Population based study of social and productive activities as predictors of survival among elderly Americans

Thomas A Glass, Carlos Mendes de Leon, Richard A Marottoli, Lisa F Berkman

Harvard University School of Public Health, Department of Health and Social Behavior, Boston, MA 02115, United States
Thomas A Glass, *assistant professor*
Lisa F Berkman, *professor and chair*
Rush Institute for Healthy Aging, Rush-Presbyterian-St Luke's Medical Center, Chicago, IL 60612, United States
Carlos Mendes de Leon, *associate professor*
Yale University School of Medicine, Department of Internal Medicine, Geriatrics, DC 023, New Haven, CT 06504, United States
Richard A Marottoli, *associate professor*

Correspondence to: TA Glass tglass@hsph.harvard.edu

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Abstract

Objectives To examine any association between social, productive, and physical activity and 13 year survival in older people.

Design Prospective cohort study with annual mortality follow up. Activity and other measures were assessed by structured interviews at baseline in the participants' homes. Proportional hazards models were used to model survival from time of initial interview.

Setting City of New Haven, Connecticut, United States.

Participants 2761 men and women from a random population sample of 2812 people aged 65 and older.

Main outcome measure Mortality from all causes during 13 years of follow up.

Results All three types of activity were independently associated with survival after age, sex, race/ethnicity, marital status, income, body mass index, smoking, functional disability, and history of cancer, diabetes, stroke, and myocardial infarction were controlled for.

Conclusions Social and productive activities that involve little or no enhancement of fitness lower the risk of all cause mortality as much as fitness activities do. This suggests that in addition to increased cardiopulmonary fitness, activity may confer survival benefits through psychosocial pathways. Social and productive activities that require less physical exertion may complement exercise programmes and may constitute alternative interventions for frail elderly people.

Introduction

All developed nations are facing demographic transitions in which the proportion of the population over the age of 65 will double in the next few decades. By the year 2050 the number of Americans age 90 and above will grow from its present 1 million to 10 million. Furthermore, life expectancy for this age group has changed dramatically over the past decades so that now over a quarter of those over 65 can expect to live until they are 90. Those who turned 65 in 1994 are expected to live 17 additional years, which is an increase of 22% since 1960. While these changes are well documented, the determinants of survival in this age group are poorly understood.

Several studies have shown a link between activity level and survival.[1–5] In these studies it has been assumed that the survival advantage conferred by activity results from improved cardiopulmonary fitness attributable to physical activity.[6] We suggest that while physical fitness itself is important and clearly related to health and survival, the exclusive focus on physical activity obscures the health benefits that may be associated with other, non-physical activities and the possibility that activities may influence health and survival via other pathways than those influencing cardiopulmonary performance or musculoskeletal strength. We examined the relation between survival and three types of activities separately: social, productive, and fitness. While several previous studies provide tentative evidence for a link between social activities and mortality,[7 8] no study has examined the impact of social and productive activities on the risk of mortality among elderly people independent of physical activities.

The exact mechanisms through which activity acts on health and survival are not known, although several mechanisms have been suggested. Activity has been found to be associated with more optimal lipid metabolism,[9] high density lipoprotein concentrations,[10] and glucose metabolism.[11] It also seems that inactivity is associated with a greater likelihood of behavioural risk factors for cardiovascular disease, including obesity, poor diet, and smoking.[12] Whether or not additional psychosocial mechanisms associated with the affiliated aspects of activity also contribute to the survival advantage enjoyed by more active people is not yet known. Recent evidence suggests that psychosocial factors may influence some of these physiological variables, raising questions as to whether the benefits of activity may operate through a wider range of mechanisms.[13 14] Social activities have been previously shown to be associated with several risk factors for cardiovascular mortality including fibrinogen,[15] blood pressure,[16] and presence of coronary heart disease.[17] This study contributes to a growing body of research in gerontology that recognises the importance of social engagement and productive activity as essential features of successful ageing.[18]

Methods

Participants

Participants for this study come from the New Haven site of the established populations for epidemiological studies of the elderly (EPESE). Data collection began in 1982 and was repeated annually for 13 years. Face to face interviews were conducted in participants' homes in 1982, 1985, 1988, and 1994 with annual telephone interviews conducted in 1983, 1984, 1986, 1987, 1989, and 1990. All data were collected from participants by trained lay interviewers who were blinded to study hypotheses.

