

# Harms and the Xmas factor

The festivities are associated with preventable harms from cards, decorations, and presents, as well as overeating and overdrinking. Given the balance of benefits and harms, Christmas may not be cost effective

**D**ays of festive feasting and merriment beckon. But what of the harms? A rummage through the archives confirms the existence of several health risks.

In our foraging, we ignored Christmas disease (haemophilia B), and reports by authors named Christmas, Chrismas, or Noel. We also ignored festively inspired acronyms such as NO Effect Level and Natural Orifice EndoLuminal technique. Nevertheless, our findings raise concerns.

Christmas cards are a source of potential harm. In 1876 a young man painted large festive cards “with colours chiefly of a bright green” and developed acute arsenic poisoning. The paint was Scheele’s Green, copper hydrogen arsenite. Posting cards is also dangerous, as the spring-loaded flap of a letter box can amputate the finger tip.

A recipe for Christmas pudding, reported enviously in a *BMJ* editorial in 1946.<sup>21</sup> The article was reprinted in 1973

A Christmas break may be just that, after falls either in the home or outside while decking the house with Christmas lights. Light-emitting diode bulbs, sharp pointed confetti stars, Christmas tree shaped decorations, and metal clips to hold them, have all found their way into toddlers’ bronchi or pharynges.

Those who pine for Christmas trees may find that contact dermatitis can ensue. Needles from trees can penetrate the bronchial tree, causing breathing difficulties. And branches can poke you in the eye, causing corneal abrasion, although that is not a cause of “Christmas tree” cataract. It is customary to light

**It is customary to light candles on Swiss trees: burns are therefore common, at least in Bern**

candles on Christmas trees in Switzerland: burns are therefore common, at least in Bern.

Christmas presents pose unforeseen dangers. A pet hamster (below, not the actual rodent) acquired as a gift spread lymphocytic choriomeningitis virus in New York state. The danger of “The propagation of syphilis by toys” such as trumpets—which the *BMJ* noted in 1879—seems to have receded.

Festive feasting is universal. In 1946, with postwar rationing still in place, the *BMJ* described a Christmas pudding providing more than 58 000 kilocalories—20 times the recommended daily intake (left)—and commented “The mind is enriched and tranquil after such a meal...,” a rather positive view of the torpor that signals postprandial diversion of blood supply from brain to digestive tract. Christmas dinner may even be good for the heart, at least in the short term: a “standard festive meal of poultry, mince pies, and a glass of wine” increased cardiac output in six healthy volunteers.

Not all effects of feasting are benign, however. “Christmas wrapped chocolate balls” once led to an outbreak of *Salmonella eastbourne* enteritis. Of 192

people who ate at a Christmas reception at the National Institute of Public Health—National Institute of Hygiene in Warsaw, 97 developed norovirus gastroenteritis from the salad.

Drinking too much alcohol can provoke atrial fibrillation—the “holiday heart syndrome.” Of the cases originally described, 22% occurred between Christmas Eve and New Year’s Day.

## Discussion

Is it worth it? In 2002 Isaacs and Fitzgerald analysed the cost effectiveness of Christmas “using clinical and economic variable estimates, derived by inspired guesswork,” and concluded that “Christmas is not cost effective.” They were criticised for failing to undertake a cost-benefit analysis, having ignored the value of eternal life. However, the only harm they assessed was food poisoning, so their conclusion might have been strengthened by including the harms identified here. But cost-effectiveness is not everything. Most of our sources are anecdotal, and we did not find strong evidence of widespread adverse effects. So we will leave you to decide whether the benefits of Christmas outweigh its harms.

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Constituent	Quantity	Approximate Calorie Equivalent
Suet .. ..	6 lb (2.8 kg)	20,000
Flour .. ..	4 lb (1.8 kg)	6,648
Demerara sugar ..	2 lb (0.9 kg)	3,646
Raisins .. ..	6 lb (2.8 kg)	7,314
Currants .. ..	6 lb (2.8 kg)	7,236
Sultanas .. ..	2 lb (0.9 kg)	2,470
Candied peel .. ..	1½ lb (0.7 kg)	1,878
Chopped almonds ..	¼ lb (0.1 kg)	680
Eggs .. ..	48	3,984
Grated peel of 3 lemons		
Brandy .. ..	1 bottle	3,500
Port .. ..	1 bottle	1,400
Total		58,756



## ORIGINAL RESEARCH Register based cohort study

# The shared risk of diabetes between dog and cat owners and their pets

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**Objective** To investigate whether dog and cat owners and their pets share a risk of developing diabetes.

**Design** Cohort study.

**Setting** Register based longitudinal study, Sweden.

**Participants** 208 980 owner-dog pairs and 123 566 owner-cat pairs identified during a baseline assessment period (1 January 2004 to 31 December 2006).

**Main outcome measures** Type 2 diabetes events in dog and cat owners and diabetes events in their pets, including date of diagnosis during the follow-up period (1 January 2007 to 31 December 2012). Owners with type 2 diabetes were identified by combining information from the National Patient Register, the Cause of Death Register, and the Swedish Prescribed Drug Register. Information on diabetes in the pets was extracted from veterinary care insurance data. Multi-state models were used to assess the hazard ratios with 95% confidence intervals and to adjust for possible shared risk factors, including personal and socioeconomic circumstances.

**Results** The incidence of type 2 diabetes during follow-up was 7.7 cases per 1000 person years at risk in dog owners and 7.9 cases per 1000 person years at risk in cat owners. The incidence of diabetes in the pets was 1.3 cases per 1000 dog years at risk and 2.2 cases per 1000 cat years at risk. The crude hazard ratio for type 2 diabetes in owners of a dog with diabetes compared with owners of a dog without diabetes was 1.38 (95% confidence interval 1.10 to 1.74), with a multivariable adjusted hazard ratio of 1.32 (1.04 to 1.68). Having an owner with type 2 diabetes was associated with an increased hazard of diabetes in the dog (crude hazard ratio 1.28, 1.01 to 1.63), which was attenuated after adjusting for owner's age, with the confidence interval crossing the null (1.11, 0.87 to 1.42). No association was found between type 2 diabetes in cat owners and diabetes in their cats (crude hazard ratio 0.99, 0.74 to 1.34, and 1.00, 0.78 to 1.28, respectively).

