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Improving generalist end of life care: national consultation with practitioners, commissioners, academics, and service user groups

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ABSTRACT

Objective To identify major concerns of national and local importance in the provision, commissioning, research, and use of generalist end of life care.

Design A national consultation and prioritising exercise using a modified form of the nominal group technique.

Participants Healthcare practitioners, commissioners, academics, and representatives of user and voluntary groups.

Setting Primary and secondary care, specialist palliative care, and academic and voluntary sectors in England and Scotland.

Results 74% of those invited (210/285) participated. The stage of life to which "end of life care" referred was not understood in a uniform way. Perceptions ranged from a period of more than a year to the last few days of life. Prominent concerns included difficulties in prognosis and the availability of adequate support for patients with advanced non-malignant disease. Generalists in both primary and secondary care were usually caring for only a few patients approaching the end of life at any one time. It was therefore challenging to maintain skills and expertise, particularly as educational opportunities were often limited. End of life care took place among many other competing and incentivised activities for general practitioners in the community. More needs to be known about models of end of life care and how these can be integrated in a generalist's workload. A greater evidence base is needed about the effectiveness and application of current tools such as the gold standards framework and Liverpool care pathway and about models of palliation in patients with diseases other than cancer.

Conclusions Definitions of end of life care need clarification and standardisation. A greater evidence base is needed to define models of good practice together with a commitment to provide education and training and adequate resources for service provision. More needs to be known about the context of provision and the influence of competing priorities and incentives.

INTRODUCTION

Most "end of life care" occurs in a generalist setting rather than a specialist palliative care setting.[1-4] In industrialised countries most people will die in institutions such as hospitals, nursing homes, and care homes. Over the past two decades, research documenting the poor control of symptoms in patients with advanced disease has fuelled the development of specialist palliative care services. Patients' choice has become a feature of government policy in several countries, but there is little evidence of an impact on the place of care and of death.[5] In England, the Department of Health published an end of life care strategy in July 2008 to improve quality of care. This recognised the need for greater support of generalists and for more research to inform service development.[6]

As part of a scoping exercise to determine research priorities in generalist end of life care[7-9] we investigated what was understood by generalist end of life care and the current concerns and preferences for service research and development from the perspectives of clinicians, user groups, commissioners, academics, and policy makers.

METHODS

Design—We undertook a national consultation and prioritisation exercise using a modified form of the nominal group technique[10] in London, the east of England, Warwickshire, and Scotland and with representatives of English national organisations.[7-9] Local research teams were established in each area, and the London team conducted the English national consultation. The consultation exercise was undertaken over seven months.

Participants—We invited health and social care practitioners from primary, secondary, and tertiary services and from specialist palliative care, service commissioners, policy makers, academics, and user and voluntary groups to participate.[8 9] Participants were selected on a purposive basis, to gain wide representation from among the different stakeholder groups.

Data collection—We used short semistructured questionnaires standardised across all five consultations (box 1). Interviews were usually undertaken by telephone but occasionally took place face to face. A

Box 1 Topics from the question schedules used for interviews and email questionnaires

- What do you understand by the term "end of life care"?
- What is the generalist's role in providing end of life care and how does this contrast with the specialist palliative care role?
- Are there any specific concerns about generalist palliative care in your area relating to:
  - Knowledge and expertise
  - Working with other agencies
  - Availability of specialist support
  - Care homes
  - Cost effectiveness
  - Continuity of care including out of hours care?
- Are there issues of inequitable access to care in your area?
- What more needs to be done in terms of:
  - Education and training for generalists
  - Providing more support for patients and families
  - Providing more support for generalists?
- What research would be most useful in supporting better generalist palliative care?

shortened version of the questionnaire was sent by email. Informants were offered a choice of method of response. We defined "generalist end of life care" as care provided by health or social care professionals other than those whose remit was specialist palliative care. We proposed that "end of life care" encompassed care provided within the last year(s) of life to anyone with an advanced progressive disease that was likely to shorten their life. We invited participants to challenge these definitions.

Nominal group technique—The nominal group technique is a method for generating consensus and involves seeking views, discussing and clarifying issues, and voting on priorities.[10] See bmj.com.

Data analysis—Each local research team undertook a thematic analysis of participants' responses by reviewing interview transcripts and identifying key themes and categories. Key themes were then discussed by all research teams and a common core of categories agreed to enable comparison together with themes specific to each locality. Participants' responses were grouped under these themes and were presented back to participants at each consultation meeting, providing attendees with an opportunity for discussion and clarification. The results from each of the five consultations were synthesised to identify widely shared issues as well as local priorities. This was undertaken by the coordinating team in discussion with the other teams. A consensus was finally achieved. The analysis was undertaken at the same time as a parallel analysis to identify research priorities for the project funders.[7-9]

Rigour—To ensure rigour and quality control across the five consultations, all research teams held regular teleconference meetings to discuss progress and refine the common protocol during data collection and analysis. The analysis was completed by drawing on the expertise within the research teams and the project advisory group.

Box 2 Definitions of end of life care

"I don't think of 'end of life' as any specific time but rather the phase from when it is clear that somebody is going to die in the foreseeable future until the end of their life" (academic)

"I believe 'end of life care' is a term that encompasses palliative and terminal phases" (generalist participant)

"I understand it to mean the last few days of life, although the term is generally not well defined and used differently according to different speakers and contexts" (generalist participant)

"End of life care is care of an ill person who may be within two years of death" (generalist participant)

"My general understanding of end of life care is that it refers specifically to the last stages of a progressive disease/condition that will end in death . . . My experience of 'reality' is that when people talk about end of life care, I assume they are talking mainly about people with cancer" (academic)

RESULTS

Of the 285 participants invited, 210 (74%) responded. See bmj.com for full details. End of life care had different meanings for different respondents (box 2).

Generalists included all those working in health and social care in acute, rehabilitation, and continuing care settings in nursing and residential homes. Generalists were seen to deal with all conditions on a daily basis and their roles included coordination of care, key worker, gatekeeper, and referrer to others, particularly specialist palliative care services.

Generalist end of life care could be more concerned with non-malignant disease compared with specialist palliative care, which was seen to be largely concerned with cancer. Because of difficulties in identifying end of life in non-malignant disease, end of life care was also thought to be biased towards cancer, whether in a generalist or specialist palliative care setting. Variability of standards of generalist end of life care was a major concern among all groups.

Skills and expertise in palliative care

Within the NHS, capacity to provide palliative care in a generalist setting was seen by generalists and specialists alike to depend on the balance of team composition, team skills, and access to specialist support. Acquisition and maintenance of skills in palliative care was thought to be difficult for generalists as they usually cared for relatively few people nearing the end of life. All groups identified education and training as key issues.

All groups were concerned that in some geographical areas, lack of skilled professionals and social carers limited the quality and quantity of good care that could be delivered.

Place, organisation, and models of care

Participants highlighted the mismatch between patients' preferences and their actual place of care

and death. Generalist models of end of life care, both in primary and secondary care settings, were a priority for development. Important gaps in knowledge about the impact of end of life care on caseloads and about the ways generalists and palliative care specialists can best work together were also noted. Many participants were concerned about the need to improve primary out of hours care at the end of life, and almost half (80/167) considered this a research priority (box 3).

Groups reported communication between health and social care as problematic. Both generalists and specialists in palliative care responded positively about end of life care tools, such as the gold standards framework (www.goldstandardsframework.nhs.uk). There were, however, concerns about the lack of evidence to support its use and development and to justify the investment of time. Within hospital settings and care homes the Liverpool care pathway (www.mcpcil.org.uk/liverpool_care_pathway) was thought to be a good model of care but was considered difficult to sustain when there was a high turnover of staff and a lack of funds to provide the necessary education.

