age and smoking adjusted relative risks and 95% confidence intervals we used the Mantel-Haenszel method by stratifying data according to age (five year categories) and smoking status. To further adjust for other covariates we used Cox's proportional hazards models.

To account for changes in diet during the follow up and to best represent long term intake, we used the cumulative average of nutrient intakes derived from all previous food frequency questionnaires.⁶ We used the Keys equation to predict serum cholesterol from dietary intake of cholesterol and saturated and polyunsaturated fat.⁷ As participants were likely to change their diets after they developed some diseases or health conditions, we stopped updating individual dietary information if a participant had diabetes mellitus, coronary heart disease, transient ischaemic attack, peripheral arterial disease, or a diagnosis of hypercholesterolaemia.

Results

During the 14 year follow up we documented 725 cases, including 455 ischaemic strokes, 125 haemorrhagic strokes, and 145 strokes of unknown type. In both age and smoking adjusted analyses and multivariate analyses, intakes of total fat, animal fat, vegetable fat, saturated fat, monounsaturated fat, polyunsaturated fat, *trans*-unsaturated fat, or cholesterol or the score from the Keys equation were not significantly associated with risk of ischaemic or haemorrhagic stroke (table). After further adjustment for intakes of other fat subtypes, the results were not appreciably altered. In addition, none of the specific types of fat intake was significantly related to risk of total stroke (data not shown).

To evaluate the effects of long term and short term dietary intakes, we examined these associations by using baseline intakes and the most recent intakes separately. The multivariate estimations were similar to those obtained using cumulative average diet, and none of the associations was statistically significant (see [bmj.com](#)).

We have reported earlier that intakes of long chain omega 3 fatty acids from seafood were inversely associated with ischaemic but not haemorrhagic stroke.⁶ However, neither total omega 3 nor omega 6 polyunsaturated fatty acid intake was significantly related to ischaemic or haemorrhagic stroke in this study (data not shown).

We further evaluated risk of strokes according to consumption of selected foods rich in fat or cholesterol, including red meat, high fat dairy products, nuts, and eggs. We found no significant associations with ischaemic or haemorrhagic stroke (see [bmj.com](#)).

Discussion

Strengths and weaknesses of the study

Our findings are unlikely to be explained by recall or selection bias, because of the prospective nature of the study design and minimal loss to follow up. The results are also unlikely to be due to confounding, as the relative risk estimates did not materially change after simultaneous adjustment for the potential confounding variables. However, as in any observational study, residual confounding from some unknown factors could not be excluded.

The food frequency questionnaire that we used in the dietary assessment has been previously evaluated as a reasonable reflection of long term diet, including fat intakes.⁴ In addition, we reduced error in dietary assessment by using repeated measurements. The questionnaire's validity is further supported by the fact that it has predicted risk of coronary heart disease in this cohort.⁸ Participants might change their diets after developing some diseases that predispose them to stroke. After the dietary recommendation in the past decades, the most likely changes would be reduction in total fat, saturated fat, and cholesterol intakes. These dietary changes would dilute a possible positive association between these nutrients and risk of stroke. To reduce bias from this source, we excluded men with cardiovascular diseases or diabetes mellitus at baseline and stopped updating individual dietary information once a participant reported any cardiovascular disease, diabetes, or hypercholesterolaemia during the follow up period. The fact that the associations remained similar when we used baseline diet, most recent diet, or cumulative average diet further suggested that the observed associations were unlikely to be substantially attenuated.

Comparison with other studies

Although ischaemic heart disease and stroke share many of the same risk factors, the association of blood cholesterol with stroke remains controversial. A meta-analysis including 45 prospective cohorts found no association between blood cholesterol and stroke.⁹ However, most studies did not distinguish ischaemic stroke from haemorrhagic stroke, which contributes approximately 20% of all strokes in Western countries, and this would probably dilute any association between blood cholesterol and ischaemic stroke. No significant association between reduction in blood cholesterol and risk of stroke was reported in an overview of trials of cholesterol lowering treatment involving more than 36 000 patients.¹⁰ However, in recent trials of cholesterol lowering treatment in patients with cardiovascular disease, the incidence of stroke was reduced in the treated groups.¹¹ Overall, it seems that serum lipid concentration is not a strong predictor of total stroke, probably because a substantial proportion of ischaemic strokes are caused by embolism or other mechanisms that are not directly related to atherosclerosis. In addition, nitric oxide and inflammation may play important roles in the pathogenesis of ischaemic stroke,^{12 13} and the findings of the beneficial effects of unsaturated fatty acids on ischaemic stroke may be in part due to their favourable effects on platelet aggregation and endothelial function.^{6 14-17}