**Conclusions** Data indicated that owners of a dog with diabetes were more likely to develop type 2 diabetes during follow-up than owners of a dog without diabetes. It is possible that dogs with diabetes could serve as a sentinel for shared diabetogenic health behaviours and environmental exposures.



## Introduction

Cross sectional studies have indicated an association between adiposity in dog owners and their pets,<sup>17 18</sup> suggesting that the two might share disadvantageous health behaviours. In this register based study, we investigated whether dog and cat owners and their pets share the risk of diabetes.

### WHAT IS ALREADY KNOWN ON THIS TOPIC

- Dog owners and their pets might share certain health behaviours, such as physical activity level
- Cross sectional studies have indicated an association between adiposity in dog owners and their pets
- No previous study has investigated shared diabetes risk in dog and cat owners and their pets

### WHAT THIS STUDY ADDS

- Dog owners who have a pet with diabetes were more likely to develop type 2 diabetes during follow-up than owners of a dog without diabetes
- Personal and socioeconomic circumstances of the dog owners could not help to explain the shared diabetes risk of the owner-dog pairs; underlying mechanisms might include shared diabetogenic health behaviours and environmental exposures
- No shared risk of diabetes was found between cat owners and their pets

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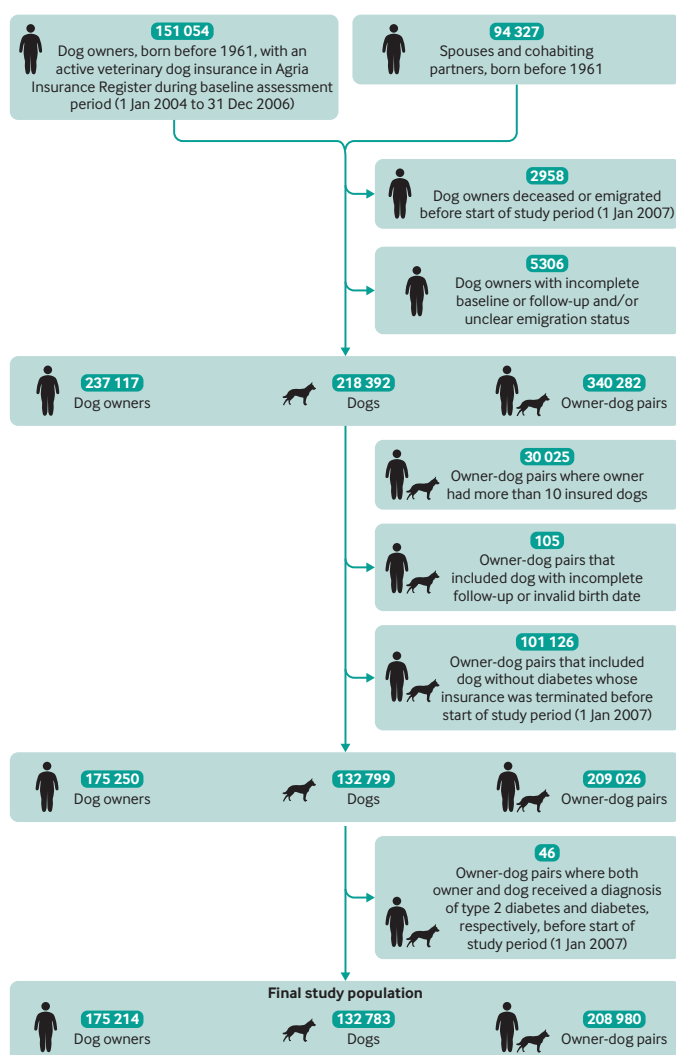


Fig 1 | Flowchart of owner-dog study population

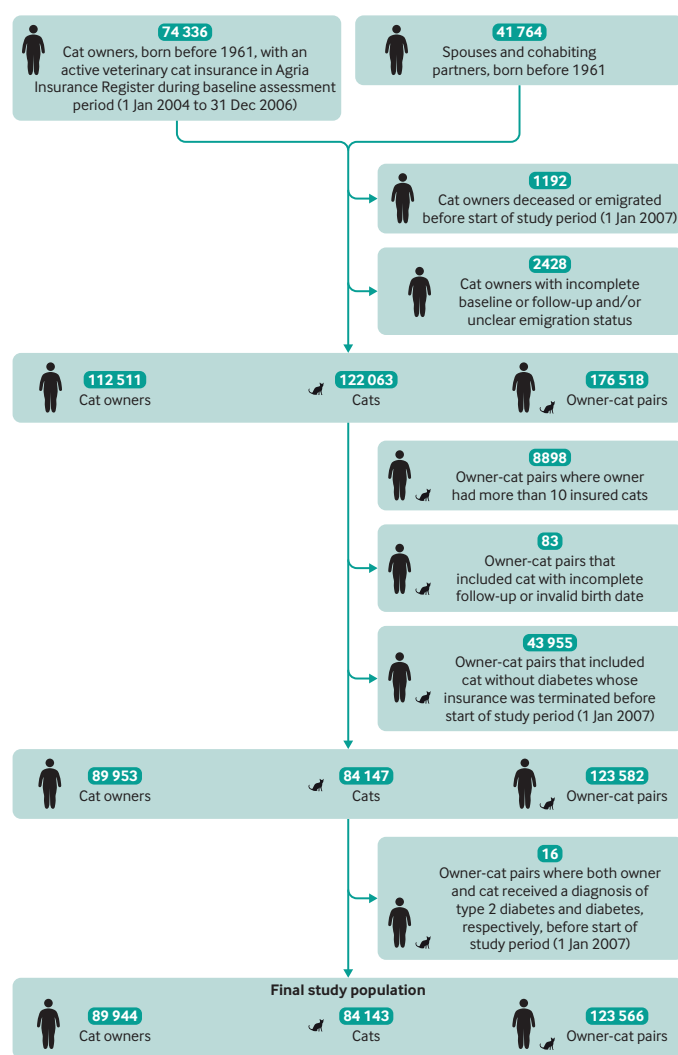


Fig 2 | Flowchart of owner-cat study population

## Methods

The study population was generated by register linkage between information from Agria Pet Insurance and official Swedish registers.<sup>28</sup>

We identified 151 054 dog owners and 74 336 cat owners born before 1961 with an active veterinary care policy at any time from 1 January 2004 to 31 December 2006 (the baseline assessment period), as well as 94 327 and 41 764 spouses or cohabiting partners of the dog owners and cat owners, respectively, who were also considered pet owners. The final study population comprised 208 980 owner-dog pairs and 123 566 owner-cat pairs (figs 1 and 2).