Need for new developments

The lack of prognostic indicators and clinical triggers to inform decision making about when end of life care should start was thought to be an important gap in applying generalist end of life care. The low priority accorded to funding end of life care within the NHS and the reliance on the voluntary sector for hospice care was seen to reflect a major weakness in the system. Difficulties in prognosis, particularly in non-malignant disease, were thought to hinder access to appropriate help from services. Support for carers was deemed a priority.

Box 3 Priority concerns about place, organisation, and delivery of care and need for new developments

Out of hours/continuity of care

"The area of concern in my practice/geographical area is the provision of care around the clock. During office working hours there is a good provision of services but other than office hours patients don't get a good service . . . there is no district nurse support for out of hours care. There is minimal specialist palliative care cover but no generic care" (generalist participant)

Health and social care interface

"The division between social services and health care is an absolute nightmare. . . There are huge delays in discharges and there is this artificial divide between whether patients' needs are health or social care, when in many cases they're both . . . the speed at which patient assessments are made is too slow, meaning that some patients who may have been able to stay at home end up having to be admitted because they didn't receive care as quickly as they required" (generalist participant)

Access

"Frail older people and their families, with or without dementia, at the end of their life are regarded as a drain on hospital resources and are not treated in the same way as younger patients with cancer. Similarly older frail people dying in care homes, if they are not part of the GSF [gold standards framework] do not have the same support from the local palliative care teams. This is exacerbated by the difficulty staff have identifying when a patient/resident is dying" (generalist participant)

Measuring outcomes

"Measuring outcomes is extremely difficult within palliative care . . . it is extremely difficult to measure quality . . . palliative care does not restore people to working life and is not economically beneficial to wider society" (generalist participant)

Box 4 Examples of research questions to improve generalist end of life care arising from the consultation

Improving service provision

How does end of life care integrate within generalist caseloads?

How to engage the disengaged generalist

How to improve access to health and social care out of hours

Do the end of life care tools provide better care, reduce costs, increase choice etc?

Care for non-cancer patients

What models of care work at the end of life?

How can non-cancer patients be best identified for supportive and palliative care in the community?

How can non-cancer assessment and planning be best done in the community?

Place of care and death

What are the full costs of keeping a patient at home?

How can national policies support locally determined delivery of best practice?

What support do care homes need to prevent emergency admission?

Experience of patients and carers

What do patients want from care providers?

What is the level of patients' experience of care we are aiming for?

What do patients know about what they can access and expect?

Differences between consultation priorities

There was a high level of agreement between the different consultations in terms of priority issues and topics for research. These included improving service provision, out of hours care, non-cancer care, place of care and death, and the experiences of patients and carers. See bmj.com.

The geographically based consultations placed higher priority on improving out of hours care than participants from the English national organisations, perhaps reflecting the greater involvement of generalist practitioners. Access to services based on geographical location was an issue of greater concern in Scotland, where remote communities have less access to hospital, hospices, and specialist end of life care.

DISCUSSION

Much needs to be done to support generalists in providing care to patients at the end of life and to their carers. It is surprising that there has been so little research and development, even in the United States, where there is considerable variation in type of care provided by hospitals.[4 11] The areas identified by two

WHAT IS ALREADY KNOWN ON THIS TOPIC

Most people are cared for by generalists at the end of life and die in generalist settings

Government policy is promoting initiatives to increase and improve generalist end of life care

Less is known about the provision of generalist end of life care compared with specialist palliative care

WHAT THIS STUDY ADDS

Practitioners, service commissioners, academics, and representatives of user and voluntary groups do not agree about what constitutes generalist end of life, palliative, and terminal care

Variability of practice, lack of routine educational and training opportunities, and limited resources are concerns

Effective models for patients with non-malignant disease, for out of hours care, and for hospital care need to be identified and trialled

Research priorities should incorporate the perspectives of patients and carers and implications on resources and health economics

working groups (care pathways, service models, commissioning, care homes, quality and outcomes, workforce development, costs) were all issues raised by our participants (www.healthcareforlondon.nhs.uk/background.asp).[12] These issues were echoed in a workshop held in Canada.[13] Lack of funding, shortage of trained professionals, and insufficient training and infrastructure reflect common international problems for generalist end of life care.

The end of life care programme in England focused on supporting generalist models of care such as the gold standards framework and the Liverpool care pathway.[6] There are concerns, however, about the evidence base of such programmes and the need for further evaluation. See bmj.com. Many of our participants were generalists who described the difficulties of integrating end of life care within a generalist caseload where there were many other competing priorities.

Our consultation was part of a scoping exercise and as such has limitations in terms of comprehensiveness. We did, however, adopt a rigorous and flexible approach in terms of sampling, data collection, and analysis to enable widespread participation. Although we recruited from a wide range of organisations, we cannot claim to represent all potential stakeholders, particularly users of services, because of our focus on user groups. While the consultation took place in difference geographical areas of England and Scotland, we cannot claim that we represent all geographical regions. There was, however, considerable enthusiasm to participate, reflected in the high response rate.

A major outcome of the consultation was the identification of research priorities in generalist end of life care.[7-9] These included learning more about models of good practice out of hours, in hospital, for non-malignant disease and among older people, with a focus on the patient and carer perspective and on resource and health economic implications. Box 4 presents examples of priority research questions suggested as a result of the consultation. These priorities should help inform the Department of Health's implementation of the end of life care strategy in developing its research programmes.[6]

Conclusion

Definitions of end of life care need clarification and standardisation as lack of clarity can hinder access to services. The competing priorities and incentives faced by generalists act as barriers to improving care at the end of life. Access to education and training in care at the end of life is limited for generalists but is essential if they are to develop and maintain their knowledge and skills.

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Effects of improved home heating on asthma in community dwelling children: randomised controlled trial

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ABSTRACT

Objective To assess whether non-polluting, more effective home heating (heat pump, wood pellet burner, flued gas) has a positive effect on the health of children with asthma.

Design Randomised controlled trial.

Setting Households in five communities in New Zealand.

Participants 409 children aged 6-12 years with doctor diagnosed asthma.

Interventions Installation of a non-polluting, more effective home heater before winter. The control group received a replacement heater at the end of the trial.

Main outcome measures The primary outcome was change in lung function (peak expiratory flow rate and forced expiratory volume in one second, FEV_1). Secondary outcomes were child reported respiratory tract symptoms and daily use of preventer and reliever drugs. At the end of winter 2005 (baseline) and winter 2006 (follow-up) parents reported their child's general health, use of health services, overall respiratory health, and housing conditions. Nitrogen dioxide levels were measured monthly for four months and temperatures in the living room and child's bedroom were recorded hourly.

Results Improvements in lung function were not significant (difference in mean FEV_1 130.7 ml, 95% confidence interval −20.3 to 281.7). Compared with children in the control group, however, children in the intervention group had 1.80 fewer days off school (95% confidence interval 0.11 to 3.13), 0.40 fewer visits to a doctor for asthma (0.11 to 0.62), and 0.25 fewer visits to a pharmacist for asthma (0.09 to 0.32). Children in the intervention group also had fewer reports of poor health (adjusted odds ratio 0.48, 95% confidence interval 0.31 to 0.74), less sleep disturbed by wheezing (0.55, 0.35 to 0.85), less dry cough at night (0.52, 0.32 to 0.83), and reduced scores for lower respiratory tract symptoms (0.77, 0.73 to 0.81) than children in the control group. The intervention was associated with a mean temperature rise in the living room of 1.10°C (95% confidence interval 0.54°C to 1.64°C) and in the child's bedroom of 0.57°C (0.05°C to 1.08°C). Lower levels of nitrogen dioxide were measured in the living rooms of the intervention households than in those of the control households (geometric mean 8.5 μg/m^3 *v* 15.7 μg/m^3, P<0.001). A similar effect was found in the children's bedrooms (7.3 μg/m^3 *v* 10.9 μg/m^3, P<0.001).

