Resilience does matter: evidence from a ten-year cohort record linkage study

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Resilience does matter: evidence from a ten-year cohort record linkage study

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ABSTRACT

Objectives To examine ten-year mortality and hospital use among individuals categorised as resilient and vulnerable to the impact of chronic pain.

Design A cohort record linkage study.

Setting Grampian, Scotland

Participants 5858 individuals from the Grampian Pain Cohort, established in 1996, were linked, by probability matching, with national routinely collected datasets.

Main outcome measures Hazard ratios for subsequent ten-year mortality and odds ratios/incidence rate ratios for subsequent ten-year hospital use, each with adjustment for potential confounding variables.

Results 36.5% of those with high pain intensity reported low pain-related disability (categorised resilient) and 7.1% of those reporting low pain intensity reported high pain-related disability (categorised vulnerable). Sex, age, housing, employment and long-term limiting illness were independently associated with being vulnerable or resilient. After adjustment for these variables, individuals in the resilient group were 25% less likely to die within 10 years of the survey compared with non-resilient individuals: Hazard Ratio (HR) 0.75, 95% Confidence Interval (CI) 0.62 to 0.91 and vulnerable individuals were 45% more likely to die than non-vulnerable individuals: HR 1.45, 95%CI 1.01 to 2.11. Resilient

individuals were less likely to have had an outpatient or day-case visit for anaesthetics: Odds Ratio (OR) 0.46, 95% CI 0.27 to 0.79, but no other clinical specialities. Vulnerable individuals were significantly less likely to have had any outpatient or day case visit (OR 0.43, 0.25 to 0.75); but more likely to have had a psychiatric visit (OR 1.96, 1.06 to 3.61). No significant differences in likelihood of any inpatient visits were found.

Conclusions Resilient individuals have better ten-year survival than non-resilient individuals indicating that resilience is a phenomenon worth researching. Further research is needed to explore who is likely to become resilient, why and how, as well as to tease out the internal and external factors that influence resilience.

ARTICLE SUMMARY

Article focus

- Little is known about the long term outcomes of resilient and vulnerable individuals.
- We examined long-term hospital use and mortality among those categorised as resilient and those categorised as vulnerable to the impact of chronic pain.
- Our hypotheses were that individual's categorized as resilient would fare better than a comparison group with a similar level of chronic pain, and individuals categorised as vulnerable would do worse.

Key messages

- Resilient individuals were 25% less likely to die within 10 years than non-resilient individuals and vulnerable individuals were 45% more likely to die than non-vulnerable individuals.
- There were few differences in the use of hospital services over the ten years between the groups.
- Our findings suggest that the concept of resilience is a phenomenon worth researching. Important gains may be made in understanding who is likely to become resilient, why and how.

Strengths and limitations of this study

- This is the first study to examine the long term effects of resilience or vulnerability to chronic pain in terms of survival and hospital use.

- A major strength of our study was its community base, meaning results from this study are more likely to be representative of people living in the community than those from studies using samples from healthcare settings, such as pain clinics.
- The prospective nature of the study meant that pain status was ascertained before outcome was measured, avoiding recall bias.
- We did not use a formal resilience measurement scale. Instead we categorised individuals on the basis of their scores on the intensity and disability sub-scales of a chronic pain measure.
- Although we were able to adjust for several socio-demographic variables in the analysis, some other potentially important factors were not fully available in the dataset (e.g. smoking).

INTRODUCTION

Chronic pain is common. [1-3] It has wide reaching physical, psychological, and social consequences [3-7] and places a heavy burden on individuals, society and healthcare services. [8, 9] While much clinical practice and research focuses on those who do badly with a condition ('vulnerable' individuals), interest is growing in understanding the characteristics and experiences of those who appear to do well ('resilient' individuals). [10 11] Recent studies have examined resilience to physical illness, [12] menopausal symptoms [13] and specific conditions such as diabetes, [14] epilepsy, [15] asthma [16] and chronic pain. [17-22] These studies have provided useful insights into the short-term importance of resilience. They have also indicated some of the factors accounting for why certain people appear to cope better with their condition than others, such as socio-economic factors, individual personality traits, psychological factors, spirituality, social support and general health. Little is known, however, about the long term outcomes of resilient and vulnerable individuals. Such information is needed to understand the clinical and research relevance of trying to identify both sets of individuals.

In this paper we linked information about respondents to a large community-based survey with routinely collected health service data to examine long-term (ten year) hospital use and mortality among those categorised as resilient and vulnerable to the impact of chronic pain. Our hypothesis was that those categorized as resilient would fare better than a comparison group with a similar level of chronic pain, and those categorised as vulnerable would do worse.

METHODS

Grampian cohort

The Grampian cohort, established in July 1996, [2] comprised 6,940 adults (aged 25+ years) recruited from 29 practices across Grampian, North East Scotland. These included 3,605 individuals recruited through random selection from everyone registered with the practice (essentially a general population sample) and 3,335 individuals recruited through random selection based on those receiving repeat prescriptions for analgesic use. Full details of the survey have been reported previously. [23] Briefly, participants were sent a postal questionnaire which included questions about the presence and severity of chronic pain and a range of items regarding health and socio-demographic details. The corrected response rate was 84.3% after two reminders. Study respondents were broadly representative of the Grampian population. [7]

Chronic pain status

Individuals with chronic pain were identified by affirmative answers to two questions based on the International Study for the Association of Pain (IASP) definition [24]: (i) Are you currently troubled by pain or discomfort, either all the time or on and off? (ii) Have you had this pain or discomfort for more than three months?