Owner type 2 diabetes was defined as a main or secondary diagnosis of type 2 diabetes in the National Patient Register or Cause of Death Register, or both, or at least one dispensed prescription of an oral diabetes drug or a non-insulin injectable diabetes drug in the Swedish Prescribed Drug Register. Information on diabetes status of the pets was extracted from the Agria Pet Insurance data.

Owner baseline personal and socioeconomic circumstances were based on extracts from the Total Population Register, and the Longitudinal Integration Database for Health Insurance and Labour Market Studies.<sup>30</sup> Information on breed, dates of birth, start and end of insurance, and death of the pets was available from the insurance data.

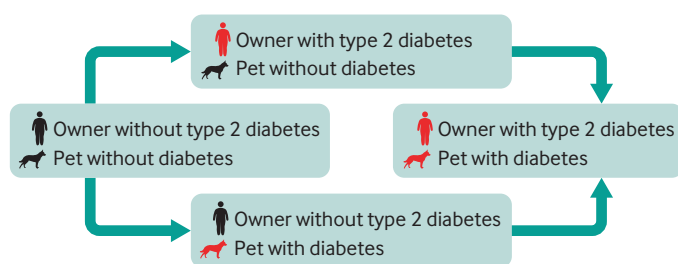
## Statistical analysis

We utilised a Weibull-Markov multistate model<sup>31</sup> in which the combined diabetes status of the owner-pet pairs during baseline determined their diagnoses in relation to diabetes at the end of the baseline assessment period (1 January 2004 to 31 December 2006). Any transitions between diagnoses were monitored during follow-up (1 January 2007 to 31 December 2012; fig 3). A total of four transitions were possible.

For each owner-pet pair, we defined the combined baseline status as no diabetes in owner or pet, owner with type 2 diabetes, diabetes in pet only, and diabetes in owner and pet. Owner-pet pairs that shared a diagnosis of diabetes during baseline were not assessed during follow-up and were excluded from analyses as they could make no further transition. During the longitudinal follow-up period, we defined a transition as when the owner or the pet received a diagnosis of type 2 diabetes or diabetes, respectively.

To investigate whether the hazard ratios differed according to diabetes status of the other part of the owner-pet pair, we investigated whether the hazard ratios were significant at an  $\alpha$  level of 0.05. We present a crude unadjusted model and a fully adjusted model (adjusted for age and sex of owner, age and sex of pet, breed group, and personal and socioeconomic characteristics of owner).





## Results

The owner-dog study population included 208 980 pairs, comprising 175 214 owners and 132 783 pets (fig 1). Most of the pairs ( $n=197\,795$ , 94.6%) did not have diabetes at the start of follow-up.

The owner-cat study population included 123 566 owner-cat pairs, consisting of 89 944 cat owners and 84 143 cats (fig 2). Most of the pairs ( $n=117\,391$ , 95.0%) had no diabetes at the start of the follow-up.

### Diabetes in dog owners and dogs

During follow-up, the incidence rate of type 2 diabetes in dog owners was 7.7 cases per 1000 person years at risk and 1.3 cases per 1000 dog years at risk.

Compared with owning a dog without diabetes, owning a dog with diabetes was associated with an increased hazard of type 2 diabetes (crude model: hazard ratio 1.38, 95% confidence interval 1.10 to 1.74, fig 4). The estimate did not change noticeably in the fully adjusted model (1.32, 1.04 to 1.68). In the crude model, the hazard of developing diabetes was found to be higher in dogs with an owner who had type 2 diabetes compared with dogs with an owner who did not have type 2 diabetes (hazard ratio 1.28, 95% confidence interval 1.01 to 1.63). This estimate, however, was attenuated in the fully adjusted model (1.11, 0.87 to 1.42).

### Diabetes in cat owners and cats

During follow-up, the incidence rate of type 2 diabetes in cat owners was 7.9 cases per 1000 person years at risk and in cats was 2.2 cases per 1000 cat years at risk.

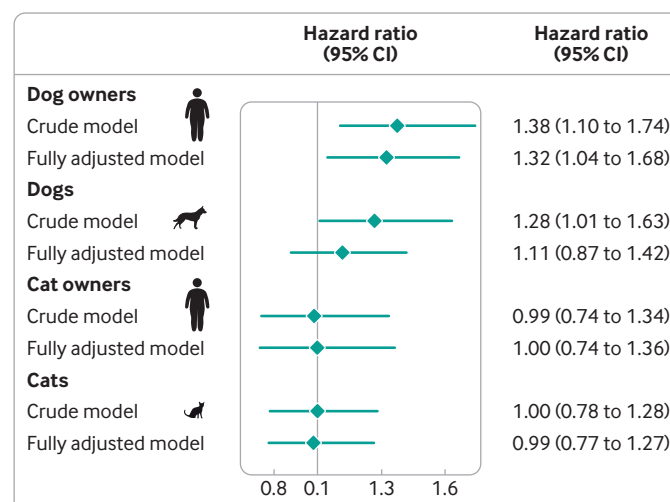
Owning a cat with diabetes was not associated with an increased hazard of type 2 diabetes in the cat owner (crude model: 0.99, 0.74 to 1.34, fully adjusted model: 1.00, 0.74 to 1.36, fig 4). Similarly, no increase in diabetes was observed in cats with an owner with type 2 diabetes (crude model: 1.00, 0.78 to 1.28, fully adjusted model: 0.99, 0.77 to 1.27).

## Discussion

In this large cohort study, we found ownership of a dog with diabetes was linked to an increased hazard of type 2 diabetes in the owner.