Sampling

At baseline the cohort comprised 2812 men and women age 65 years and older living in the community. All provided informed consent. The baseline response rate was 82% (1169 men and 1643 women). By using data from the 1980 United States census the sample was designed to be similar to the local population with respect to age, sex, marital status, living arrangements, and race/ethnicity. Men and those living in housing for elderly people were oversampled to increase the sampling efficiency. Sample design variables including weights and cluster variables were constructed for use in the analysis to allow for accurate generalisation to the population, correcting for the impact of the sample design on variable estimates and their sampling errors. These weights were also constructed to take differential rates of non-response into account. All analyses presented are corrected to take account of this sampling design. Further details of the sampling design have been described elsewhere.[19]

Measures

The outcome measure, death, was assessed by using several methods including daily review of newspapers and hospital admissions records and annual recontact with all study participants or their next of kin and by using the national death index. We were able to achieve nearly complete mortality surveillance on all participants regardless of whether they dropped out of the study. Vital status could not be confirmed in 27 participants (1%) who, because they were not found in the index search, were assumed to be alive at the end of follow up. The interview schedule was a 75 page structured interview that took just over an hour to complete.

Variables used in the analyses

Sociodemographics—Items on age (years at 1982 interview), marital status (married versus nonmarried), education (years of schooling completed), and race/ethnicity (white versus other) were included in the present analysis. Annual family income was categorised into two dichotomous variables for low (<$5000 (£7500)) and moderate income ($5000-9999 £7500-14 999)), with high income group (>$10 000 (£15 000)) serving as the reference group. To retain subjects who refused to report income (13%) a separate dichotomous variable was created for missing values.

Social, productive, and fitness activities—Information on the extent of engagement in three types of activities, our primary independent variables, was ascertained during a structured interview at home in 1982. In the current study, only baseline assessments of activity were used. Subjects were asked about the frequency of performance of 14 common activities (see table 2 for details) in the past month. Response options were "often" (code 2), "sometimes" (code 1), "never" (code 0), "refused," and "don't know." Full or part time employment was coded 2, and participation in groups was coded 1. Separate indices were constructed by summing responses across the three types of activity. Each index was set to missing if answers to two or more of the component questions were missing.

Health status measures—These measures included self reported medical conditions, a functional disability index, and relative weight. Subjects were asked if a doctor had told them that they had any of seven chronic health conditions (myocardial infarction, stroke, hypertension, hip fracture, diabetes, liver disease, and cancer or tumour). Relative weight was assessed by body mass index and then divided into approximate thirds to create dichotomous variables for low (<23 kg/m^2), middle (23-27 kg/m^2), and high (>27 kg/m^2) body mass index. As for income a dichotomous variable for missing values was created to permit inclusion of subjects with missing values (6%). Final analyses were repeated after exclusion of cases with missing data on income and body mass index, and the interpretation of the results did not change. Functional health status was assessed by three commonly used, self reported measures of disability: a seven item Katz index of basic activities of daily living; a three item measure of gross mobility based on the work by Rosow-Breslau; and a five item measure of basic strength and range of motion developed by Nagi.[20] This disability information was summarised into a Guttman scale of 5 levels (0-4), ranging from no disability in any item of each measure (0) to disability in at least one item of each measure (4).[20]

Data analysis

The analysis consisted of a series of proportional hazard models to estimate the effect of activity on risk of death. Kaplan-Meier life tables were computed to verify the proportionality assumption across quarters of each activity index (not shown). For the main analysis a continuous time model was specified with duration of survival as the dependent variable, and each activity subscale was entered as a continuous predictor variable. Participants who were still alive at the end of observation were considered censored. Estimates of model variables and their standard errors were accomplished through construction of a partial likelihood function. Results are presented in two ways: first as regression variables, which represent the gradient effect on the risk of death of a one unit increment in each activity subscale, and, secondly, hazard ratios were computed by comparing the scores of those on or above the 75th centile and on or below the 25th centile in the baseline distribution of each activity index. These comparisons do not constitute a separate test but are presented for heuristic purposes as an indication of the relative magnitude of each effect. To account for the complex sampling design all bivariate and multivariate models were computed with SUDAAN software.[21]

Results

Table 1 summarises levels of the three types of activities at baseline, and table 2 gives weighted baseline proportions of participants reporting activities within each group. Activity level was slightly to moderately correlated with several other covariates included in the final models, including age, functional disability, marital status, missing body mass index, and history of stroke, diabetes, and cancer. The three activity types were only modestly correlated with each other, with Spearman (non-parametric) correlation coefficients ranging from 0.25 (social and fitness) to 0.32 (social and productive), suggesting that these type measure relatively independent domains of activity.