Pain severity

Chronic pain severity was assessed using the Chronic Pain Grade (CPG) questionnaire. [25] This is a seven-item instrument that measures severity in two dimensions: intensity sub-scale (three visual analogue scale items: current, worst and average pain intensity in the last six months) and disability sub-scale (three visual analogue scale items: interference with daily

activities, social activities and daily work in the last six months; and one item on number of days off work). A score is generated from the three visual analogue scale items for each sub-scale, from 0 (best possible pain state) to 100 (worst possible pain state). These scores and the item on number of days off work are then used to classify chronic pain into four hierarchical grades, from Grade I (low disability-low intensity pain) to Grade IV (high disability-severely limiting pain). The CPG has been shown to be valid and reliable for use in a self-completion postal questionnaire in the UK general population. [26] Only those who gave affirmative answers to both of the chronic pain questions were asked to complete the CPG questionnaire.

General health & socio-economic details

The questionnaire included several questions about general health. For this paper we used results from a question on the presence or absence of a long-term limiting illness drawn from the National Census (http://www.gro-scotland.gov.uk/files/hseform.pdf). The questionnaire also included items regarding sex, age, marital status, education, housing, social support and employment status.

National routinely collected datasets

In Scotland, routinely collected health information and statistics are collated and stored in a national database by the Information Services Division (ISD), NHS Scotland (http://www.isdscotland.org/isd/1.html). These routinely collected national datasets can be linked with existing cohorts where adequate personal details are available. An advantage of using national datasets is the ability to follow up members of a cohort who remain in Scotland but who move away from their recruitment location. Data (from 1996 to 2006

inclusive) about respondents to the Grampian survey was requested from four of the national datasets: the General Register Office death records; SMR00- first attendances at outpatient clinics; SMR01- inpatient and day case episodes in general and acute wards of hospitals; and SMR04- inpatient and day cases in psychiatric units and hospitals.

Record linkage

A copy of the Grampian cohort dataset was forwarded to the Medical Records Linkage Team at ISD who undertook the linkage. ISD-held data were linked using standard probability matching procedures based on common patient identifiable fields. The new linked dataset was stripped of patient identifiers by ISD and returned to the research team in an anonymised format. This approach enabled detailed analysis of the linked data, whilst maintaining patient confidentiality. The study was approved by the Privacy Advisory Committee of NHS National Services, Scotland. Grampian Research Ethics Committee approved the original questionnaire survey and subsequently confirmed that ethical approval was not required for the new linkage since no information was being collected from participants and the linked dataset was anonymised.

Identification of resilient and vulnerable individuals

Individuals were categorised into one of four groups based on their scores on the intensity and disability sub-scales of the CPG. Individuals with low pain-related disability (<50/100) despite high pain intensity (≥50/100) were categorised as 'resilient'; these individuals were compared with 'non-resilient' individuals who reported both high pain-related disability (≥50/100) and high intensity pain (≥50/100). Individuals with high pain-related disability (≥50/100) in spite of low intensity pain (<50/100) were categorised as 'vulnerable'; these

individuals were compared with 'non-vulnerable' individuals who reported low intensity pain (<50/100) and low pain-related disability (<50/100).

Grouping of hospital-related data

Routine data were available for 42 different clinical specialties and included the number of visits (as out-patient or day-case) and the total number of days spent as an in-patient, for each specialty. In order to maximise our statistical power we pooled the different visit types and collapsed the data into six categories: 1) medicine (general medicine, geriatric medicine, all major medical specialties except rheumatology), 2) surgery (general surgery, all surgical specialties e.g. ENT, gynaecology, but excluding orthopaedic surgery); 3) musculo-skeletal (rheumatology and orthopaedic surgery); 4) anaesthetics (as pain clinics are coded by this specialty); 5) oncology (including palliative care and haematology); and 6) psychiatry. Full details of the categorisation are in appendix 1. Information about use of Accident & Emergency services, which are largely accessed in an unscheduled way, was not available since the datasets requested relate to scheduled care.

Statistical analysis

Data were analysed using SPSS for Windows (version 19) and R 2.15.2. Descriptive statistics examined the proportion of people categorised as resilient or vulnerable. Binary logistic regression was then used to examine the demographic, socio-economic and health factors associated with being in each group. In each case resilient individuals were compared with those in the non-resilient comparison group and those in the vulnerable group were compared with those in the non-vulnerable comparison group.

Cox regression survival analysis was conducted to obtain unadjusted and adjusted hazard ratios (HR) with 95% confidence intervals (CI) for all-cause mortality and cause of death. Adjustments were made for factors independently associated with being vulnerable or resilient on multivariate analysis. The assumption of constant time dependent covariates was checked for each model and found to hold.