Strengths of this study include the population based prospective study design, unique data linkage, and essentially complete follow-up. Some potential limitations apply. Firstly, information on health behaviours were not available. Secondly, owners with type 2 diabetes, or owners of a dog with diabetes, might have an increased awareness of overt diabetes symptoms and thus contribute to a surveillance bias effect within the owner-dog pair. Thirdly, we were not able to identify individuals with type 2 diabetes who do not receive drug treatment.<sup>37</sup> Furthermore, crossbreed or mixed breed dogs and dogs older than 10 years might be under-represented in the insurance database,<sup>8</sup> and our findings might not

**Fig 3** | Weibull-Markov multistate model. Owner-pet pairs were classified according to combined diabetes status during the baseline assessment period (1 January 2004 to 31 December 2006). During follow-up (1 January 2007 to 31 December 2012) all owner-pet pairs were monitored for a new diabetes diagnosis in either owner or pet, which constituted a transition between states. Hazard ratios for type 2 diabetes in owners and diabetes in pets were calculated comparing the transition rate from pet with diabetes to diabetes in owner and pet with that of transition from no diabetes in owner or pet to owner with type 2 diabetes, and comparing the transition rate from owner with type 2 diabetes to diabetes in both owner and pet with that of transition from no diabetes in owner or pet to diabetes in pet.



**Fig 4** | Hazard ratios and 95% confidence intervals for type 2 diabetes in dog and cat owners and diabetes in their pets during follow-up from 1 January 2007 to 31 December 2012 ( $n=211\,914$  owner-dog pairs and  $n=123\,566$  owner-cat pairs). Fully adjusted models adjusted for age and sex of owner, age and sex of pet, breed group, and personal and socioeconomic characteristics of the owner, including country of birth, population density, region of residence, highest attained education level, marital status, and disposable income.

apply to these owner-dog pairs. Lastly, the overall generalisability of our findings might not extend to other countries with dissimilar regulations and practices for pet ownership.<sup>38</sup>

Several underlying mechanisms might explain the observed association between type 2 diabetes in owner-dog pairs. Owners and their dogs could share behaviours that affect the risk of diabetes, in terms of adiposity and dietary habits.<sup>17 18 15 16 40</sup> It is also possible that owners and dogs share frequency and intensity of exercise and that this could constitute an underlying mechanism in our findings.

Moreover, shared exposures to diabetogenic factors in the environment in terms of noise, pollution, or chemicals, might influence the risk of diabetes in both owners and their dogs.

In contrast, we could not detect any association between incidence of type 2 diabetes in cat owners and the development of diabetes in their pets, even though the cat diabetes phenotype more closely resembles that of humans with type 2 diabetes than that of canine diabetes. However, owner-cat pairs might share fewer health behaviours with regard to dietary habits and physical activity than owner-dog pairs. It is also possible that an association between type 2 diabetes in cat owners and diabetes in cats might have gone undetected in our study because of the smaller sample size.

### Conclusion

Owning a dog with a diagnosis of diabetes was associated with an increased hazard of type 2 diabetes. No shared risk of diabetes was found between cat owners and their pets.



## ORIGINAL RESEARCH Uncontrolled, blinded, comparative behavioural analysis

# Nonsensus in the treatment of proximal humerus fractures

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**Objective** To investigate the inter-rater reliability of Barbary macaques compared with an expert group of surgeons for the choice of treatment and predicted outcome of proximal humerus fractures.

**Design** Uncontrolled, blinded, comparative behavioural analysis.

**Setting** Germany and United States.

**Participants** 10 blinded experts in the specialty of orthopaedic trauma surgery (*Homo chirurgicus accidentus*), with special focus on upper extremity surgery from Germany and the US, and five Barbary macaques (*Macaca sylvanus*) from a semi-free range enclosure.

**Main outcome measures** The reliability of agreement between raters assessed with Fleiss'  $\kappa$ .

**Results** Barbary macaques seem to have inferior inter-rater reliability in comparison with experts for choice of treatment (non-surgical v surgical), but for the geriatric age group most frequently affected by proximal humeral fractures, they performed similarly to the experts in their choices of treatment and choice of surgical procedure. Agreement about predicted outcome was poor among the macaques and slight among the experts. All experts almost always predicted the outcome incorrectly and tended to underestimate it. Only 4 (4.4%) of 90 experts' predictions were correct, compared with 13 (28.9%) of 45 macaques' predictions.

**Conclusions** Consensus on treatment and expected outcomes of proximal humeral fractures is lacking even beyond the human species. Although Barbary macaques tend to predict the clinical outcome more accurately, their reliability to assist surgeons in making a consistent decision is limited. Future high quality research is needed to guide surgeons' decision making on the optimal treatment of this common injury.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- To date, no consensus has been reached on the optimal treatment of proximal humerus fractures
- Increasing evidence suggests that non-operative management might have functional outcomes similar to those of operative management but with lower risks of complications and reoperation
- Evidence based guidelines are lacking to inform decision making between different interventions, and expert consensus is considered to be poor

## WHAT THIS STUDY ADDS

- Consensus on the treatment and expected outcomes of proximal humeral fractures is lacking even beyond the human species
- Future high quality research is needed to guide surgeon decision making on the optimal treatment of this common injury

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Conservation status of proximal humeral fractures and Barbary macaques according to the International Union for Conservation of Nature.<sup>11</sup> The figure shows a minimally displaced proximal humerus fracture according to the most commonly used Neer classification.<sup>12</sup> A 70 year old woman was treated with an intramedullary nail at a German trauma centre in 2019, probably owing to its biomechanical superiority over extramedullary implants.<sup>13</sup> After only three months, conversion to reverse shoulder arthroplasty was performed, probably owing to its biomechanical superiority over intramedullary nails

## Introduction

Proximal humeral fractures are a common injury.<sup>1</sup> Around 70% of these fractures occur in patients older than 60.<sup>4</sup>

The latest Cochrane review suggests that non-operative management might have similar functional outcomes to operative management with lower risks of complications, but there is insufficient evidence to inform decision making between different interventions for these fractures.<sup>8-10</sup>

But there is still hope. Deep in the Thuringian basin, Barbary macaques (*Macaca sylvanus*) live and still roam the vast beech forests of Germany. Besides humans, the Barbary macaques are the only free-living primates in Europe, and besides geriatric patients with proximal humerus fractures, are one of the most endangered species in the world (figure).