Conclusion Installing non-polluting, more effective heating in the homes of children with asthma did not significantly improve lung function but did significantly reduce symptoms of asthma, days off school, healthcare utilisation, and visits to a pharmacist.

Trial registration Clinical Trials NCT00489762.

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INTRODUCTION

Cold temperatures, damp, mould, and pollutants have been implicated in aggravating the symptoms of asthma.[1] Children may be especially vulnerable to indoor pollutants because of their immature immune systems and rapid growth and development.[2] Infants and children also inhale a larger dose of air per unit of body mass at a given level of activity than do adults in the same environment.[3]

In New Zealand a third of households have unflued gas heaters[4] and previous studies have found that rooms with such heaters have higher concentrations of nitrogen dioxide than rooms with electric or flued gas heaters.[5] Nitrogen dioxide is a proinflammatory gas and can exacerbate respiratory symptoms such as wheeze or cough. It can also reduce immunity to lung infections and increase the severity and duration of an episode of flu.[6] Retrofitting insulation improves respiratory symptoms.[7] We investigated the impact of a heating intervention on symptoms of asthma in children in homes that had already been insulated before this trial.

METHODS

We carried out a randomised controlled trial in five areas in New Zealand—Porirua and the Hutt Valley in the North Island and Christchurch, Dunedin, and Bluff in the South Island. Households were recruited from December 2004 to May 2005 and baseline measures were collected in winter (June to September) 2005. Overall, 422 of 899 households (47%) met the inclusion criteria: the family had a child aged between 6 and 12 years with doctor diagnosed asthma and symptoms in the past 12 months; the child slept at least four nights a week at home; the house contained a less effective form of heating (unflued gas or plug-in electric heaters); the family intended to live at home over the two winter periods; and the homeowner agreed that the household could participate in the study. If more than one child in a household met the study criteria then the child whose birthday occurred first after 1 June became the index child. After enrolment and before winter 2005 the study houses were insulated to the current New Zealand building standard.[8]

Children kept daily diaries of their respiratory symptoms, giving a score from 0 to 3 for each of six lower respiratory tract symptoms and each of five upper respiratory tract symptoms.[6] They also recorded the number of puffs of asthma preventer and reliever drugs daily and whether a reliever was used at night. At each of four monthly visits the community coordinators downloaded data from Piko meters (nSpire Health, Longmont, CO), which the children had used to record peak expiratory flow rate and forced expiratory volume in one second (FEV_1). Diffusion tubes for recording nitrogen dioxide levels and temperature loggers were placed in the living rooms and child's bedroom.

The homeowners chose a replacement heater: heat pump, wood pellet burner, or flued gas. An independent statistician then randomised the households to intervention or control groups, stratified by area and heater choice. The heaters were installed before winter 2006. The control group were to receive their heater at the end of the study.

We repeated the baseline measures after the intervention at follow-up in winter 2006. In 2006 we changed the format of the questionnaire slightly, and data from the Piko meters were recorded in the symptom diaries. The temperature loggers were reset to record every hour instead of every 20 minutes.

The primary outcome measure was changes to lung function. The study was powered to show a reduction in the amplitude of diurnal changes expressed as a percentage of their mean peak expiratory flow rate over winter (amplitude % mean). Secondary outcomes were reported asthma symptoms, scores for lower respiratory tract symptoms, asthma drug use, healthcare utilisation, and days off school. Intermediate outcomes were temperature and nitrogen dioxide levels in the living room and child's bedroom.

Statistical analysis

Data were double entered. We analysed the binary information using standard generalised linear models and analysis of covariance (adjusting for outcome at baseline) generalised linear models with the logistic link function. From these models we derived unadjusted odds ratios (95% confidence intervals) as measures of effect size and adjusted odds ratios (95% confidence intervals) as measures for precision of estimates. We similarly analysed the numerical counts but with a Poisson link function. For these models we present the change for the intervention group compared with the control group as mean number of events, with 95% confidence intervals.

We present data only for the index child. When baseline measurements were not available we used the overall mean and validated the results using the complete data.

We combined the results for the three questions on cough and the three on wheeze to give a score for each (scale 0 to 9). These six questions on lower respiratory tract symptoms were also combined to give a score on a scale of 0 to 18, and the five questions on upper respiratory tract symptoms were likewise combined to give a score on a scale of 0 to 15. We measured FEV_1 and peak expiratory flow rate from three good forced expiratory manoeuvres, each morning and evening.

For all daily records we used a linear mixed model,[9] which finds the estimate of effect size that maximises the model likelihood as given by a distribution function. We used a Poisson distribution to model the daily symptom scores and their combinations and the number of puffs for preventer and reliever. A normal distribution function was used for peak expiratory flow rate and FEV_1.

We tested model distributions by examining the dispersion variable in the Poisson models and QQ plots for the normal models. Ethnicity was collected using

Table 1 | Effect of intervention on lung function in children

Variable	No of person days	No of children	Unadjusted		Adjusted*	
			Effect size (β) (95% CI)	P value	Effect size (β) (95% CI)	P value
Amplitude % mean peak expiratory flow rate	26 439	359	1.41 (−2.80 to 5.62)	0.51	1.41 (−2.80 to 5.62)	0.62
Daily FEV_1	26 960	360	130.7 (−20.3 to 281.7)	0.09	129.4 (−21.4 to 280.3)	0.09
Morning FEV_1	22 157	346	57.6 (−74.8 to 190.1)	0.40	57.0 (−75.4 to 189.4)	0.4
Evening FEV_1	23 406	353	121.7 (−37.0 to 280.3)	0.13	120.6 (−38.1 to 279.4)	0.14
Daily peak expiratory flow rate	27 007	360	12.29 (−4.57 to 29.15)	0.15	12.12 (−4.76 to 29.00)	0.16
Morning peak expiratory flow rate	22 450	347	9.01 (−7.54 to 25.56)	0.28	8.92 (−7.66 to 25.50)	0.29
Evening peak expiratory flow rate	23 413	353	12.30 (−4.14 to 28.74)	0.14	12.17 (−4.3 to 28.63)	0.15
Percentage predicted†:						
FEV_1	22111	283	2.46 (−11.62 to 16.54)	0.73	2.6 (−11.52 to 16.73)	0.72
Morning FEV_1	18 465	276	−1.07 (−12.62 to 10.49)	0.85	−0.87 (−12.46 to 10.72)	0.88
Evening FEV_1	19 279	280	2.60 (−12.00 to 17.20)	0.73	2.59 (−12.05 to 17.24)	0.73
Peak expiratory flow rate	22139	283	3.54 (−1.41 to 8.48)	0.16	3.56 (−1.39 to 8.52)	0.16
Morning peak expiratory flow rate	18 613	276	2.99 (−1.77 to 7.75)	0.22	3.01 (−1.77 to 7.78)	0.22
Evening peak expiratory flow rate	19 279	280	3.65 (−1.14 to 8.45)	0.14	3.68 (−1.13 to 8.49)	0.13

FEV_1=forced expiratory volume in one second.
ß coefficients are estimated effect size of intervention on peak expiratory flow rate and FEV_1.
*Controlled for baseline measure.
†Percentage of predicted FEV_1 or peak expiratory flow rate based on 283 available heights.