Hospital use was analysed using a two stage procedure to test for differences in both binary (any visits or none) and continuous (number of visits in those having at least one visit) components. In view of over-dispersion in the data we used negative binomial regression for the continuous component with logistic regression for the binary. Results were expressed as odds ratios (OR) for the binary and incidence rate ratios (IRR) for the continuous component.

Sensitivity analyses were conducted to explore how our findings changed if: i) pain-related disability was measured in a different way; and ii) we adjusted for additional factors with incomplete data.

RESULTS

ISD managed to link 5,858 (84.4%) of the 6,940 individuals in the original Grampian cohort. The characteristics of the linked cohort were very similar to the original complete cohort with no significant differences in demographic, socio-economic or pain factors. A total of 4139 (70.7%) of those in the linked cohort had chronic pain at baseline of which 3739 (90.3%) had detailed information on pain intensity and disability and were included in subsequent analyses (see Figure 1).

Resilience and vulnerability

Of the 2242 individuals reporting high intensity pain, 819 (36.5%) reported low pain-related disability and were categorised as resilient, while 1423 (63.5%) reported high pain-related disability and were categorised as non-resilient. Among the 1497 individuals reporting low intensity pain, 107 (7.1%) had high pain-related disability and so were categorised as vulnerable, compared with 1390 (92.9%) who reported low pain-related disability and were categorised as non-vulnerable.

Factors associated with being resilient and vulnerable

Table 1 presents the measured demographic, socio-economic and health factors associated with being in the resilient and vulnerable groups. On univariate analysis, individuals were *less* likely to be classified as resilient to their chronic pain if they were female, older, no longer married, had less than an university education, lived in rented accommodation, lived with no other adults, were not working and had a long-term limiting illness. Conversely, individuals were *more* likely to be classified as vulnerable to their chronic pain if they lived in rented council accommodation, lived with no other adults, were unable to work and had a long-term limiting illness. On multivariate analysis: sex, age, housing, employment and long-term limiting illness were identified as the factors independently associated with being vulnerable or resilient and were adjusted for in subsequent analyses.

Mortality

During the ten-year follow-up period, 21.1% of the resilient group and 31.9% of the non-resilient group died (Table 2). In comparison, 32.7% of the vulnerable group and 20.9% of

the non-vulnerable group died. The main causes of death were broadly similar in each group (Table 2).

Kaplan Meier survival plots (Figure 2) show a progressive divergence over time between resilient and non-resilient groups, and between vulnerable and non-vulnerable groups, with no discontinuity. Table 2 details the results of the Cox proportional hazards regression (expressed as hazard ratios). After adjusting for sex, age, housing, employment (independently associated socio-demographic factors), and long term limiting illness individuals in the resilient group were 25% less likely to die within 10 years of the survey compared with non-resilient individuals: HR 0.75, 95% CI 0.62 to 0.91. A statistically significant reduction in death from cancer among the resilient group also remained (HR 0.64, 0.44 to 0.93) after adjustment. After adjustment, vulnerable individuals were more likely to die over the ten year period than non-vulnerable individuals: HR 1.45, 1.01 to 2.11 and vulnerable individuals were significantly more likely to die from circulatory diseases than those in the non-vulnerable group (HR 1.91, 1.08 to 3.38).

Hospital use

Most individuals in each group used a hospital service at least once during the ten year follow up period. Outpatient or day-case attendance occurred in 720 (87.9%) of resilient individuals, 1211 (85.1%) of non-resilient individuals, 86 (80.4%) vulnerable individuals and 1238 (89.1%) of the non-vulnerable individuals. At least one inpatient admission occurred in 514 (62.8%) resilient individuals, 1017 (71.5%) non-resilient individuals, 82 (76.6%) vulnerable individuals and 865 (62.2%) non-vulnerable individuals.

Details of hospital use over the ten-year follow-up period are presented in table 3 (comparing resilient and non-resilient groups) and table 4 (comparing vulnerable and non-vulnerable groups). Table 3 shows that compared with non-resilient individuals, resilient individuals with chronic pain were less likely to have had an outpatient or day-case visit for anaesthetics, the specialty which hosts pain clinics: adjusted OR 0.46, 0.27 to 0.79. There were no other statistically significant differences in visits for other clinical specialities. There were no statistically significant differences in the number of outpatient or day case visits. Nor were there any statistically significant differences in inpatient days between resilient and non-resilient groups. Compared with non-vulnerable individuals, those in the vulnerable group were significantly less likely to have any outpatient or day case visits (Table 4: adjusted OR 0.43, 0.25 to 0.75); and more likely to have an outpatient or day case psychiatric visit (OR 1.96, 1.06 to 3.61). There were no statistically significant differences in the number of outpatient or day case visits. No differences were observed between vulnerable and non-vulnerable groups for likelihood of any inpatient visits, or total number of inpatient days (except for anaesthetics). However, the very small number of inpatient admissions in the vulnerable group indicates that any inference from these should be viewed with caution.

DISCUSSION

This is the first study to examine the long term effects of resilience or vulnerability to chronic pain in terms of survival and hospital use. We found that resilience to chronic pain (as defined by low disability in spite of high intensity pain) was associated with a significantly reduced risk of death over the subsequent ten years. With the exception of pain services, resilient individuals made the same use of specialist services as the non-

resilient comparator group. We also found that individuals classified as vulnerable to their chronic pain had poorer survival than those in the non-vulnerable comparison group. The few differences between vulnerable and non-vulnerable individuals in their use of hospital services related mainly to psychiatric and anaesthetic services.