Table 3 shows the proportion of participants who died between their baseline interview and the end of observation (August 1995) with correction for the complex sampling design. Of the entire cohort, 62% died during follow up. There was a clear mortality gradient across levels of reported activity for each type of activity. Those in the least active quarter were 34.7% more likely to die than those in the most active quarter in productive activity; the figures being 20.3% for social activity and 18.8% for fitness activity.

Table 1 Descriptive statistics for index of social, fitness, and productive activities at baseline in elderly people in New Haven, CT, United States

Activity	Full sample			Mean (SD) for men	Mean (SD) for women	P value* for difference between sexes
	Range	Mean (SD)	Median (25th, 75th centiles)			
Social	0–9	2.7 (2.4)	1.8 (0.6, 3.6)	2.6 (1.7)	2.7 (2.5)	0.181
Fitness	0–6	1.8 (1.5)	1.3 (0.2, 2.2)	2.2 (1.7)	1.6 (1.4)	<0.001
Productive	0–12	4.0 (2.2)	3.5 (2.4, 4.7)	3.8 (1.8)	4.1 (2.4)	<0.001

**t* Test.

Table 4 shows how the proportional hazards models (unadjusted and adjusted) predict the hazard of death over the 13 years of follow up. Preliminary models and previous research were considered when we selected covariates for this model to control for possible confounding by variables extraneous to the activity-mortality relation. Additional factors available in the dataset that were included in previous models but were rejected because they showed no impact on risk of mortality and did not modify the effect of activity level included education, history of hypertension, hip fracture, and angina, depression, cognitive function, and number of chronic conditions. Both the unadjusted and the fully adjusted results show that each of the three activity types examined was significantly associated with longer survival in these prospective data. Older age, male sex, high body mass index, longer history of smoking, and history of stroke, diabetes, myocardial infarction, and functional disability were all significantly related to mortality. Several other variables including income, marital status, and race or ethnicity did not reach significance but were retained in the models because of their associations with both the outcome and with the primary independent variable of interest.

After we controlled for other factors related to survival, social activity was significantly associated with survival. In the adjusted model those who were more socially active had longer survival compared with those who were less socially active. Fitness activities were also significantly associated with mortality in both the adjusted and unadjusted models. Finally, productive activities were also found to be protective against the risk of all cause mortality in both unadjusted and adjusted models.

Because of concerns about the independence of the effect of non-physical activities we conducted additional analyses to examine the extent to which social and productive activities were protective against mortality across the highest, middle, and lowest thirds of fitness activity. The trend toward lowered risk of mortality was fairly stable (table 5). The effect of productive activity was weakest among those who were most active in terms of fitness activities. Because of fluctuations in the standard error the significance level of social activities fell below the 0.05 threshold in the most and least active thirds; as can be seen from the coefficients, however, the trend toward consistently lower mortality was evident in each case. Indeed, the effect of social and productive activity on mortality was the strongest among the least physically active (as measured by the hazard ratio)—that is, the most active quarter enjoyed the strongest survival advantage compared with the least active quarter among those least physically active. Because of decreased efficiency in the estimates these values dip below significance. The direction and strength of the association, however, is quite consistent.

Table 2 Details of activities and proportion (percentage) of participants who engaged in them at baseline in 2812 elderly people in New Haven, CT, United States

Detail of activity	Sometimes	Often	No of participants with missing data
Social:			
Church attendance	43.8	1.7	50
Visits to cinema, restaurants, sporting events	34.2	25.4	51
Day or overnight trips	22.1	9.9	52
Playing cards, games, bingo	14.6	20.5	52
Participation in social groups	41.2	NA	50
Fitness:			
Active sports or swimming	5.4	5.2	53
Walking	29.5	42.4	52
Physical exercise	18.0	17.8	52
Productive:			
Gardening	13.9	17.0	51
Preparing meals	13.2	70.3	51
Shopping	22.4	62.6	53
Unpaid community work	5.6	8.1	52
Paid community work	1.9	1.2	54
Other paid employment	NA	12.5	37

NA=not applicable.