As evidence based guidelines are lacking and expert consensus is considered to be poor, this species could be promising for future decision making processes owing to its impartiality and the ability to put itself into the same threatened position as patients with proximal humeral fractures. The aim of this behavioural analysis is to investigate inter-rater reliability of Barbary macaques in comparison with an expert group of surgeons for the management of proximal humerus fractures, and to determine the extent of consensus on treatment of this common injury.

## Methods

We identified independent experts in the field of orthopaedic trauma surgery with special focus on upper extremity surgery from Germany and the US and invited them by email to participate in an anonymous web based survey (SoSci Survey, Munich, Germany). The survey consisted of nine case reports of acute proximal humerus fractures. All cases were randomly selected from a prospective, observational registry study (Hannover Humerus Registry, NCT03060876).

We informed all the experts about the intention of this analysis. They were blinded only to the actual treatment procedure and outcome. Their response to the following questions with corresponding answer options was evaluated:

1 Which treatment regimen would you recommend?

Answer: Non-operative or operative.

2 Which procedure would you recommend, if you had to treat surgically?

Answer: Locking plate, cement augmented locking plate, intramedullary nail, hemiarthroplasty, reverse shoulder arthroplasty, allograft augmented locking plate, or something else.

3 Which outcome (Constant score adapted for age and sex<sup>15</sup>) would you expect one year after conservative treatment?

Answer: Less than or equal to 59, 60-69, 70-79, 80-89, or 90-100, out of 100 points.

Similarly, the behaviour of Barbary macaques was evaluated for the same nine cases and questions in a semi-free range enclosure in Europe (Affenwald Straussberg, Sonderhausen, Thuringia, Germany) during the winter season in January 2020. The web based case presentations were printed as 29.7×42 cm coloured posters and positioned serially with the related and aforementioned three questions using a customer stopper from a local ice cream vendor in the enclosure. With the aid of internationally accepted and validated rating scales, consisting of disposable, cellulose kidney dishes and laminated pictograms, the behaviour of the macaques was observed. Each kidney dish represented one of the aforementioned possible responses. Equal doses of Mediterranean sultanas, peanuts, and Californian walnuts functioned as environmental enrichment and were placed in the kidney dishes. The first grasp into a kidney dish was defined as a treatment or outcome selection, and this behaviour was noted. For question number 2, any non-responding among the macaques was defined as the response option "something else." Apart from that, macaques that did not respond completely to all cases and those with apparently severe conflicts of interests were excluded from evaluation.

### Statistical analysis

To assess the reliability of agreement between raters, Fleiss'  $\kappa$  was determined. We used the benchmark scale developed by Landis and Koch to interpret the strength of agreement for Fleiss'  $\kappa$  values.<sup>16</sup>

### Patient and public involvement

Patients' clinical and radiographic records were used from an observational registry study (Hannover Humerus Registry, NCT03060876) for the survey, and we thank them for their records. We did not involve patients in the design or analysis of the data.

## Results

Ten independent experts in the specialty of orthopaedic trauma surgery with special focus on upper extremity surgery from Germany and the US were available for the survey. Only five of 22 macaques provided complete responses to all cases, probably fearing loss of reputation.

Among the experts, operative treatment was the preferred treatment (51 of 90 selections), but the macaques more often chose non-operative treatment (25 of 45 selections). Overall inter-rater agreement for this choice was moderate among the experts and poor among the macaques, although there were noticeable differences between the two different nations.

In a post hoc subgroup analysis of the cases by patient age, the inter-rater agreement of the experts for choice of treatment and of surgical procedure was as poor as that of the macaques for patients older than 65, and only slight for patients younger than 65. Once again there were noticeable differences between the nations.

While the US experts achieved unanimous agreement with respect to non-operative treatment for patients older than 65, German experts reached only poor agreement, with four (26.7%) of 15 tending to choose surgical treatment.

All nine presented cases were actually treated non-operatively, with an excellent clinical outcome. Agreement about prediction of outcome was poor among the macaques and slight among the experts. All experts almost always predicted the outcome incorrectly and tended to underestimate it. Only 4 (4.4%) of 90 experts' predictions were correct, compared with 13 (28.9%) of 45 macaques' predictions.

## Discussion

This study investigated inter-rater reliability of Barbary macaques compared with an expert group for management and prediction of clinical outcome of proximal humerus fractures. Barbary macaques seemed to have inferior inter-rater reliability compared with the experts for choice of treatment (non-surgical v surgical), but they performed similarly to the experts for the geriatric age group most frequently affected by proximal humeral fractures, in their choices of treatment and choice of surgical procedure. These findings highlight the continuing controversy and lack of expert consensus on the optimal treatment of these fractures even outside the human species.<sup>4-21</sup>

Our study had some limitations; although it is a promising observation that the macaques chose non-operative treatment more often than the experts, their agreement about optimal treatment was consistently poor. A systematic confounding behaviour was unfortunately seen during the whole study. Some senior primates with apparently severe conflicts of interest biased responders during their selections. We believe that this might have adversely affected the results of these responders, and that their agreement and their outcome prediction ability would be much better without this disruptive factor.

In addition, in retrospect, the mixture of Mediterranean sultanas, peanuts, and Californian walnuts as environmental enrichment was an unfavourable choice by the authors. Unfortunately, considerable differences in the popularity of these treats could be observed in the aforementioned order. This difference led in parts to dependent selections, when the kidney dishes were not refilled equally immediately.

This form of selection bias must be seen as a major methodological weakness. The authors recommend Californian walnuts as single treats for future behavioural analysis.





## ORIGINAL RESEARCH Observational study

# Patient mortality after surgery on the surgeon's birthday

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**Objective** To determine whether patient mortality after surgery differs between surgeries performed on surgeons' birthdays compared with other days of the year.

**Design** Retrospective observational study.

**Setting** US acute care and critical access hospitals.

**Participants** Fee-for-service Medicare beneficiaries aged 65 to 99 years who underwent one of 17 common emergency surgical procedures in 2011-14.

**Main outcome measures** Patient postoperative 30 day mortality, defined as death within 30 days after surgery, with adjustment for patient characteristics and surgeon fixed effects.