Table 2 | Effect of heating intervention on daily differences of asthma symptoms and drug use as reported in daily diaries

Variable	No of person days	No of children	Unadjusted		Adjusted*	
			Mean ratio† (95% CI)	P value	Mean ratio† (95% CI)	P value
Lower respiratory tract symptoms	23 475	345	0.83 (0.66 to 1.05)	0.12	0.77 (0.73 to 0.81)	0.01
Cough at night	26 532	352	0.80 (0.63 to 1.00)	0.05	0.72 (0.59 to 0.89)	0.002
Wheeze at night	26 407	351	0.78 (0.54 to 1.12)	0.18	0.67 (0.49 to 0.93)	0.02
Cough on waking	26 514	352	0.74 (0.58 to 0.94)	0.02	0.67 (0.53 to 0.84)	<0.001
Wheeze on waking	26 417	351	0.68 (0.49 to 0.94)	0.02	0.60 (0.45 to 0.81)	0.001
Cough during day	27 348	365	0.90 (0.75 to 1.10)	0.31	0.84 (0.70 to 1.01)	0.06
Wheeze during day	27 117	363	0.85 (0.61 to 1.17)	0.32	0.78 (0.59 to 1.04)	0.09
Cough symptoms	23 713	349	0.82 (0.67 to 1.02)	0.08	0.75 (0.62 to 0.92)	0.005
Overall wheeze symptoms	23 532	345	0.76 (0.54 to 1.07)	0.11	0.67 (0.50 to 0.91)	0.01
No of reliever puffs	27 261	364	0.73 (0.46 to 1.14)	0.17	0.68 (0.44 to 1.05)	0.08
Reliever use at night (yes or no)‡	26 725	352	0.52 (0.24 to 1.13)	0.10	0.55 (0.28 to 1.08)	0.08
No of preventer puffs	27 567	363	1.05 (0.61 to 1.8)	0.87	1.08 (0.67 to 1.74)	0.74
Upper respiratory tract symptoms	26 844	360	0.95 (0.76 to 1.19)	0.65	0.92 (0.74 to 1.14)	0.43

*Adjusted for baseline outcome.
†Average score for intervention group divided by average score for control group.
‡Binary model used and results presented as odds ratio.

the standardised self identity question of Statistics New Zealand.

RESULTS

Overall, 409 households were randomised. After exclusions and withdrawals 349 (85%) households remained (see bmj.com). The intervention and control groups had similar characteristics (see bmj.com).

In 2006, after the intervention, a non-significant increase occurred in daily FEV_1 (129.4 ml, 95% confidence interval −21.4 to 280.3; P=0.09) and daily peak expiratory flow rate (12.12 l/min, 95% confidence interval −4.76 to 29.00; P=0.16; table 1). Fewer children in the intervention group than control group had health rated as suboptimal by their parents (adjusted odds ratio 0.48, 95% confidence interval 0.31 to 0.74; P<0.001). Parental reports also showed a reduction in sleep disturbed by wheeze (adjusted odds ratio 0.55, 95% confidence interval 0.35 to 0.85; P<0.001) and cough at night (0.52, 0.32 to 0.83; P=0.01). Attacks of wheezing, speech limited by wheeze, and wheeze during exercise improved but not significantly.

Results from the daily symptom diaries and questionnaires completed at the end of winter 2006 showed a significant reduction in lower respiratory tract symptoms (adjusted mean ratio 0.77, 95% confidence interval 0.73 to 0.81; P=0.013; table 2), cough (0.75, 0.62 to 0.92; P=0.005), and wheeze (0.67, 0.50 to 0.91; P=0.011). A non-significant reduction occurred in the use of a reliever at night (adjusted odds ratio 0.55, 95% confidence interval 0.28 to 1.08; P=0.081).

Parents of children in the intervention group reported fewer days off school for asthma during the winter of 2006: 0.73 (95% confidence interval −0.67 to 1.94, P=0.28; see bmj.com). Statutory school records on absence, however, showed that children in the intervention group had 1.80 fewer days off school (0.11 to 3.13, P=0.04) during the winter term (100 school days). Parents also reported an average of 0.5 fewer episodes of cold and flu (95% confidence interval 0.14 to 0.79, P=0.01), 0.4 fewer visits to the doctor for asthma (0.11 to 0.62, P=0.01), 0.25 fewer visits to a pharmacist for asthma (0.09 to 0.32, P=0.01), and 0.27 fewer other visits to the doctor (0.01 to 0.46, P=0.04).

During winter 2006 the average living room temperature of intervention households was 17.07°C compared with 15.97°C for control households: difference 1.10°C (95% confidence interval 0.54°C to 1.67°C, P<0.001). The average temperature in the child's bedroom for intervention households was 14.84°C compared with 14.26°C for control households: mean difference 0.57°C (95% confidence interval 0.05°C to 1.08°C, P=0.03).

In 2006 the intervention group had significantly (P<0.001) lower geometric mean nitrogen dioxide levels in the living room than the control group (8.5 $\mu g/m^3$ *v* 15.7 $\mu g/m^3$, P<0.001). A similar significant effect was found in the child's bedroom (7.3 $\mu g/m^3$ *v* 10.9 $\mu g/m^3$, P<0.001).[10]

DISCUSSION

Installing non-polluting, more effective home heating in the households of children with asthma in New Zealand did not significantly improve lung function but did lead to a reduction in symptoms of asthma, improved wellbeing, and fewer days off school.

Possible reasons for not finding a statistically significant improvement in lung function (FEV_1 and peak expiratory flow rate) are that improvement in symptoms led to less use of reliever drugs, an error occurred during measurement using the Piko meter, or the magnitude of the effect from the intervention was smaller then anticipated in our power calculations. We chose lung function because it was more objective and because the study could not be double blinded. It may be that lung function is less important to the daily life of children with asthma than are the frequency and severity of symptoms. In addition symptoms may be more sensitive to change and more reliable than

WHAT IS ALREADY KNOWN ON THIS TOPIC

Observational, but few intervention, studies have shown associations between asthma symptoms and dampness and cold in poorly heated homes

WHAT THIS STUDY ADDS

Non-polluting, effective heating did not significantly affect measured lung function of children with asthma but it improved wellbeing and reduced symptoms of asthma and days off school

laboratory based measures carried out by children in a community setting.

Although we were unable to show significant improvements in lung function, we did find significant reductions in asthma symptoms, days off school, cough at night, and sleep disturbed by wheeze. These changes are consistent with significantly reduced exposure to nitrogen dioxide at night.

The results suggest that improving both the type and amount of heating in the homes of children with asthma does not significantly affect measured lung function but does have several beneficial effects.