Table 3 Mortality over 13 years in elderly people in New Haven, CT, United States* by quarter of distribution of each type of activity

Quarter	Social activity	Productive activity	Fitness activity
Low	74.0	85.6	74.0
Low-medium	69.6	74.0	69.8
Medium-high	62.5	61.2	62.4
High	53.7	50.9	55.2

*Sample size at baseline was 2761 after deletion of cases with missing data. Percentages and sample sizes calculated with SUDAAN to account for complex sampling design.

Discussion

This study reports on the impact of activity on risk of all cause mortality among elderly people. More active elderly people were less likely to die than those who were less active. Social and productive activities were observed to confer equivalent survival advantages compared with fitness activities. This observation is important because it suggests that activities that entail little or no physical exertion may also be beneficial. A wider range of mechanisms, both physiological and psychosocial, may be involved in the association between activity and mortality than had been previously thought.

Limitations and strengths

There were several limitations of this study. We asked about only a limited number of activities. In addition, our ability to grade the frequency of participation in

Table 4 Adjusted and unadjusted results of survival models comparing social, productive, and fitness activities at baseline in elderly people in New Haven, CT, United States*

	Social activities		Fitness activities		Productive activities	
Statistic	**Unadjusted**	**Adjusted†**	**Unadjusted**	**Adjusted†**	**Unadjusted**	**Adjusted†**
Regression coefficient‡ (SE)	−0.132 (0.019)§	−0.069 (0. 016)§	−0.168 (0.024)§	−0.078 (0.026)§	−0.248 (0.020)§	−0.112 (0.020)§
Hazard ratio¶ (95% CI) between highest and lowest quarter	0.67 (0.60 to 0.75)	0.81 (0.74 to 0.89)	0.71 (0.65 to 0.78)	0.85 (0.77 to 0.95)	0.57 (0.52 to 0.62)	0.77 (0.71 to 0.85)

*Sample size at baseline 2812 after deletion of missing data, 2761 cases included in analysis.
†Adjusted for age, sex, race/ethnicity, marital status, body mass index, current smoking status, income, functional status, and history of smoking, cancer, stroke, diabetes, and myocardial infarction.
‡Regression coefficients are estimates of population effect variables representing effect of 1 unit increment in each activity index on log of hazard (risk) of death adjusted for other factors in model. All survival models estimated with SUDAAN, which corrects for complex sampling design.
§P<0.001.
¶Hazard ratios represent risk of death for those in highest versus lowest category of each activity type.

Table 5 Trends in mortality and social and productive activities across levels of fitness activities in elderly people in New Haven CT, United States*

	Productive activities		Social activities	
Third of fitness activity	**Hazard ratio† (95% CI)**	**P value**	**Hazard ratio† (95% CI)**	**P value**
Lowest (n=824)‡	0.76 (0.64 to 0.90)	0.002	0.79 (0.61 to 1.02)	0.073
Middle (n=1021)‡	0.77 (0.66 to 0.910	0.003	0.85 (0.74 to 0.970	0.017
Highest (n=761)‡	0.83 90.70 to 0.99)	0.047	0.86 (0.72 to 1.01)	0.071

*Sample size at baseline was 2812. After deletion of missing data 2761 cases were included in analysis.
†Represent risk of death for those in highest versus lowest quarter of each activity type. All models adjusted for age, sex, race/ethnicity, marital status, body mass index, current smoking staus, income, functional status, and history of smoking, cancer, stroke, diabetes, myocardial infarction.
‡Because of corrections for sample weighting and ties, observed sample sizes of groups are not equal. These are approximate thirds based on corrections for sample weighting.

each activity was somewhat crude. For that reason, our measures of activities convey more information about the number of activities in which people participate than information about the extent of that participation. For this reason the survival advantages of a heavy investment in only one or two activities would not have been observed. It may have been possible to find more substantial effects had we been able to assess more fully the frequency and extent of participation. In addition, the number of activities assessed was not consistent across the three types of activity. Questions were asked only about activities in the previous month, which may have introduced some measurement error.