**Results** 980 876 procedures performed by 47 489 surgeons were analysed. 2064 (0.2%) of the procedures were performed on surgeons' birthdays. Patient characteristics, including severity of illness, were similar between patients who underwent surgery on a surgeon's birthday and those who underwent surgery on other days. The overall unadjusted 30 day mortality on the operating surgeon's birthday was 7.0% (145/2064) and that on other days was 5.6% (54 824/978 812). After adjusting for patient characteristics and surgeon fixed effects (effectively comparing outcomes of patients treated by the same surgeon on different days), patients who underwent surgery on a surgeon's birthday exhibited higher mortality compared with patients who underwent surgery on other days (adjusted mortality rate, 6.9% v 5.6%; adjusted difference 1.3%, 95% confidence interval 0.1% to 2.5%;  $P=0.03$ ). Event study analysis of patient mortality by day of surgery relative to a surgeon's birthday found similar results.

**Conclusions** Among Medicare beneficiaries who underwent common emergency surgeries, those who received surgery on the surgeon's birthday experienced higher mortality compared with patients who underwent surgery on other days. These findings suggest that surgeons might be distracted by life events that are not directly related to work.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- Distractions due to clinical or personal events in the operating room are common
- Although laboratory experiments have shown that distractions can have a detrimental effect on surgeons' performance, empirical evidence using real world data is limited about how distractions in surgery affect patient outcomes
- Operations performed on surgeons' birthdays might provide a unique opportunity to assess the relationship between personal distractions and patient outcomes, but the association between surgeon's birthday and patient mortality has not been investigated

## WHAT THIS STUDY ADDS

- Patients who underwent common emergency surgical procedures on the operating surgeon's birthday showed higher 30 day mortality compared with patients who underwent surgery on other days of the year
- The findings suggest a surgeon's performance might be affected by distracting life events not directly related to work



## Introduction

Although many system and physician level factors influence surgical outcomes,<sup>18-20</sup> the role of distractions has received little empirical investigation. Distractions are common in the operating room, including noise (eg, beeper pages), problems with equipment, and conversations not pertinent to the procedure.<sup>21-24</sup> Although laboratory experiments have shown that distractions can have a detrimental effect on surgeons' performance,<sup>25-28</sup> empirical evidence using real world data is limited as to how distractions in surgery affect patient outcomes. Outside of healthcare, studies have found that distractions due to extraneous factors, including losses of sports teams, have a meaningful impact on decision making processes.<sup>29-31</sup> However, as surgeon level information on potentially distracting events is difficult to obtain, how distractions caused by extraneous factors affect surgeons' performance and patient outcomes has not been investigated.

Operations performed on birthdays of surgeons might provide a unique opportunity to assess the relationship between personal distractions and patient outcomes, under the hypothesis that surgeons are more likely to be distracted or rush procedures on their birthdays, which might worsen patient outcomes. We therefore examined whether patients' postoperative mortality differed for surgeries performed on surgeons' birthdays versus other days.

## Methods

We analysed 100% of Medicare fee-for-service beneficiaries aged 65 to 99 treated at acute care and critical access hospitals in 2011-14. To minimise the impact of potential selection bias from surgeons choosing patients based on illness severity, or patients choosing surgeons based on their preference, we focused our analyses on emergency procedures. We identified all patients who underwent one of 17 major surgical procedures.

Surgeon characteristics, including their birthdays, were obtained from the Centers for Medicare & Medicaid Services' MD-PPAS file. About 98% of our Medicare beneficiary data could be linked to the MD-PPAS using the national provider identifier.

The primary outcome was 30 day mortality, defined as death within 30 days after the operative procedure.

Association between surgeon's birthday and patient postoperative mortality

Day	No of procedures	Model 1: patient characteristics*			Model 2: patient characteristics*+hospital fixed effects			Model 3: patient characteristics*+surgeon fixed effects		
		Adjusted mortality rate, % (95% CI)	Adjusted difference, % (95% CI)	P value	Adjusted mortality rate, % (95% CI)	Adjusted difference, % (95% CI)	P value	Adjusted mortality rate, % (95% CI)	Adjusted difference, % (95% CI)	P value
Surgeon's birthday	2064	7.2 (6.0 to 8.4)	1.6 (0.4 to 2.8)	0.01	7.2 (6.0 to 8.4)	1.6 (0.4 to 2.8)	0.01	6.9 (5.7 to 8.1)	1.3 (0.1 to 2.5)	0.03
Other days	978812	5.6 (5.5 to 5.7)	Reference		5.6 (5.6 to 5.7)	Reference		5.6 (5.6 to 5.6)	Reference	

\*Patient characteristics included patient age, sex, race or ethnicity, procedure type, coexisting conditions, median household income in zip code, Medicaid status, year indicators, and surgical day of the week.

### Adjustment variables

We adjusted for patient characteristics and hospital or surgeon fixed effects. Patient characteristics included the type of procedure, age, sex, race and ethnicity, indicator variables for 24 comorbidities,<sup>42</sup> median household income estimated from residential zip codes, an indicator for dual Medicaid coverage, and year and day of the week of surgery. Including hospital or surgeon fixed effects as adjustment variables in regression analysis controlled for both time invariant measured and unmeasured characteristics of hospitals or surgeons, effectively comparing outcomes of patients who were treated at the same health system or by the same surgeon.<sup>45 46</sup>

### Statistical analysis

We first compared patient characteristics and illness severity on an operating surgeon's birthday with those on other days, to investigate whether severity differed based on the date of surgery. To estimate illness severity for each patient, we regressed 30 day mortality on patients' characteristics using a logistic regression model and estimated the predicted probability of 30 day mortality for each patient.

We compared the operative mortality of patients who underwent surgery on a surgeon's birthday with patients whose operation was performed on other days of the year, adjusting for patient characteristics (model 1), patient characteristics and hospital fixed effects (model 2), or patient characteristics and surgeon fixed effects (model 3).

We used multivariable linear probability models (fitting ordinary least squares to binary outcomes) to overcome the issue of complete or quasi-complete separation of logistic regression models, owing to a large number of fixed effects.<sup>47 48</sup> Standard errors were clustered at the surgeon level to account for potential correlation between patient outcomes within the same surgeon. After fitting regression models, adjusted patient outcomes were calculated using the marginal standardisation form of predictive margins.<sup>49</sup>

Finally, we conducted an event study analysis to investigate how patient 30 day mortality differed around surgeons' birthdays. We regressed patient 30 day mortality on a set of relative date indicators within two weeks before and after a surgeon's birthday (using other days of the year as reference category), adjusting for patient characteristics and surgeon fixed effects (model 3). To avoid unstable estimates from relatively small sample sizes for any given day, we grouped every two days into a single category for the event study analysis.