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Diagnosis-specific sickness absence as a predictor of mortality: the Whitehall II prospective cohort study

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ABSTRACT

Objective To investigate whether knowing the diagnosis for sickness absence improves prediction of mortality.
Design Prospective cohort study established in 1985-8. Sickness absence records including diagnoses were obtained from computerised registers.
Setting 20 civil service departments in London.
Participants 6478 civil servants aged 35-55 years.
Main outcome measures All cause, cardiovascular, and cancer mortality until 2004, average follow-up 13 years.
Results After adjustment for age, sex, and employment grade, employees who had one or more medically certified spells of sickness absence (>7 days) in a three year period had a mortality 1.7 (95% CI 1.3 to 2.1) times greater than those with no medically certified spells. Inclusion of diagnoses improved the prediction of all cause mortality (P=0.03). The hazard ratio for mortality was 4.7 (2.6 to 8.5) for absences with circulatory disease diagnoses, 2.2 (1.4 to 3.3) for surgical operations, and 1.9 (1.2 to 3.1) for psychiatric diagnoses. Psychiatric absences were also predictive of cancer mortality (2.5 (1.3 to 4.7)). Associations of infectious, respiratory, and injury absences with overall mortality were less marked (hazard ratios from 1.5 to 1.7), and there was no association between musculoskeletal absences and mortality.
Conclusions Major diagnoses for medically certified absences were associated with increased mortality, with the exception of musculoskeletal disease. Data on sickness absence diagnoses may provide useful information to identify groups with increased health risk and a need for targeted interventions.

INTRODUCTION

The annual rate of medically certified spells of sickness absence seems to be a good global measure of health and predicts mortality at least as well as more established indicators of health.[1] One way to clarify the reasons for the predictive value of sickness absence

is to include diagnoses for sickness absence in the analysis.

In this study, we investigated whether diagnosis-specific sickness absence predicts subsequent mortality from all causes and from specific causes in the Whitehall II cohort of British civil servants. We also determined whether including information on diagnoses for sickness absence improved the prediction of mortality compared with overall sickness absence rates irrespective of diagnoses.

METHODS

Participants

The target population for the Whitehall II study was all London based office staff aged 35-55 working in 20 civil service departments. Baseline screening was carried out between 1985 and 1988.[2] With a response rate of 73%, the final cohort consisted of 10 308 (6895 men, 3413 women).

Sickness absence

We obtained computerised sickness absence records from 1 January 1985 onwards from civil service pay centres for 9179 employees. For absences longer than seven calendar days, a medical certificate was required.

Diagnosis for absence was recorded in 12 of the 20 participating departments (61% of participants) from 1985 onwards and was recorded for all 20 departments from 1991 onwards. The exposure in this study was medically certified sickness absence during the first three years for which diagnosis was recorded. For the 12 departments with full records of diagnosis for absence, we used data on sickness absence during the three years after the baseline screening date as the exposure; for the other eight departments we used data on sickness absence during the three years from 1 January 1991 as the exposure time.

Sickness absence diagnoses were coded by the civil service using a detailed coding system based on the international classification of diseases (ICD-8). See bmj.com. We converted these codes to the morbidity coding system of the Royal College of General Practitioners (RCGP), to which we added four extra disease categories (gastrointestinal, headache and migraine, neurosis, neurosis ill-defined) that accounted for a high proportion of sickness absence spells. See bmj.com.

Mortality

We obtained mortality data for almost all the participants (n=10 297) up to 30 September 2004 from the National Health Service Central Register mortality register. In addition to deaths from all causes, we analysed deaths from cardiovascular diseases and cancer.

Other measures

Smoking, alcohol consumption, presence of hypertension, body mass index, self rated health over the past 12 months, and presence of longstanding illness, disability, or infirmity were recorded at baseline. We created a composite physical illness indicator (diabetes, diagnosed heart trouble, electrocardiographic abnormalities, hypertension, and respiratory illness). Self reported diagnosis of cancer was recorded at baseline and at phase 4 follow-up of the Whitehall II study (1995-6). There were missing data for the measure of longstanding illness as this was introduced only after the start of the baseline survey: where data were missing, we used reported longstanding illness from the phase 2 follow-up survey (1989-90).

Statistical analysis

For each employee, we computed the numbers of medically certified spells (>7 days) of sickness absence for each diagnostic category during the three year exposure period. Follow-up for mortality was from the first day after the three year exposure period until 30 September 2004. We used Cox's proportional hazard models to estimate hazard ratios for having taken one or more spells of absence for each sickness absence diagnostic category. The reference group was participants who had no sickness absence spells lasting >7 days during the exposure period. All analyses were adjusted for sex, age, and employment grade. If participants had two (or more) spells of sickness absence in different diagnostic categories, they were included in both categories.

Using the likelihood ratio χ^2 test, we tested for an improvement in predictive power for mortality by taking account of absence diagnoses. We compared a multivariate model including indicators for the main diagnostic categories with the simpler model ignoring diagnoses. Further analyses adjusted for other known predictors of mortality (smoking, alcohol consumption, hypertension, and body mass index). See bmj.com.

RESULTS

Excluded participants

Of the 10 308 participants in the Whitehall II study, there were 3830 exclusions (see bmj.com). We compared mortality after 1993 in the remaining sample of 6478 participants with the sample excluded from analysis. After adjustment for age, sex, and employment grade, mortality was lower in the analysed sample than in the excluded sample (hazard ratio 0.81, 95% confidence interval 0.67 to 0.98).

Overall sickness absence and mortality

Of the 6478 participants, 288 died during the follow-up period from the first day after the sickness absence exposure to September 2004. Mean follow-up was 13.2 (SD 2.3, range 0.1-16.1) years. Mortality in the 12 civil service departments where absence diagnoses were recorded from baseline was similar to that in the other eight departments where recording began in 1991 (hazard ratio 0.98, 0.74 to 1.31).

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A total of 1906 employees (29%) had one or more spells of medically certified sickness absence during the three year exposure period, 18% having one spell only and 11% having two or more. Altogether, there were 3214 such spells of absence, with a median length of 16 days.

Among the participants who had had one or more medically certified absence in the three year exposure period, mortality (adjusted for age, sex, and employment grade) was 1.7 times higher than among those with no such absences (see table). Further adjustment for self rated health, longstanding illness, and the composite physical illness indicator had little effect on this (hazard ratio 1.59, 1.16 to 2.17). We also found a dose-response association between rates of medically certified absence with subsequent mortality: compared with having no medically certified absences, the hazard ratio for having two or more medically certified absences was 1.97 (1.43 to 2.71) and for having one such absence was 1.48 (1.11 to 1.98).

Diagnosis-specific sickness absence and mortality

The commonest diagnostic categories were respiratory, surgery, musculoskeletal, psychiatric, infectious diseases, and injury (table). Comparison of our models with and without sickness absence diagnoses indicated that inclusion of diagnoses significantly improved the prediction of mortality (P for improvement in χ^2=0.03). This statistical test of improvement in model fit is equivalent to testing whether hazard ratios for mortality vary by diagnosis. The only diagnosis where the hazard ratio for all cause mortality significantly exceeded the hazard ratio of 1.66 for all absences was circulatory disease (P<0.001).

None of the interactions between diagnostic category and sex was significant. Having multiple absences with two or more different diagnoses during the three year exposure period was associated with slightly higher mortality, but this was not significant (hazard ratio 1.34, 0.75 to 2.39, for ≥2 absences with different diagnoses *v* ≥2 absences with same diagnosis).

Hazard ratios for all cause mortality (adjusted for age, sex, and employment grade) among 6478 civil service employees by specific diagnoses for medically certified spells of sickness absence

Diagnostic category (category code)*	No of participants (deaths)	Hazard ratio (95% CI)
No medically certified sickness absence	4570 (161)	1.00
Any medically certified absence (all diagnoses):	1906 (127)	1.66 (1.30 to 2.13)
Infectious and parasitic diseases (1)	244 (15)	1.51 (0.88 to 2.59)
Circulatory (9-11)	61 (12)	4.68 (2.58 to 8.51)
Diseases of respiratory system (12)	685 (46)	1.63 (1.15 to 2.29)
Diseases of musculoskeletal system and connective tissue (17)	257 (12)	1.04 (0.57 to 1.89)
Injury and poisoning (23)	230 (17)	1.66 (0.99 to 2.78)
Surgical operations (37)	318 (27)	2.16 (1.42 to 3.26)
Psychiatric (40, 41):	235 (19)	1.91 (1.17 to 3.11)
Neurosis (40)	87 (7)	1.91 (0.89 to 4.11)
Neurosis ill-defined (41)	164 (14)	2.03 (1.16 to 3.55)
Other (2-8, 13-16, 20, 35, 38, 39)	377 (27)	1.78 (1.17 to 2.70)
Diagnosis not codeable or missing	289 (22)	2.09 (1.33 to 3.30)

*Modified RCGP morbidity coding system (see text for details).