The association between dietary fat intake and risk of haemorrhagic stroke is far from clear. In the nurses'

health study, Iso et al observed an inverse association between risk of intraparenchymal haemorrhagic stroke and intake of saturated fat or *trans* unsaturated fat but no associations with total fat, polyunsaturated fat, monounsaturated fat, or dietary cholesterol.³ Although

we did not observe any significant association between dietary fat intake and risk of haemorrhagic stroke, we could not exclude any important association because of the modest number of cases of haemorrhagic stroke. Further studies are needed.

Relative risks of stroke (95% confidence intervals) according to fifths of total fat, specific types of fat, dietary cholesterol, and Keys score

	Fifths of nutrient intake					P for trend
	1	2	3	4	5	
Total fat						
Median intake (g/day)	54	64	70	77	86	—
Ischaemic stroke:						
No of cases	89	87	91	97	91	—
Adjusted for age and smoking	1.0	0.96 (0.72 to 1.29)	0.97 (0.72 to 1.30)	1.04 (0.78 to 1.39)	0.93 (0.68 to 1.25)	0.91
Multivariate*	1.0	0.93 (0.68 to 1.26)	1.02 (0.74 to 1.39)	1.02 (0.74 to 1.42)	0.91 (0.65 to 1.28)	0.77
Haemorrhagic stroke:						
No of cases	18	30	28	23	26	—
Adjusted for age and smoking	1.0	1.66 (0.93 to 2.98)	1.50 (0.83 to 2.71)	1.23 (0.66 to 2.30)	1.32 (0.71 to 2.45)	0.73
Multivariate*	1.0	1.76 (0.95 to 3.25)	1.49 (0.79 to 2.83)	1.18 (0.60 to 2.35)	1.16 (0.58 to 2.32)	0.83
Animal fat						
Median intake (g/day)	25	33	39	45	54	—
Ischaemic stroke:						
No of cases	80	90	95	88	102	—
Adjusted for age and smoking	1.0	1.07 (0.78 to 1.45)	1.13 (0.84 to 1.53)	1.05 (0.77 to 1.43)	1.16 (0.86 to 1.58)	0.55
Multivariate*	1.0	1.14 (0.83 to 1.56)	1.12 (0.81 to 1.55)	1.04 (0.74 to 1.46)	1.20 (0.84 to 1.70)	0.47
+ vegetable fat†	1.0	1.11 (0.81 to 1.53)	1.10 (0.79 to 1.52)	1.02 (0.72 to 1.44)	1.15 (0.80 to 1.65)	0.61
Haemorrhagic stroke:						
No of cases	21	21	25	35	23	—
Adjusted for age and smoking	1.0	0.95 (0.52 to 1.77)	1.14 (0.63 to 2.06)	1.61 (0.92 to 2.82)	1.01 (0.54 to 1.90)	0.45
Multivariate*	1.0	0.95 (0.50 to 1.79)	1.12 (0.60 to 2.10)	1.49 (0.80 to 2.78)	0.90 (0.45 to 1.81)	0.90
+ vegetable fat†	1.0	0.92 (0.49 to 1.74)	1.08 (0.58 to 2.04)	1.44 (0.77 to 2.70)	0.86 (0.42 to 1.77)	0.99
Vegetable fat						
Median intake (g/day)	20	26	30	34	42	—
Ischaemic stroke:						
No of cases	94	105	96	70	90	—