A major strength of our study was its community base. Results from this study are more likely to be representative of people living in the community than those from studies using samples from healthcare settings, such as pain clinics. The prospective nature of the study meant that pain status was ascertained before outcome was measured, avoiding recall bias. Furthermore, long-term outcomes were available for analysis. We did not use a formal resilience measurement scale. [27] Our analyses assume that self reported pain intensity and disability due to pain correctly differentiated respondents into those resilient or vulnerable to the effects of chronic pain. Individuals were categorised based on their scores on the intensity and disability sub-scales of the CPG. Use of the two sub-scales allowed us to use a measure of disability that was directly related to pain, rather than use of a generic measure of health that could have been influenced by other conditions. This approach meant that the two sub-scales were directly comparable. Since we did not use the 'days off work' question in the CPG questionnaire normally used to grade people, a sensitivity analysis was undertaken to examine the effect of including this additional question. Analysis showed that the findings did not materially change, with the same overall pattern of results seen (data not shown). A strength of our approach is that it moves away from groupings based on help seeking behaviour which is known to be a poor marker of actual functioning. [28 29] Consulting a health care professional may not always identify individuals who are "resilient" or "vulnerable" to their symptoms.

Resilience and vulnerability were associated with several socio-demographic variables and we were able to adjust for these in the analysis. Some other potentially important factors were not fully available in the dataset, but were examined in an additional set of sensitivity analyses to examine the effects of smoking and mental health in relation to survival. Data on cigarette smoking was available from a follow up survey (conducted four years after baseline) for 1572 of the 3739 individuals. There were no specific measures of mental health in the original survey although it did include the SF-36 measure of health related quality of life which includes a Mental Health component. Adding both of these variables in turn into the survival models did not change the hazard ratios substantially, although incomplete data led to wider confidence intervals. While we found few differences in specialist care use between groups, our analyses did not allow for different survival between groups, which meant that resilient individuals tended to have a longer period of time in which to receive specialist treatment than non-resilient individuals; and vulnerable individuals less time than non-vulnerable individuals. These patterns of survivorship are likely to exaggerate differences between groups, rather than diminish them.

There is growing interest in the phenomenon of resilience in a range of health and social sciences. While hard to define, [11 30 31] it has been suggested that resilience describes something more than either hardiness (for instance not becoming unwell) or coping. Instead it implies both experiencing adversity (illness) and adapting in order to bounce back and thrive, sometimes in changed ways. [32] Our finding of generally comparable healthcare use between resilient and non-resilient individuals suggests that resilience in our study was not simply measuring hardiness.

Whatever resilience is, and however it is measured, our finding of better survival among resilient people with chronic pain, suggests that resilience is a phenomenon worth researching. It was noteworthy that a larger proportion (36.5%) of individuals were resilient than vulnerable (7.1%). This suggests that important gains may be made in understanding who is likely to become resilient, why and how. Further research is now needed to tease out both the internal (e.g. personality traits, self-efficacy) and external (e.g. social support) factors that influence an individual's resilience. Of particular importance will be the identification of modifiable factors that could be used to help build additional resilience in individuals who could benefit.

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Figure 1: Flow chart depicting study process