Sickness absence and cause-specific mortality

The two leading causes of death were cancer (144 deaths) and cardiovascular mortality (72 deaths), accounting for 50% and 25% of all deaths. Other causes (68 deaths) accounted for 24% of all deaths. Among the cancer deaths, 30% were assessed as smoking related.

Medically certified spells of sickness absence were associated with both cardiovascular mortality (hazard ratio 2.0) and cancer mortality (hazard ratio 1.7). Absence attributable to psychiatric disorder showed a stronger association with cancer mortality (hazard ratio 2.5) than with cardiovascular mortality (hazard ratio 1.2), but the difference was not significant. The association with cancer mortality was seen for both psychiatric categories—"neurosis" (hazard ratio 2.2, 0.8 to 6.2) and "neurosis ill-defined" (3.0, 1.5 to 5.9)—and was also observed in the subgroup whose absences were all attributable to psychiatric disorder (hazard ratio 2.4). We repeated the analysis excluding the 166 participants with a self reported diagnosis of cancer either at baseline or follow-up in 1995-6; in the subgroup without cancer, participants who had absences with a psychiatric diagnosis had cancer mortality 2.4 times higher (95% CI 1.2 to 4.6) than did those with no absence.

None of the interactions between sex and diagnosis-specific absence were significant either for cancer mortality or cardiovascular mortality. Adjustment for smoking, alcohol consumption, body mass index and hypertension did not remove the associations of medically certified sickness absence with cause-specific mortality (see bmj.com).

DISCUSSION

This study shows that knowing the diagnosis for medically certified sickness absence from work significantly improves the prediction of mortality. Employees taking one or more medically certified spells of absence (>7 days) for the common diagnostic categories had increased mortality compared with colleagues taking no medically certified absence. The only exception was musculoskeletal absence, which was not associated with increased mortality. Unexpectedly, employees who had one or more absence for psychiatric reasons had a considerable 2.5-fold greater cancer mortality.

Comparison with other studies

Previous studies have shown that medically certified absence rates predict all cause mortality,[1 3] but to our knowledge only one study, of very long term sickness absence (>8 weeks),[4] has linked diagnosis-specific sickness absence with mortality. We found associations with mortality for most diagnosis-specific absences, but particularly strongly for absences with a cardiovascular diagnosis or with a psychiatric diagnosis. We found no

WHAT IS ALREADY KNOWN ON THIS TOPIC

Rates of medically certified sickness absence from work are associated with increased all cause mortality

It is not known whether this association is restricted to specific diagnoses for sickness absence

WHAT THIS STUDY ADDS

All the common diagnostic categories for sickness absence predicted overall mortality, with the exception of musculoskeletal diagnoses

Sickness absence with a psychiatric diagnosis, one of the commonest diagnoses for medically certified absence, was a strong predictor of cancer related mortality

Routinely collected data on sickness absences that include the diagnosis may help to identify groups at increased risk of fatal disease and allow targeted early interventions

association between rates of absence for a musculoskeletal reason and mortality.

Few studies on sickness absence have examined cause-specific mortality. We found that sickness absence predicts both cardiovascular and cancer mortality, the two leading causes of death in Western societies, replicating findings for Finnish municipal employees.[3]

Why is sickness absence with a psychiatric diagnosis related to all cause and cancer mortality? Several studies have found that depression and negative affective dispositions are risk factors for all cause mortality and cardiovascular mortality.[5-8] The large population based Norwegian HUNT study showed that depression predicted subsequent cancer mortality as well as cardiovascular mortality.[9] One possible explanation for the association is that depression may interfere with help seeking behaviour.[9] A further possible explanation is that psychiatric disorders affect cancer prognosis rather than aetiology.[10] Depression may also impair adherence to cancer treatment, although recent reviews on breast cancer found no conclusive evidence that psychological factors influence survival or relapses.[11,12] It is also possible that these psychiatric diagnoses are early symptoms of undiagnosed cancer.

Strengths and limitations

The strengths of our study were the large sample covering a wide range of employment grades from low to high incomes, the long follow-up for mortality, the use of reliable mortality registers, and the high validity of sickness absence data that included information on diagnosis.

Some limitations are noteworthy. Firstly, some data on sickness absence diagnosis were missing in the early years of the Whitehall II study. However, associations of overall sickness absence with mortality from all causes, cancer, and cardiovascular disorders were similar in the total sample and in the sample analysed in this study. Secondly, numbers of deaths were small in some of the diagnostic categories for sickness absence, and our results therefore need replication. Thirdly, the recorded diagnosis for a sickness absence may not cover all of the actual causes. Only one diagnosis is recorded for each sick leave, and thus coexisting diseases are not covered. Also the stage and severity of disease when affected individuals decide to take sick leave may vary between diagnoses.

Conclusions and policy implications

We found that the almost 30% of participants who had a sickness absence spell of more than seven days over a three year period had a 66% increased risk of premature death. Taking of sick leave may be a marker of circumstances and health problems that increase mortality.

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Patterns of skeletal fractures in child abuse: systematic review

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ABSTRACT

Objectives To systematically review published studies to identify the characteristics that distinguish fractures in children resulting from abuse and those not resulting from abuse, and to calculate a probability of abuse for individual fracture types.

Design Systematic review.

Data sources All language literature search of Medline, Medline in Process, Embase, Assia, Caredata, Child Data, CINAHL, ISI Proceedings, Sciences Citation, Social Science Citation Index, SIGLE, Scopus, TRIP, and Social Care Online for original study articles, references, textbooks, and conference abstracts until May 2007.

Study selection Comparative studies of fracture at different bony sites, sustained in physical abuse and from other causes in children ‹18 years old were included. Review articles, expert opinion, postmortem studies, and studies in adults were excluded.

Data extraction and synthesis Each study had two independent reviews (three if disputed) by specialist reviewers including paediatricians, paediatric radiologists, orthopaedic surgeons, and named nurses in child protection. Each study was critically appraised by using data extraction sheets, critical appraisal forms, and evidence sheets based on NHS Centre for Reviews and Dissemination guidance. Meta-analysis was done where possible. A random effects model was fitted to account for the heterogeneity between studies.

Results In total, 32 studies were included. Fractures resulting from abuse were recorded throughout the skeletal system, most commonly in infants (‹1 year) and toddlers (between 1 and 3 years old). Multiple fractures were more common in cases of abuse. Once major trauma was excluded, rib fractures had the highest probability for abuse (0.71, 95% confidence interval 0.42 to 0.91). The probability of abuse given a humeral fracture lay between 0.48 (0.06 to 0.94) and 0.54 (0.20 to 0.88), depending on the definition of abuse used. Analysis of fracture type showed that supracondylar humeral fractures were less likely to be inflicted. For femoral fractures, the probability was between 0.28 (0.15 to 0.44) and 0.43 (0.32 to 0.54), depending on the definition of abuse used, and the developmental stage of the child was an important discriminator. The probability for skull fractures was 0.30 (0.19 to 0.46); the most common fractures in abuse and non-abuse were linear fractures. Insufficient comparative studies were available to allow calculation of a probability of abuse for other fracture types.