Adjusted for age and smoking	1.0	1.18 (0.89 to 1.56)	1.11 (0.83 to 1.47)	0.82 (0.60 to 1.12)	0.98 (0.74 to 1.31)	0.27
Multivariate*	1.0	1.22 (0.91 to 1.62)	1.23 (0.91 to 1.66)	0.83 (0.60 to 1.16)	1.07 (0.77 to 1.47)	0.66
+ animal fat†	1.0	1.22 (0.91 to 1.62)	1.24 (0.92 to 1.67)	0.84 (0.60 to 1.18)	1.09 (0.78 to 1.51)	0.79
Haemorrhagic stroke:						
No of cases	25	23	27	27	23	—
Adjusted for age and smoking	1.0	0.96 (0.54 to 1.69)	1.16 (0.68 to 2.00)	1.17 (0.68 to 2.04)	0.95 (0.53 to 1.69)	0.83
Multivariate*	1.0	1.01 (0.56 to 1.82)	1.20 (0.68 to 2.13)	1.25 (0.70 to 2.25)	0.87 (0.46 to 1.63)	0.80
+ animal fat†	1.0	1.00 (0.56 to 1.80)	1.20 (0.67 to 2.13)	1.24 (0.68 to 2.24)	0.86 (0.45 to 1.64)	0.80
Saturated fat						
Median intake (g/day)	17	21	24	26	31	—
Ischaemic stroke:						
No of cases	81	92	95	88	99	—
Adjusted for age and smoking	1.0	1.10 (0.82 to 1.49)	1.15 (0.86 to 1.54)	1.01 (0.75 to 1.38)	1.08 (0.80 to 1.46)	0.65
Multivariate*	1.0	1.16 (0.85 to 1.59)	1.19 (0.86 to 1.65)	1.08 (0.77 to 1.52)	1.16 (0.81 to 1.65)	0.59
+ poly, mono, <i>trans</i> †	1.0	1.24 (0.87 to 1.76)	1.26 (0.84 to 1.88)	1.13 (0.73 to 1.76)	1.21 (0.75 to 1.97)	0.63
Haemorrhagic stroke:						
No of cases	18	24	34	26	23	—
Adjusted for age and smoking	1.0	1.30 (0.71 to 2.39)	1.86 (1.05 to 3.31)	1.36 (0.73 to 2.54)	1.15 (0.60 to 2.19)	0.63
Multivariate*	1.0	1.27 (0.66 to 2.42)	1.74 (0.93 to 3.26)	1.34 (0.68 to 2.66)	0.99 (0.48 to 2.04)	0.85
+ poly, mono, <i>trans</i> †	1.0	1.30 (0.64 to 2.64)	1.93 (0.91 to 4.08)	1.56 (0.67 to 3.67)	1.17 (0.45 to 3.07)	0.83
Monounsaturated fat						
Median intake (g/day)	20	24	27	30	34	—
Ischaemic stroke:						
No of cases	90	82	91	99	93	—
Adjusted for age and smoking	1.0	0.88 (0.65 to 1.18)	0.99 (0.74 to 1.33)	1.06 (0.80 to 1.41)	0.88 (0.66 to 1.19)	0.96
Multivariate*	1.0	0.89 (0.65 to 1.21)	1.03 (0.75 to 1.42)	1.03 (0.74 to 1.42)	0.91 (0.65 to 1.28)	0.83
+ poly, sat, <i>trans</i> †	1.0	0.85 (0.59 to 1.22)	1.01 (0.67 to 1.53)	1.06 (0.67 to 1.68)	1.00 (0.58 to 1.70)	0.85
Haemorrhagic stroke:						
No of cases	22	27	25	23	28	—
Adjusted for age and smoking	1.0	1.22 (0.70 to 2.15)	1.14 (0.64 to 2.02)	1.04 (0.57 to 1.87)	1.14 (0.64 to 2.03)	0.82
Multivariate*	1.0	1.23 (0.68 to 2.22)	1.00 (0.54 to 1.88)	0.91 (0.47 to 1.75)	0.95 (0.49 to 1.83)	0.62
+ poly, sat, <i>trans</i> †	1.0	0.96 (0.48 to 1.93)	0.69 (0.30 to 1.56)	0.61 (0.24 to 1.55)	0.68 (0.24 to 1.96)	0.40