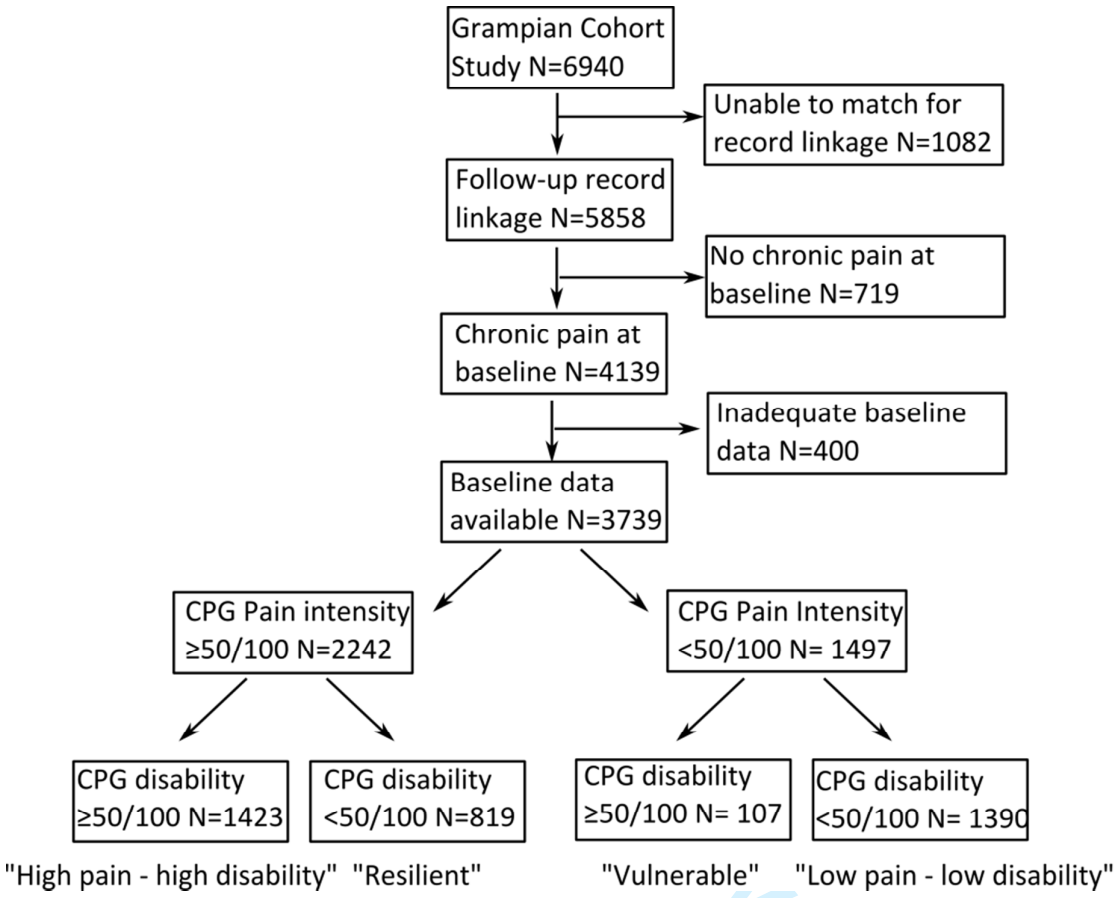
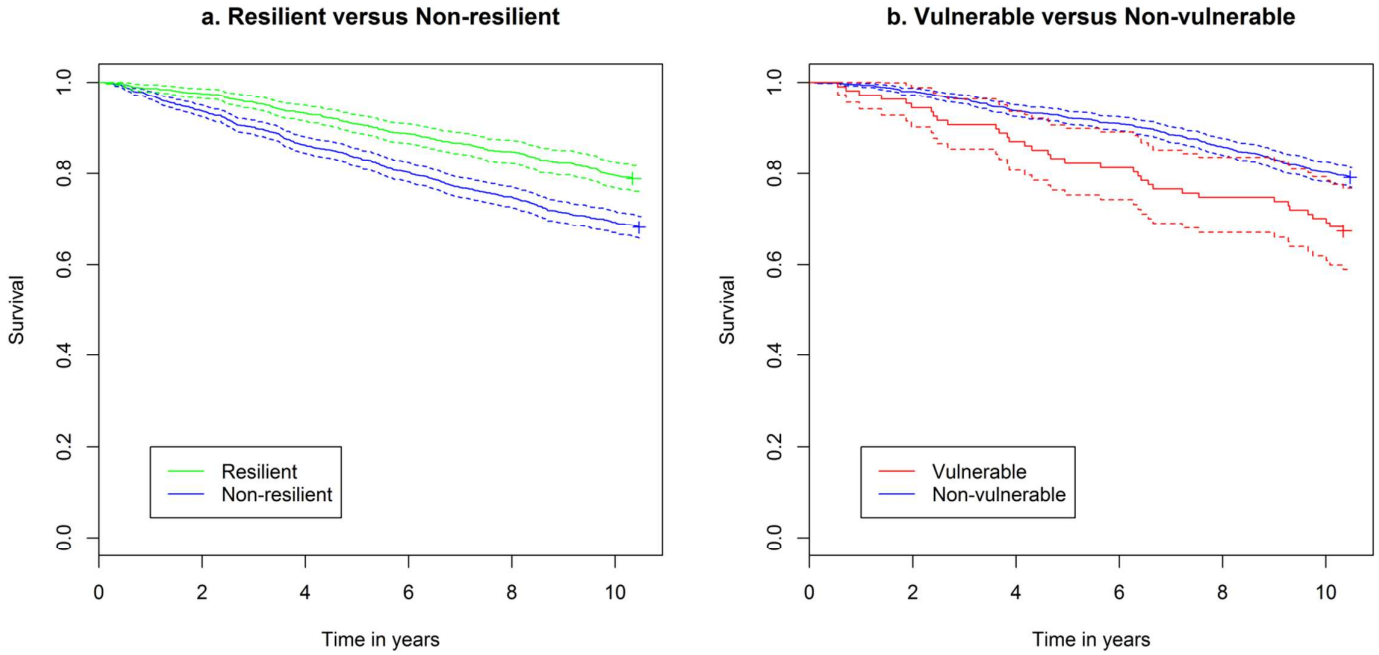


Table 1: Factors associated with being in the resilient or vulnerable groups.