Conclusion When infants and toddlers present with a fracture in the absence of a confirmed cause, physical abuse should be considered as a potential cause. No fracture, on its own, can distinguish an abusive from a non-abusive cause. During the assessment of individual fractures, the site, fracture type, and developmental stage of the child can help to determine the likelihood of abuse. The number of high quality comparative research studies in this field is limited, and further prospective epidemiology is indicated.

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INTRODUCTION

Skeletal fractures are diagnosed in up to a third of children who have been investigated for physical abuse.[1-3] The fractures are often occult,[1 4] and they occur in infants and toddlers who cannot give a causal explanation. Children who have been physically abused represent a small proportion of the total number of childhood fractures. Most children who sustain fractures do so from falls, motor vehicle crashes, or other non-abusive trauma. Health professionals should be able to recognise the characteristics of fractures resulting from abuse. In reality, the possibility of child abuse is often overlooked in clinical practice.[5 6] We systematically reviewed the published world literature to answer the question "What features differentiate fractures resulting from abuse from those sustained from other causes?"

METHODS

We did a literature search of international publications for original studies (see bmj.com). We included comparative studies of children under 18 years old that described the distribution of fractures identified on radiographs, in which the fractures resulting from physical abuse were compared with those from other causes.

Each study had two independent reviewers (three if disputed) who critically appraised each study. We classified the included studies according to the child protection outcome decision and whether abuse had been excluded in the non-abused group. In the absence of a "gold standard" diagnostic test for child abuse, we used ranking schemes that were designed to ensure the best security of diagnosis.[7]

We estimated the probability of abuse according to individual bony sites. We did a meta-analysis of cross sectional studies of consecutive cases of children with fractures seen in a given hospital or regional centre over a given time period.

Comparing these studies was not straightforward because many factors differed between them. The definition of abuse that was used to classify cases varied between studies. Some used a category of confirmed

abuse, either excluding cases of suspected abuse or combining them with the non-abuse cases, whereas others combined confirmed and suspected abuse cases. Age distribution varied greatly between studies, as did the site and type of fracture.

For each bone for which the data justified meta-analysis, a forest plot shows the calculated probability of abuse for all studies, plotted by year of publication. The estimates of the probability of abuse showed considerable heterogeneity between studies, so we fitted a random effects model (see bmj.com). In addition, we have provided a descriptive analysis about specific features that relate to each fracture site.

RESULTS

We included 32 comparative studies overall.[w1-w32] We included 26 cross sectional studies in the meta-analyses; six additional studies provided useful comparative data but were not eligible for meta-analysis. Seventy eight per cent of studies were done in the United States. All were retrospective studies and based in the hospital setting. Studies variously included children attending or admitted to hospital. Data sources included reviews of a combination of medical records, social records, and radiographs. A small proportion implemented independent review of records or radiographs by several investigators who were blinded to case allocation (see web extra tables 2-6).

Fracture patterns in physical abuse and non-abuse

Seven studies compared the distribution of fractures in cases of abuse and non-abuse. Fractures resulting from abuse predominantly occurred in infant and toddler age groups. One study of children under 12 years old showed that 80% of all fractures from abuse were seen in children under 18 months.[w1] In contrast, 85% of fractures not caused by abuse occurred in children over 5 years. Six further studies estimated that between 25% and 56% of fractures in children under 1 year of age arose from child abuse.[w2-w7] Studies showed that in children under 3 years old, skull fractures were by far the most common fracture type in both abused and non-abused children.[w3 w4] Two studies found a highly significant association between multiple fractures and abuse[w1 w4]; another study did not confirm this, but half of the children in the non-abused group had factors predisposing to bone fragility.[w5]

Fractures of lower limbs

Thirteen studies of femoral fractures met the criteria for meta-analysis.[w3 w6 w8-w18] These included 1100 children under the age of 15, of whom 222 were classified as confirmed abuse, and 120 as suspected abuse. Four studies looked specifically at fractures of the femoral shaft.[w10 w14-w16]

For the studies that included the combined categories of suspected and confirmed abuse, the overall estimated probability of abuse given a femoral fracture was 0.43 (95% confidence interval 0.32 to 0.54), excluding children who were involved in a motor vehicle crash or violent trauma. When we excluded cases of suspected abuse, the probability that a femoral fracture was due to confirmed abuse was 0.28 (0.15 to 0.44).

Five studies provided sufficient data to enable a comparison between the mean ages of children who had a femoral fracture from abuse and those who had femoral fractures from other causes.[w8-w10 w15 w16] However, in some cases we had to estimate standard deviations. In these five studies, the mean age in the abused cases was significantly less than in the non-abused ones. One study looked at motor milestones and found that fractures from abuse were significantly more common in children who were not walking (web table 3).[w16]

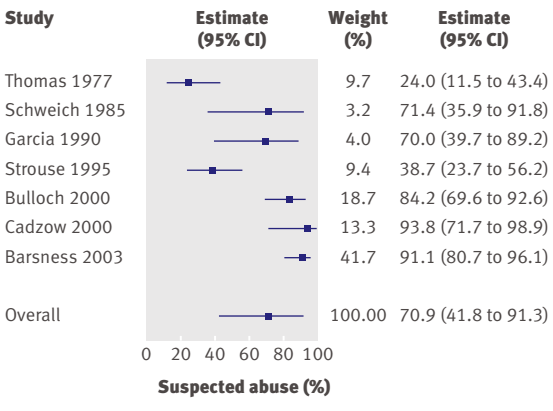
The most common location of femoral fracture in both abused and non-abused children was the mid-shaft of the femur.[w9 w10] Overall, we found no difference in the distribution of transverse, spiral, or oblique fractures between the groups.[w6 w8 w10 w12 w15 w17] Only one study analysed spiral fractures by age; it found that a spiral fracture was the most common abusive femoral fracture in children under 15 months.[w12] Metaphyseal fractures were reported in a greater proportion of abused than non-abused children (web table 3),[w8 w9] but insufficient data were available for further meaningful analysis.

Only two studies described tibial or fibular fractures.[w3 w11] One, in children under 3 years old, reported one fracture from abuse out of a total of eight fractures. In the other, for children under 18 months, 96% (23/24) of all tibial or fibular fractures resulted from abuse.

Fractures of upper limbs

Six cross sectional studies looked at abusive humeral fractures: two studies examined specific fracture types,[w19 w20] and four studies were suitable for meta-analysis.[w3 w6 w17 w21] These studies included a total of 154 children who sustained a fracture of the humerus, of whom 30 were classified as abused and 23 as suspected abuse. All children were under 3 years old.

The overall estimate of the probability of abuse, given a humeral fracture, in a child under 3 was 0.54 (0.20 to 0.88). When we excluded cases of suspected abuse, the probability that a humeral fracture was due to abuse was 0.48 (0.06 to 0.94).