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Relative risks of stroke (95% confidence intervals) according to fifths of total fat, specific types of fat, dietary cholesterol, and Keys score *contd*

	Fifths of nutrient intake					P for trend
	1	2	3	4	5	
Polyunsaturated fat						
Median intake (g/day)	10	11	13	14	17	—
Ischaemic stroke:						
No of cases	96	101	92	89	77	—
Adjusted for age and smoking	1.0	1.13 (0.85 to 1.50)	1.04 (0.78 to 1.39)	1.03 (0.77 to 1.38)	0.88 (0.65 to 1.19)	0.28
Multivariate*	1.0	1.14 (0.85 to 1.53)	1.11 (0.82 to 1.49)	0.99 (0.73 to 1.34)	0.88 (0.64 to 1.21)	0.25
+ mono, sat, <i>trans</i> †	1.0	1.15 (0.85 to 1.55)	1.11 (0.81 to 1.53)	0.98 (0.70 to 1.37)	0.86 (0.59 to 1.25)	0.26
Haemorrhagic stroke:						
No of cases	27	22	28	25	23	—
Adjusted for age and smoking	1.0	0.87 (0.50 to 1.52)	1.14 (0.67 to 1.93)	1.00 (0.58 to 1.73)	0.92 (0.53 to 1.59)	0.97
Multivariate*	1.0	0.85 (0.47 to 1.52)	1.12 (0.64 to 1.96)	1.02 (0.57 to 1.82)	0.86 (0.47 to 1.56)	0.75
+ mono, sat, <i>trans</i> †	1.0	0.89 (0.49 to 1.64)	1.20 (0.66 to 2.19)	1.09 (0.57 to 2.09)	0.95 (0.46 to 1.98)	0.99
Trans unsaturated fat						
Median intake (g/day)	1.67	2.34	2.86	3.44	4.42	—
Ischaemic stroke:						
No of cases	91	93	83	97	91	—
Adjusted for age and smoking	1.0	1.01 (0.76 to 1.35)	0.90 (0.67 to 1.22)	1.10 (0.83 to 1.45)	0.93 (0.69 to 1.25)	0.79
Multivariate*	1.0	1.01 (0.75 to 1.37)	0.86 (0.62 to 1.19)	0.98 (0.71 to 1.35)	0.87 (0.62 to 1.22)	0.42
+ poly, mono, sat†	1.0	0.96 (0.70 to 1.33)	0.80 (0.57 to 1.14)	0.90 (0.63 to 1.29)	0.80 (0.54 to 1.17)	0.26
Haemorrhagic stroke:						
No of cases	18	29	22	22	34	—
Adjusted for age and smoking	1.0	1.66 (0.93 to 2.97)	1.20 (0.63 to 2.26)	1.24 (0.66 to 2.31)	1.78 (0.99 to 3.19)	0.16
Multivariate*	1.0	1.54 (0.83 to 2.87)	1.16 (0.59 to 2.27)	1.06 (0.53 to 2.15)	1.76 (0.90 to 3.45)	0.20
+ poly, mono, sat†	1.0	1.44 (0.76 to 2.73)	1.13 (0.55 to 2.30)	1.11 (0.53 to 2.36)	1.90 (0.90 to 3.98)	0.13
Cholesterol						
Median intake (mg/d)	189	239	278	321	398	—
Ischaemic stroke:						
No of cases	87	81	85	89	113	—
Adjusted for age and smoking	1.0	0.90 (0.67 to 1.23)	0.90 (0.67 to 1.22)	0.89 (0.65 to 1.20)	1.06 (0.79 to 1.41)	0.72
Multivariate*	1.0	0.97 (0.72 to 1.32)	0.85 (0.62 to 1.16)	0.82 (0.60 to 1.13)	1.02 (0.75 to 1.39)	0.99
+ poly, mono, sat, <i>trans</i> †	1.0	0.93 (0.68 to 1.27)	0.80 (0.57 to 1.10)	0.76 (0.54 to 1.06)	0.93 (0.66 to 1.30)	0.63
Haemorrhagic stroke:						
No of cases	24	19	25	24	33	—
Adjusted for age and smoking	1.0	0.77 (0.42 to 1.38)	0.95 (0.55 to 1.65)	0.82 (0.46 to 1.44)	1.10 (0.66 to 1.86)	0.51
Multivariate*	1.0	0.70 (0.37 to 1.32)	1.02 (0.57 to 1.83)	0.91 (0.50 to 1.65)	1.04 (0.58 to 1.88)	0.61
+ poly, mono, sat, <i>trans</i> †	1.0	0.66 (0.34 to 1.26)	0.99 (0.54 to 1.82)	0.90 (0.48 to 1.70)	1.16 (0.61 to 2.20)	0.37
Keys score‡						
Median score	27.0	33.1	37.0	41.0	47.4	—
Ischaemic stroke:						
No of cases	86	84	88	91	106	—
Adjusted for age and smoking	1.0	0.93 (0.69 to 1.25)	0.99 (0.73 to 1.33)	0.97 (0.72 to 1.30)	1.04 (0.77 to 1.39)	0.66
Multivariate*	1.0	0.92 (0.67 to 1.26)	0.96 (0.69 to 1.33)	0.96 (0.69 to 1.34)	1.04 (0.74 to 1.48)	0.71
Haemorrhagic stroke:						
No of cases	19	21	28	33	24	—
Adjusted for age and smoking	1.0	1.04 (0.55 to 1.94)	1.48 (0.83 to 2.65)	1.64 (0.92 to 2.92)	1.00 (0.52 to 1.92)	0.40
Multivariate*	1.0	1.12 (0.58 to 2.15)	1.46 (0.77 to 2.76)	1.59 (0.84 to 3.02)	1.07 (0.53 to 2.19)	0.68

Poly=polyunsaturated fat; mono=monounsaturated fat; sat=saturated fat; *trans*=*trans* unsaturated fat.