	Non-resilient	Resilient			Non-vulnerable	Vulnerable		
	N	N	OR	(95%CI)	N	N	OR	(95%CI)
Sex								
Male	630	402			716	52		
Female	793	417	0.82	(0.69 to 0.98)	674	55	1.12	(0.76 to 1.67)
Age group								
25-34	80	68			113	10		
35-44	198	113	0.67	(0.45 to 1.00)	187	15	0.91	(0.39 to 2.09)
45-54	301	173	0.68	(0.47 to 0.98)	255	14	0.62	(0.27 to 1.44)
55-64	323	172	0.63	(0.43 to 0.91)	299	24	0.91	(0.42 to 1.96)
65-74	266	172	0.76	(0.52 to 1.11)	325	23	0.80	(0.37 to 1.73)
75+	255	121	0.56	(0.38 to 0.82)	211	21	1.12	(0.51 to 2.47)
Marital status								
Single	126	80			113	12		
Married / cohabit	909	587	1.02	(0.75 to 1.37)	1005	65	0.61	(0.32 to 1.16)
No longer married	367	147	0.63	(0.45 to 0.89)	253	28	1.04	(0.51 to 2.12)
Education								
University	118	123			305	17		
High school	260	178	0.66	(0.48 to 0.90)	335	24	1.29	(0.68 to 2.44)
No qualifications	878	470	0.51	(0.39 to 0.68)	656	60	1.64	(0.94 to 2.86)
Housing								
Owned/mortgaged	663	547			977	59		
Rented privately/other	62	30	0.59	(0.37 to 0.92)	64	6	1.55	(0.65 to 3.73)
Rented from council	675	236	0.42	(0.35 to 0.51)	323	40	2.05	(1.35 to 3.12)
Social support								
Other adults in home	968	602			1030	68		
No other adults	368	173	0.76	(0.61 to 0.93)	271	35	1.96	(1.27 to 3.00)
Employment								
Working	271	386			657	34		
Retired	474	270	0.40	(0.32 to 0.50)	527	42	1.54	(0.97 to 2.46)
Unable to work	504	76	0.11	(0.08 to 0.14)	38	16	8.14	(4.13 to 16.03)
Unemployed	122	66	0.38	(0.27 to 0.53)	130	11	1.64	(0.81 to 3.31)
Long-term limiting illness								
No	222	420			941	23		
Yes	1182	389	0.18	(0.15 to 0.22)	420	82	7.99	(4.96 to 12.86)

Figure 2: Kaplan Meier survival plots comparing: (a) resilient versus non-resilient; (b) vulnerable versus non-vulnerable groups.



Dotted lines indicate 95% confidence intervals

Table 2: Hazard ratios (HR) and 95% confidence intervals (CI) for ten-year mortality amongst vulnerable and resilient groups

	Deaths n (%)		Resilient group			Deaths n (%)		Vulnerable group		
Cause of death	**Resilient**	**Non-resilient**	**Unadjusted HR (95% CI)**	**Adjusted HR [a] (95% CI)**	**Adjusted HR [b] (95% CI)**	**Vulnerable**	**Non-vulnerable**	**Unadjusted HR (95% CI)**	**Adjusted HR [a] (95% CI)**	**Adjusted HR [b] (95% CI)**
All cause mortality	173 (21.1)	454 (31.9)	**0.61 (0.51 to 0.73)**	**0.67 (0.55 to 0.81)**	**0.75 (0.62 to 0.91)**	35 (32.7)	290 (20.9)	**1.73 (1.22 to 2.46)**	**1.73 (1.20 to 2.49)**	**1.45 (1.01 to 2.11)**
Circulatory system	68 (9.5)	184 (16.0)	**0.57 (0.43 to 0.76)**	**0.67 (0.49 to 0.90)**	0.79 (0.58 to 1.07)	16 (18.2)	117 (9.6)	**2.05 (1.22 to 3.45)**	**2.07 (1.19 to 3.59)**	**1.91 (1.08 to 3.38)**
Neoplasm	52 (7.4)	112 (10.4)	**0.71 (0.51 to 0.98)**	**0.65 (0.46 to 0.92)**	**0.64 (0.44 to 0.93)**	7 (8.9)	98 (8.2)	1.10 (0.51 to 2.36)	1.16 (0.53 to 2.54)	0.93 (0.42 to 2.08)
All other causes	53 (6.5)	158 (11.1)	**0.53 (0.39 to 0.73)**	**0.63 (0.45 to 0.87)**	0.77 (0.55 to 1.09)	12 (11.2)	75 (5.4)	**2.31 (1.25 to 4.24)**	**2.21 (1.16 to 4.18)**	1.64 (0.85 to 3.17)

Those classified as resilient compared against non-resilient and those classified as vulnerable compared against those non-vulnerable

[a] Adjusted for sex, age group , housing, and employment

[b] Adjusted for sex, age group , housing, employment and long-term limiting illness

Table 3: Specialist (hospital) care use over 10-year follow-up: comparison of resilient and non-resilient groups

	Any outpatient/day case visit					Number of outpatient/day case visits (excluding pts with no visits)				
	Non-resilient N	Resilient N	Adjusted OR†	(95%CI)	p	Non-resilient median	Resilient median	Adjusted IRR†	(95%CI)	p
Medicine	840	478	1.11	(0.90 to 1.37)	0.34	3	3	1.07	(0.86 to 1.34)	0.53
Surgical	1010	593	0.97	(0.77 to 1.23)	0.82	4	4	0.96	(0.82 to 1.12)	0.61
Musculoskeletal	204	89	0.95	(0.69 to 1.30)	0.74	4	4	1.11	(0.71 to 1.75)	0.65
Oncology	147	83	1.01	(0.72 to 1.42)	0.93	5	5	1.05	(0.65 to 1.72)	0.83
Anaesthetics	107	26	**0.46**	**(0.27 to 0.79)**	**0.002**	3	2	1.07	(0.44 to 2.56)	0.89
Psychiatry	155	73	1.03	(0.72 to 1.47)	0.89	3	2	0.85	(0.42 to 1.72)	0.65
All	1211	720	1.21	(0.90 to 1.64)	0.21	9	8	0.94	(0.83 to 1.07)	0.38