## Results

The study sample included 980876 procedures performed by 47 489 surgeons, whose birthdays were evenly distributed throughout the year. Among those procedures, 2064 (0.2%) were performed on surgeons' birthdays. Patients who underwent operations on surgeons' birthdays had similar characteristics to those who underwent operations on other days, suggesting that surgeons did not selectively choose patients to operate on on their birthdays on the basis of patient characteristics, including illness severity.

The overall unadjusted 30 day mortality on the surgeon's birthday was 7.0% (145/2064) and that on other days was 5.6% (54 824/978 812). Thirty day mortality was found to be higher on surgeons' birthdays compared with other days, after adjusting for patient characteristics (model 1) or for patient characteristics plus hospital fixed effects (model 2). A similar pattern was found after adjusting for patient characteristics and surgeon fixed effects in model 3 (6.9% on surgeons' birthdays v 5.6% on other days; adjusted difference 1.3%, 0.1% to 2.5%;  $P=0.03$ ) (table). In an event study analysis, 30 day mortality was higher for surgeries performed on a surgeon's birthday compared with those performed on other days, after adjusting for patient characteristics and surgeon fixed effects.

## Discussion

Using national data on Medicare beneficiaries undergoing emergency surgical procedures, we found a higher risk of 30 day mortality after surgery when the operation was performed on a surgeon's birthday. No difference was found in a broad range of patient characteristics, including predicted mortality rates, between patients who underwent surgery on a surgeon's birthday versus other days, indicating that these findings were unlikely to be explained by differences in patient factors. These findings suggest that a surgeon's performance may be affected by life events that are not directly related to work, a hypothesis that although intuitive has been otherwise difficult to assess owing to lack of detailed information on events that are potentially distracting to an individual surgeon.

Our study has limitations. Although we adjusted for a broad set of patient level confounders and hospital or surgeon fixed effects, we could not eliminate the possibility of unmeasured confounding. Also, owing to the lack of detailed clinical information in the claims data, we were not able to identify the mechanisms through which patients experienced higher mortality when they received surgeries on surgeons' birthdays. Our findings might not be generalisable to younger patient populations or to other surgical procedures.

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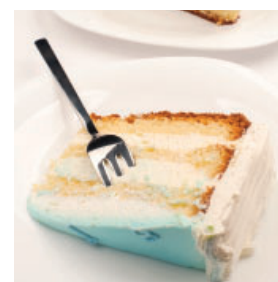
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## ORIGINAL RESEARCH

## Literature review

# Toxicological analysis of George's marvellous medicine

Graham Johnson,<sup>1,2</sup> Patrick Davies<sup>2,3</sup>

**Objective** To analyse the therapeutic effects and toxicity of the eponymous concoction described in Roald Dahl's book *George's Marvellous Medicine*.

**Design** Literature review.

**Setting** Two literature loving households in England.

**Participants** George Kranky and grandma Kranky.

**Main outcome measures** Clinical and toxic effects of the individual ingredients checked against those listed in ToxBase, the National Poisons Information Service's poisons database.

**Results** The medicine contained 34 ingredients. The most common toxic effect identified on ToxBase was nausea and vomiting (16 ingredients, 47%). Potentially life threatening effects were associated with 13 (38%) ingredients, including depression of the central nervous system, kidney injury, convulsions, cardiac toxicity, and mucosal erosion. The effects described in the book were accurate initially but then diverted from the most likely clinical outcome (death).

**Conclusions** Although Dahl ought to be applauded for his accuracy about the toxicology of the initial ingredients in George's marvellous medicine, the overall effect would be fatal catastrophic physiological collapse. Scientific exploration and experimentation should be encouraged in children, although any medicinal ingredients need to be checked for potential toxicity before being administered—to grandmas or anyone else.

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## Introduction

Generations of young readers have enjoyed Roald Dahl's book *George's Marvellous Medicine* since it was first published in 1981.<sup>1,2</sup> The 1998 edition was dedicated to "Doctors Everywhere,"<sup>3</sup> but changed in subsequent versions to "WARNING TO READERS: Do not try to make George's Marvellous Medicine yourselves at home. It could be dangerous," possibly because of children experimenting on grandmas.

Unintentional poisoning is a leading cause of accidental death in children in the UK and EU.<sup>6,7</sup> With many children being home schooled during the coronavirus disease 2019 (covid-19) pandemic, the risk from unintentional poisoning has increased.<sup>9</sup>

As some of the ingredients in George's marvellous medicine can be easily found in houses, we decided to concoct a similar mixture to George's and to compare the known effects with the outcomes claimed in the book.

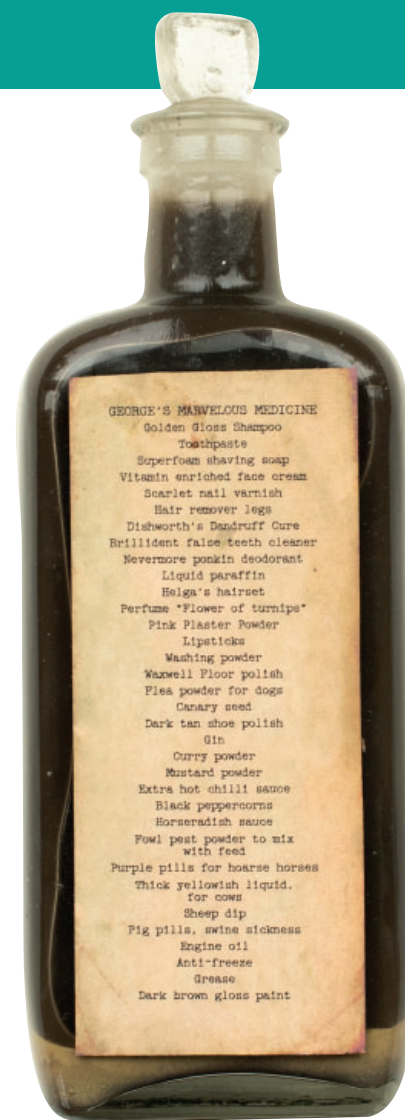
## Methods

Five researchers read George's Marvellous Medicine, recorded the ingredients and amounts, and then cross referenced these with ToxBase.<sup>13</sup> When exact matches were not found, we chose the nearest approximation (eg, purple pills for hoarse horses matched to the pale purple tablets of phenylbutazone used to treat "the stranglers" in horses<sup>14</sup>). The severity of any potential effects was graded. As poisoning shows a dose-response, moderate doses were analysed.