Strengths of this study included the use of a cohort design that involved a representative sample of elderly people living in the community. Response rates were high, and complete mortality surveillance was achieved.

One possible explanation for these findings is that activity levels measured at baseline were actually measuring health status in ways not otherwise controlled for. If this were the case, the elimination of those who died within the first 5 years of follow up would attenuate the relation seen between activity and survival. We conducted subsequent analyses to check for this possibility and found that the protective effects of social and productive activity remained consistent and significant (results available from the authors). The beneficial impact of fitness activity was reduced in this model and fell below significance.

Also, despite the fact that the activity types were weakly correlated, social and productive activities may be acting as proxy measures of physical activity. To test this hypothesis we ran an additional model in which all three types of activity were entered simultaneously. In that model (which contained the same covariates as before) social activities (hazard ratio 0.88; $P=0.024$) and productive activities (0.81; $P<0.001$) remained significant independent predictors of survival and fitness activities (0.92; $P=0.194$) fell below significance. This may be due to the fact that fewer questions were asked about fitness activities. None the less, these results add to our confidence that social and productive activities exert an independent protective effect not due exclusively to the impact of physical activity.

Another potential criticism is that several of our indicators of productive activity may make a substantial contribution to an individual's overall level of cardiovascular fitness. To check for this possibility we ran similar models in which shopping and gardening were dropped from the productive activity index. The results indicated that the beneficial impact of productive activity remains significant (0.92; $P=0.003$). Further analyses revealed that no single activity was driving the association of activity types and mortality. In unadjusted analyses all the individual activities with the exception of the rarest (paid community work) was associated with a lower risk of mortality.

Beyond physical activity

Previous studies of activity and mortality have assumed that physiological pathways mediate this association. This has led to substantial investment in exercise interventions in older people. The activities in which older people engage, however, result in a complex array of effects beyond improved fitness. Social activities may involve a broad range of goals, including leisure and enjoyment, reinforcement of social status and sense of worth, social engagement, and productivity. It is worth noting that the initial studies that showed the benefits of activity were not based on laboratory experiments of exercise but rather on observational studies of activity embedded within a social context.[7 22]

Psychosocial pathways may be involved in the health benefits of activity. Recent research has shown that social contacts influence several biological factors. Substantial evidence indicates that social contacts may reduce the deleterious effects of psychological stress through enhancement of both cellular and humoral immune response.[23] Secondly, social and productive activity involves the performance of meaningful social roles. These roles may have important consequences that go beyond the benefits of fitness alone. Meaningful social role performance promotes a sense of self efficacy that has been linked to several important health outcomes in later life.[24 25] Social and productive activity may result in a sense of meaning and purpose in life, which has been linked to survival in at least one study.[26] Finally, social and productive activity reinforces relationships as well as norms of reciprocity and mutuality. Social and productive activity may enhance social networks and social support, which have been linked to survival in several prospective studies.[7 27–28]

Our findings corroborate those of a small number of studies that have found a link between survival and social activities that entail little or no physical exertion.[29] This finding has important implications for public policy and clinical practice. Clinicians might recommend a broader range of activity options for older people. For patients with chronic conditions such as arthritis social activity may promote wellbeing more effectively than physical activity.[30] Evidence from the national health and nutrition examination survey and other population studies suggests that the prevalence of inactivity is considerable among adults in the United States and that it increases substantially among those aged 65 and older.[31] Public policy measures that reduce barriers to continued social engagement would be important interventions—for example, public investment in transport and day centres for elderly people. Among people in institutions these results suggest the importance of alternative programmes of activity as a complement to exercise programmes. Several trials of interventions in occupational therapy have shown the feasibility of increasing levels of leisure and social activity.[32]

Summary

In summary, these findings build on a substantial body of studies that show the benefits of remaining active in later life. Furthermore, an exclusive emphasis on exercise and fitness activity may be overly narrow. While it is recognised that all social activity has the potential to include physical activity, as has been argued by Yates,[33] it is important that clinicians and policymakers recognise that the physical actions in which humans engage are inherently social in nature as well. Clinicians can add powerful new intervention tools by recognising the health benefits of social and productive activities as complements to exercise. On their own, social and productive activities may have independent health benefits as well.