	Any inpatient days					Total inpatient days (excluding pts with no visits)				
	Non-resilient N	Resilient N	Adjusted OR†	(95%CI)	p	Non-resilient median	Resilient median	Adjusted IRR†	(95%CI)	p
Medicine	755	373	1.02	(0.82 to 1.28)	0.84	19	15	1.01	(0.81 to 1.26)	0.90
Surgical	646	331	0.84	(0.68 to 1.03)	0.10	7	6	0.85	(0.64 to 1.11)	0.23
Musculoskeletal‡	53	16	0.72	(0.39 to 1.31)	0.28	12	10	0.76	(0.38 to 1.51)	0.43
Oncology	70	49	1.06	(0.67 to 1.67)	0.80	11	15	1.58	(0.44 to 5.64)	0.48
Anaesthetics‡	54	17	0.76	(0.42 to 1.36)	0.35	2	4	1.21	(0.25 to 5.88)	0.81
Psychiatry‡	53	19	0.72	(0.41 to 1.27)	0.26	47	58	1.54	(0.52 to 4.59)	0.43
All	1017	514	0.80	(0.64 to 1.01)	0.06	21	17	1.06	(0.86 to 1.30)	0.60

†Analysis adjusted for sex, age, housing, employment, and long term limiting illness; except where rows marked otherwise.
‡ Analysis adjusted for long term limiting illness only.

Table 4: Specialist (hospital) care use over 10-year follow-up: comparison of vulnerable and non-vulnerable groups

	Any outpatient/day case visit					Number of outpatient/day case visits (excluding pts with no visits)				
	Non-vulnerable N	Vulnerable N	Adjusted OR†	(95%CI)	p	Non-vulnerable median	Vulnerable median	Adjusted IRR†	(95%CI)	p
Medicine	695	55	0.79	(0.51 to 1.22)	0.29	3	3	0.97	(0.58 to 1.64)	0.92
Surgical	1046	73	0.68	(0.43 to 1.09)	0.11	4	5	1.11	(0.79 to 1.56)	0.54
Musculoskeletal‡	116	7	0.56	(0.25 to 1.26)	0.16	4	13	1.48	(0.48 to 4.53)	0.50
Oncology‡	139	7	0.62	(0.28 to 1.38)	0.24	5	10	1.27	(0.46 to 3.53)	0.65
Anaesthetics‡	16	4	2.45	(0.75 to 7.96)	0.14	2	1.5	6.39	(0.73 to 55.97)	0.09
Psychiatry‡	107	16	**1.96**	**(1.06 to 3.61)**	**0.03**	2	1.5	1.45	(0.46 to 4.58)	0.52
All	1238	86	**0.43**	**(0.25 to 0.75)**	**0.003**	6	8	1.18	(0.88 to 1.58)	0.27

	Any inpatient days					Total inpatient days (excluding pts with no visits)				
	Non-vulnerable N	Vulnerable N	Adjusted OR†	(95%CI)	p	Non-vulnerable median	Vulnerable median	Adjusted IRR†	(95%CI)	p
Medicine	579	56	1.1	(0.68 to 1.77)	0.70	12	21	1.32	(0.84 to 2.07)	0.24
Surgical	569	54	1.37	(0.89 to 2.12)	0.16	6	7	1.07	(0.68 to 1.69)	0.76
Musculoskeletal‡	14	2	1.05	(0.23 to 4.86)	0.95	7.5	9	0.68	(0.24 to 1.94)	0.47
Oncology‡	65	5	0.92	(0.35 to 2.40)	0.86	13	18	0.71	(0.24 to 2.04)	0.52
Anaesthetics‡	28	2	0.82	(0.18 to 3.65)	0.80	3	2	**0.06**	**(0.00 to 0.93)**	**0.04**
Psychiatry‡	27	4	1.54	(0.50 to 4.70)	0.45	123	11.5	0.29	(0.09 to 0.98)	0.05
All	865	82	1.56	(0.92 to 2.67)	0.10	13	19	1.13	(0.76 to 1.68)	0.56

†Adjusted for sex, age, housing, employment, and long term limiting illness; except where rows marked otherwise.
‡ Adjusted for long term limiting illness only.