Probability of abuse given rib fracture after exclusion of children involved in motor vehicle crash or violent trauma, using threshold of confirmed abuse

Features associated with possible child abuse

Physical abuse should be considered in the differential diagnosis when an infant (under 18 months) presents with a fracture in the absence of an overt history of important trauma or a known medical condition that predisposes to bone fragility. The following indicators can be used to inform decisions about the likelihood of child abuse:

- Multiple fractures are more common after physical abuse than after non-abusive traumatic injury
- A child with rib fractures has a 7 in 10 chance of having been abused
- A child with a femoral fracture has a 1 in 3-4 chance of having been abused
- Femoral fractures resulting from abuse are more commonly seen in children who are not yet walking
- A child aged under 3 with a humeral fracture has a 1 in 2 chance of having been abused
- Mid-shaft fractures of the humerus are more common in abuse than in non-abuse, whereas supracondylar fractures are more likely to have non-abusive causes
- An infant or toddler with a skull fracture has a 1 in 3 chance of having been abused
- Parietal and linear skull fractures are the most common type of skull fracture seen in abuse and non-abuse
- No clear difference exists in the distribution of complex skull fractures between the two groups

One study, which gave the lowest probability for abuse,[w21] adopted very high diagnostic criteria (web table 4). The authors analysed the data by age and found that the prevalence of abuse was significantly greater in children under 15 months with a humeral fracture than in those between 15 months and 3 years of age. This was confirmed in another analysis of fractures of the humeral shaft.[w20]

Supracondylar fractures were more likely to be associated with non-abusive injury.[w17 w21] This was confirmed in a large cross sectional study.[w19] However, another study reported supracondylar fractures from abuse in three of 10 abused children under 3.[w21] The most common type of humeral fracture from abuse in children under 15 months of age was a spiral/oblique fracture (web table 4).[w20 w21]

One study reported the proportion of radial and ulnar fractures caused by abuse as 25% (3/12).[w3] Another study described the type of fractures in 10 children with radial/ulnar fractures from abuse, of which two were greenstick, one was transverse, one was periosteal, and three were metaphyseal chip fractures; in comparison, 37/40 fractures from other causes were greenstick fractures.[w1]

Rib fractures

Seven cross sectional studies including rib fractures were suitable for meta-analysis.[w22-w28] They included details of a total of 233 children, of whom 128 were abused. The pooled estimate of the probability of abuse given a rib fracture was 0.71 (0.42 to 0.91) (figure). Five studies included conditions that predispose to bone fragility as a possible cause and showed that osteopenia of prematurity or bone dysplasia were common causes of rib fractures in the infant/toddler population.[w22-w24 w27 w28]

The radiological investigations varied between studies and may explain the variation in prevalence figures. All but one study stated that children who had rib fractures from abuse had more rib fractures than those who had not been abused (web table 5).[w23] Rib fractures from abuse were reported at any location on the rib[w23-w25 w28]; they could be unilateral or bilateral. Two studies confirmed that anterior fractures were significantly more common in abuse and that lateral fractures were more common in non-abused children.[w22 w24] Findings on posterior fractures were variable.[w22-w24]

Skull fractures

Seven studies of children with skull fractures met our criteria for meta-analysis.[w3 w5 w6 w29-w32] These involved a total of 520 children under the age of 6.5 years; 124 were classified as abused. All but one study covered an infant/toddler age group.[w32]

Skull fractures are more commonly reported after non-abusive trauma than after abusive head injury; the point estimate of the probability of abuse given a skull fracture was 0.30 (0.19 to 0.46). We could not give an estimate for confirmed cases of abuse or exclude motor vehicle crashes.

The most common fracture site in both the abuse and non-abuse groups was parietal,[w30] and the most common fracture type was linear.[w31] This finding was supported in two further comparative studies.[w1 w4] The significance of complex fractures varied between studies (web table 6).

DISCUSSION

This systematic review has combined cross sectional studies in a meta-analysis to estimate the probability of abuse given rib fractures, skull fractures, or long bone fractures. We have also identified features related to the child or type of fracture sustained that should alert clinicians to consider physical abuse as a possible cause (box).

Fractures resulting from abuse have been described in virtually every bone in the body. We identified a strong inverse relation between the age of the child and the likelihood of fracture from abuse. Osteopenia of prematurity and bone dysplasia were also reported in the infant and toddler age group, and the prevalence of non-abusive traumatic causes increased with age, which is unsurprising.

Limitations of review

During this study, we faced many of the difficulties identified by researchers who do diagnostic systematic reviews, for which the methods have yet to be fully developed.[8] A high degree of heterogeneity existed between studies, which is reflected in the forest plots.

The ranking of abuse varied considerably across studies. International definitions and thresholds for abuse also vary greatly. The vast majority of studies were from the United States, where definitions of abuse differ from state to state; these research findings are not always directly applicable to the United Kingdom.

All of the studies were retrospective and may have been compromised by incomplete datasets. They had the benefit, however, of information derived from case work-up and outcomes. The absence of detail on the radiological techniques used in many of the larger studies weakens the data. The optimal investigation

WHAT IS ALREADY KNOWN ON THIS TOPIC

Children who have been physically abused often sustain bony fractures

Different fracture types have variously been described as having a high probability for abuse

WHAT THIS STUDY ADDS

No one fracture in isolation is specific for physical abuse

Rib fractures, regardless of type, are highly specific for abuse in the absence of an overt traumatic or organic cause

Fractures from child abuse are significantly more common in children under 18 months of age than in older children, which should inform the differential diagnostic approach in this age group

strategy to identify all fractures in children with suspected abuse includes a skeletal survey including oblique views of the chest, which has a much higher sensitivity for identifying rib fractures than a standard chest radiograph.[9 10] Most non-abused children are unlikely to have skeletal surveys. As a result, an intrinsic and unavoidable bias exists within these studies. No comparative data were available to determine the probability of abuse for many fracture sites. Published research in this field has its limitations, and high quality prospective studies would be valuable to examine the deficiencies that we have identified.

Conclusions

The main benefits of this work are threefold. Firstly, we have identified that a high proportion of fractures in infants arise from physical child abuse. We recommend that in the absence of an overt cause child abuse should be investigated as part of the differential diagnosis in this age group. However, no fracture on its own can be used to diagnose child abuse. We have shown that the age and motor developmental level of the child together with the type and site of the fracture are important features to assess. Secondly, we have provided a comprehensive literature review,[11] which will help clinicians who are acting as expert medical witnesses in court and child protection proceedings. Finally, and most importantly, we have identified many deficiencies in the scientific research, and have identified methodological limitations that will inform future research.

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TinyURL

One of the problems with our reliance on the internet, and the development of website programming languages, is the rise of the unintelligible universal resource locator (URL). The URL is the text you write into your internet browser to get the web page you want.

Remembering a URL is not too difficult when it is a simple address such as www.bma.org.uk, but more and more scientific papers now refer to URLs within their text that link to papers buried deep in other websites, and many of these URLs end with long strings of numbers, letters, and even question marks and are very difficult for a reader to then type into an internet browser.

Fortunately there is a solution—a solution I implore researchers to use when writing their scientific papers, a solution that will save endless cursing of the computer as yet another "URL not found" message appears because of mistyping a huge URL. The answer is TinyURL.

www.tinyurl.com is a website that can turn any URL into www.tinyurl/ followed by a short sequence of letters and numbers. For example, http://www.bma.org.uk/pressrel.nsf/wlu/SGOY-79FKE6?OpenDocument&vw=wfmms becomes http://tinyurl.com/28fuhd.

Not only is the tinyurl much easier to copy into an address bar, it also never expires so remains unique to the link. So, researchers, next time you are writing a paper please remember the poor reader who may want to look up those web references. Think Tiny.

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Editor's note: TinyURLS are fine as long as the providers of this service remain in business, but there's no long term guarantee of that. A short outage last year provided a preview of what would happen if the plug was pulled—access to documents identified by TinyURLs disappeared (www.readwriteweb.com/archives/tinyurl_outage_shows_fragility.php). So, think Tiny if you want, but be prepared to think Gone. Forever.
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