*Adjusted for body mass index (<21, 21-22.9, 23-24.9, 25-29.9, or ≥30), physical activity (fifths), history of hypertension (yes or no), smoking status (never, past, and current with 1-14, 15-24, or ≥25 cigarettes/day), aspirin use (yes or no), multivitamin use (yes or no), and consumption of alcohol (0, 0.1-9.9, 10-19.9, 20-29.9, or ≥30g/day), potassium (fifths), fibre (fifths), and vitamin E (fifths), total servings of fruit and vegetables (fifths), total energy intake (continuous), and hypercholesterolaemia (yes or no) at baseline.

†Additional adjustments. All additional variables are fifths.

‡Keys score=1.26(2S-P)+1.5(square root (C)); S=percentages of total energy from saturated fat; P=percentages of total energy from polyunsaturated fat; C=daily cholesterol intake in mg/1000 kcal.

Conclusion

Our findings from this large cohort of middle aged US male healthcare professionals without a history of cardiovascular disease or diabetes mellitus indicate that intakes of total fat, specific types of fat, or dietary cholesterol do not seem to be related to the development of stroke.

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Contributors: See bmj.com

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What is already known on this topic

The associations between different types of fat and coronary heart disease do not seem to apply to stroke

Ecological data indicate that dietary fat intake is inversely related to risk of stroke

What this study adds

Intake of total fat, cholesterol, or major specific types of fat was not associated with risk of stroke

Consumptions of red meats, high fat dairy products, nuts, and eggs were also not appreciably related to risk of stroke

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Family attitudes to research using samples taken at coroner's postmortem examinations: review of records

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The response of families asked for cadaveric blood and tissue may have been affected by adverse publicity about hospitals retaining tissues and organs removed at post mortem without consent. The tissue bank at Peterborough was asked to contribute control samples to an English Department of Health funded study to validate tests for viral markers in postmortem material. The study required samples of cadaveric blood (10-20 ml), lymph node (one intrathoracic), and liver (2 cm³).¹ Peterborough was selected because it does not have a high prevalence of bloodborne viral infections and because the tissue bank had the infrastructure to retrieve postmortem tissue for research.² Participation in this study enabled us to evaluate the attitudes of families who were asked to allow the pathologist to take samples for research during a postmortem examination being done at the request of the coroner.

Participants, methods, and results

The coroner's officers identified deaths reported to the coroner that required postmortem examination and

fulfilled the requirements of the viral markers study.¹ The officers contacted families by telephone. After dealing with routine coroner's procedure, the officers asked the family members whether they were prepared to be contacted by a research nurse from Peterborough District Hospital. The officers explained that this would require a telephone interview of up to half an hour and that the research was being done to investigate tests for bloodborne viruses in relation to tissue transplantation. Reasons for refusal were recorded and sent to the research nurses.

The research nurses were given the name and contact number of family members willing to participate. The nurses then conducted the telephone interview according to the study protocol and notified the mortuary staff and pathologist if the family consented for retrieval of blood and tissue at the time of postmortem examination. The interview included lifestyle questions to allow researchers to determine risk factors for hepatitis and HIV if the viral marker tests gave positive results. Reasons for refusal were recorded.

Of 106 families asked to take a telephone call from a research nurse, 75 (71%) agreed to do so. The table gives the reasons for refusal to participate. One family member admitted a negative influence from media coverage about organ and tissue retention and wanted the deceased to remain "whole." The interview was not completed in five cases (family not available in three cases, nurse unavailable in one, and interview terminated because of distress in one case). All those who completed the interview agreed to samples being taken.

See also
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Reasons for refusal among families asked by coroner's officers to take a telephone call from a research nurse

Reason for refusal	No of families (n=31)
No reason given	11
Family time pressures	8
Family distressed/too upset	6
Family/deceased against tissue donation	5
Negative influence from media coverage	1