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Contributors: TAG initiated the study, conducted the analyses of the data, was the primary author of the paper, and had primary responsibility for correspondence with the editors. CMdeL assisted in the data analysis, conducted several subsidiary analyses, and participated in the writing and editing of the paper. RAM contributed to the writing and editing of the paper, provided guidance on the clinical significance of the study, and participated in the development of the activity measures. LFB initiated and was responsible for the design and conduct of the study in which the data were collected under NIH contract, made substantial contributions to the development, writing, and editing of the manuscript, and contributed substantially to correspondence with the editors. TAG is the guarantor.

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Key messages

- Little is known about predictors of survival among elderly people
- Physical activity is clearly good for health, but the potential benefits of social activities have not been studied
- Social and productive activities are as effective as fitness activities in lowering the risk of death
- Enhanced social activities may help to increase the quality and length of life

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Perinatal mortality and morbidity among babies delivered in water: surveillance study and postal survey

Ruth E Gilbert, Pat A Tookey

Department of Epidemiology and Public Health, Institute of Child Health, London WC1N 1EH
Ruth E Gilbert, *senior lecturer in clinical epidemiology*
Pat A Tookey, *senior research fellow*
Correspondence to: Dr Gilbert r.gilbert@ich.ucl.ac.uk

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Abstract

Aim To compare perinatal morbidity and mortality for babies delivered in water with rates for babies delivered conventionally (not in water).
Design Surveillance study (of all consultant paediatricians) and postal survey (of all NHS maternity units).
Setting British Isles (surveillance study); England and Wales (postal survey).
Subjects Babies born in the British Isles between April 1994 and March 1996 who died perinatally or were admitted for special care within 48 hours of birth after delivery in water or after labour in water followed by conventional delivery (surveillance study); babies delivered in water in England and Wales in the same period (postal survey).
Main outcome measures Number of deliveries in water in the British Isles that resulted in perinatal death or in admission to special care within 48 hours of birth; and proportions (of such deliveries) of all water births in England and Wales.
Results 4032 deliveries (0.6% of all deliveries) in England and Wales occurred in water. Perinatal mortality was 1.2/1000 (95% confidence interval 0.4 to 2.9) live births; 8.4/1000 (5.8 to 11.8) live births were admitted for special care. No deaths were directly attributable to delivery in water, but 2 admissions were for water aspiration. UK reports of mortality and special care admission rates for babies of women considered to be at low risk of complications during delivery who delivered conventionally ranged from 0.8/1000 (0.2 to 4.2) to 4.6/1000 (0.1 to 25) live births and from 9.2 (1.1 to 33) to 64/1000 (58 to 70) live births respectively. Compared with regional data for low risk, spontaneous, normal vaginal deliveries at term, the relative risk for perinatal mortality associated with delivery in water was 0.9 (99% confidence interval 0.2 to 3.6).
Conclusions Perinatal mortality is not substantially higher among babies delivered in water than among those born to low risk women who delivered conventionally. The data are compatible with a small increase or decrease in perinatal mortality for babies delivered in water.

Introduction

In the 1980s few clinicians offered delivery in water.[1 2] By 1993 all maternity units in England and Wales had managed labour or delivery in water and nearly half had installed birthing pools.[3] Perceived advantages include women feeling relaxed[4] and more autonomous than in conventional deliveries[5]—although a review of three randomised controlled trials[4 6 7] of labour in water showed no clear beneficial or adverse effects on mother or baby.[8]

The main advantage claimed for delivery in water is a gentler experience for the baby. Reports of possible adverse effects—hypoxic ischaemic encephalopathy[9] and one death attributed to labour taking place in warm water[10] and infection due to delivery in water[11–13]—raise theoretical causal links. Only one report of a baby who died with waterlogged lungs[14] is clearly attributable to delivery in water. No studies, however, have yet compared maternal or paediatric outcomes in similar groups of women delivering in water and delivering conventionally (not in water).

We conducted national surveys of maternity units and paediatricians to determine the risks of death or admission for special care for babies delivered in water and identified clinical findings that might relate to the use of water. We compared these results with rates for women at low risk of complications during labour or delivery who delivered conventionally.

Methods

From April 1994 to April 1996 (25 months) all 1500 consultant paediatricians in the British Isles were surveyed each month by the British Paediatric Surveillance Unit[15] and asked to report whether or not they