## Results

Overall, 34 ingredients identified. The most common potential symptoms associated with these were nausea and vomiting (16 ingredients, 47%), depression of the central nervous system (CNS) (13, 38%), diarrhoea (11, 32%), cardiac involvement (6, 18%), foaming or hypersalivation (4, 12%), gastrointestinal tract ulceration and haematemesis (4, 12%), lung injury (7, 21%), and seizures (4, 12%). Five ingredients (15%) were foodstuffs, which were particularly spicy and might cause vomiting in high doses. Only the "extra hot" chilli sauce has a Toxbase entry.

Treatments for this multivariate poisoning were complex and would require immediate high level care (figure).



## WHAT IS ALREADY KNOWN ON THIS TOPIC

- In *George's Marvellous Medicine*, grandma experiences sudden and major growth and invigoration after being administered the medicine
- Lockdown has meant that children are spending more time at home for education
- Most unintentional poisonings occur at home, and coupled with children's desire for experimentation and mimicry, the risk of attempted reproduction of George's marvellous medicine has increased

## WHAT THIS STUDY ADDS

- George's marvellous medicine is highly toxic
- Far from experiencing major growth and invigoration, grandmas would be at high risk of death
- Parents of budding pharmacists should remain vigilant, particularly during lockdown

Far from being  
marvellous, George's  
medicine is in fact  
incredibly toxic

Ingredients of George's  
marvellous medicine and  
the likely clinical effects  
of ingestion. CNS=central  
nervous system

See [bmj.com](https://www.bmj.com) for  
interactive infographic

	Nausea	Vomiting	Diarrhoea	Foaming	Kidney injury	CNS depression	Convulsions	Erosion	Lung injury	Cardiac toxicity
Golden gloss hair shampoo										
Toothpaste										
Superfoam shaving soap										
Vitamin enriched face cream										
Scarlet nail varnish										
Hair remover, legs										
Dishworth's dandruff cure										
Brillident false teeth cleaner										
Nevermore ponking deodorant										
Liquid paraffin										
Helga's hairset										
Perfume "Flowers of turnips"										
Pink plaster powder										
Lipsticks										
Superwhite washing powder										
Waxwell floor polish										
Flea powder for dogs										
Canary seed										
Dark tan shoe polish										
Gin										
Curry powder										
Mustard powder										
"Extra hot" chilli sauce										
Black peppercorns										
Horseradish sauce										
Fowl pest powder to mix with feed										
Purple pills for hoarse horses										
Thick yellowish liquid, for cows										
Sheep dip										
Pig pills, swine sickness										
Engine oil										
Antifreeze										
Grease										
Dark brown gloss paint										

## Discussion

Far from being marvellous, George's medicine is in fact incredibly toxic. It is known that mimicry plays a role in poisoning in children,<sup>17</sup> and both increased time at home and the ongoing search for a treatment for covid-19 might inspire budding pharmacists.

The account of the likely effects of ingestion of the medicine is initially accurate. Grandma "shot up *whoosh* into the air" and on landing shouted "My stomach's on fire!" This was likely due to capsaicin although sheep dip (organophosphate), shoe polish (white spirit, heavy naphtha, trimethylbenzene), and floor polish (heavy naphtha) cause mucosal erosion and severe gastric dyspepsia. George's treatment using a jug of water might have increased the risk of aspiration and later cardiogenic shock due to excess preload if grandma had developed myocarditis.

Subsequently grandma swelled, before developing a puncture and deflating. Although

gastrointestinal bloating is to be expected from foaming ingredients, puncturing is not recommended in ToxBase.

Thereafter "Grandma's body gave a sudden sharp twist and a sudden sharp jerk and she flipped herself clear out of the chair." Four of the ingredients cause convulsions or myoclonic jerks.

The account then diverges from reality—grandma no longer feels ill effects and grows to the size of a house. None of the ingredients cause excess growth.<sup>18</sup>

The true clinical course would be more sombre. The best case scenario is that immediate, intractable, and vigorous vomiting would have prevented systemic absorption of a fatal dose. However, the caustic ingredients would have caused immediate and severe oesophageal burns risking a catastrophic oesophageal-aortic erosion and a lifetime of dysphagic complications.

The considerable amounts of CNS depressants would cause drowsiness and coma. Combined with vomiting, this would probably lead to aspiration pneumonitis, if not

complete airway obstruction and eventual suffocation.

Should grandma have survived this physiological insult, seizures and respiratory depression would add to the risk of death. Myocarditis and arrhythmias would follow with gastrointestinal erosions, upper gastrointestinal haemorrhage, and gastrointestinal perforation. If these did not prove fatal, disseminated intravascular coagulopathies and irreversible hepatorenal failure would result.

Much progress has been made since *George's Marvellous Medicine* was published, with child proof packaging, clearer labelling, and bans on the more dangerous products. A factsheet detailing the most potentially dangerous items in the home, and a checklist, are available<sup>20,21</sup>; the latter contains a warning to "NEVER mix cleaning products." Children have always been fascinated by potions with magical properties.<sup>22</sup> Some toxic magical ingredients are available in British gardens (eg, wormwood, mistletoe) and parents may need to exercise extra caution with their potion makers.

## Limitations of this study

We did not combine the Medicine as described, so cannot comment on any chemical interactions. The precise dose is not documented, leading to some assumptions on the effects. We have not addressed the effects of heat, and the effects of chanting and dancing, despite effects in rainmaking,<sup>23</sup> are unlikely to have materially affected the medicine.

## Conclusion

Although we applaud Dahl's initial accuracy about the effects of George's marvellous medicine, it would result in catastrophic collapse. It is unlikely that children will recreate each step in the making of the medicine, there are many household ingredients used that commonly cause severe morbidity in paediatric practice. We encourage scientific exploration and experimentation in children but suggest that any medicines are first checked for potential toxicity.