Appendix 1: Grouping of hospital activity categories

Pooled categories analysed	Original specialty group (ISD coding)
Medicine	General medicine (A1)
	Geriatric medicine (AB)
	Cardiology (A2)
	Endocrinology and diabetes (A8)
	Endocrinology (A81)
	Diabetes (A82)
	Gastroenterology (A9)
	Renal medicine (AG)
	Respiratory medicine (AQ)
	Clinical genetics (A3)
	Infectious diseases (A6)
	Dermatology (A7)
	Homeopathy (AC)
	Neurology (AH)
	Rehabilitation medicine (AP)
	GP other than obstetrics (E12)
Surgical	General surgery (C1)
	General surgery excluding vasc & max (C11)
	Vascular surgery (C12)
	ENT (C5)
	Gynaecology (F2)
	Cardiac surgery (C41)
	Thoracic surgery (C42)
	Neurosurgery (C6)
	Plastic surgery (C9)
	Opthalmology (C7)
	Urology (CB)
	Oral surgery (D3)
	Oral medicine (D4)
	Orthodontics (D5)
	Restorative dentistry (D6)
Musculoskeletal	Rheumatology (AR)
	Orthopaedic surgery (C8)
Oncology	Medical oncology (AD)
	Clinical oncology (H2)
	Haematology (J4)
	Palliative medicine (AM)
Anaesthetics	Anaesthetics (C3)
Psychiatry	General psychiatry (G1)
	Forensic psychiatry (G3)
	Psychiatry of old age (G4)
	Learning disability (G5)

Competing interest declaration

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Author Contribution

AME and PCH planned and designed the paper. AME and CDB conducted the analysis. AME produced the first draft of the paper. CDB and PCH read and commented on the paper. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. All authors have seen and approved the final version of the paper. AME is the guarantor of the paper. She accepts full responsibility for the conduct of the study.

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Ethical approval

The study was approved by the Privacy Advisory Committee of NHS National Services, Scotland. Grampian Research Ethics Committee approved the original questionnaire survey and

subsequently confirmed that ethical approval was not required for the new linkage since no information was being collected from participants and the linked dataset was anonymised.

Data sharing

Patient level data from the linked dataset could be made available from the corresponding author when relevant. Informed consent was not obtained because the presented data are completely anonymous.

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Resilience does matter: evidence from a ten-year cohort record linkage study

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Resilience does matter: evidence from a ten-year cohort record linkage study

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ABSTRACT

Objectives To examine ten-year mortality and hospital use among individuals categorised as resilient and vulnerable to the impact of chronic pain.

Design A cohort record linkage study.

Setting Grampian, Scotland

Participants 5858 individuals from the Grampian Pain Cohort, established in 1996, were linked, by probability matching, with national routinely collected datasets.

Main outcome measures Hazard ratios for subsequent ten-year mortality and odds ratios/incidence rate ratios for subsequent ten-year hospital use, each with adjustment for potential confounding variables.

Results 36.5% of those with high pain intensity reported low pain-related disability (categorised resilient) and 7.1% of those reporting low pain intensity reported high pain-related disability (categorised vulnerable). Sex, age, housing, employment and long-term limiting illness were independently associated with being vulnerable or resilient. After adjustment for these variables, individuals in the resilient group were 25% less likely to die within 10 years of the survey compared with non-resilient individuals: Hazard Ratio (HR) 0.75, 95% Confidence Interval (CI) 0.62 to 0.91 and vulnerable individuals were 45% more

likely to die than non-vulnerable individuals: HR 1.45, 95%CI 1.01 to 2.11. Resilient individuals were less likely to have had an outpatient or day-case visit for anaesthetics: Odds Ratio (OR) 0.46, 95% CI 0.27 to 0.79, but no other clinical specialities. Vulnerable individuals were significantly less likely to have had any outpatient or day case visit (OR 0.43, 0.25 to 0.75); but more likely to have had a psychiatric visit (OR 1.96, 1.06 to 3.61). No significant differences in likelihood of any inpatient visits were found.

Conclusions Resilient individuals have better ten-year survival than non-resilient individuals indicating that resilience is a phenomenon worth researching. Further research is needed to explore who is likely to become resilient, why and how, as well as to tease out the internal and external factors that influence resilience.

ARTICLE SUMMARY

Article focus

- Little is known about the long term outcomes of resilient and vulnerable individuals.
- We examined long-term hospital use and mortality among those categorised as resilient and those categorised as vulnerable to the impact of chronic pain.
- Our hypotheses were that individual's categorized as resilient would fare better than a comparison group with a similar level of chronic pain, and individuals categorised as vulnerable would do worse.

Key messages

- Resilient individuals were 25% less likely to die within 10 years than non-resilient individuals and vulnerable individuals were 45% more likely to die than non-vulnerable individuals.
- There were few differences in the use of hospital services over the ten years between the groups.
- Our findings suggest that the concept of resilience is a phenomenon worth researching. Important gains may be made in understanding who is likely to become resilient, why and how.

Strengths and limitations of this study

- This is the first study to examine the long term effects of resilience or vulnerability to chronic pain in terms of survival and hospital use.

- A major strength of our study was its community base, meaning results from this study are more likely to be representative of people living in the community than those from studies using samples from healthcare settings, such as pain clinics.
- The prospective nature of the study meant that pain status was ascertained before outcome was measured, avoiding recall bias.
- We did not use a formal resilience measurement scale. Instead we categorised individuals on the basis of their scores on the intensity and disability sub-scales of a chronic pain measure.
- Although we were able to adjust for several socio-demographic variables in the analysis, some other potentially important factors were not fully available in the dataset (e.g. smoking).

INTRODUCTION

Chronic pain is common. [1-3] It has wide reaching physical, psychological, and social consequences [3-7] and places a heavy burden on individuals, society and healthcare services. [8, 9] While much clinical practice and research focuses on those who do badly with a condition ('vulnerable' individuals), interest is growing in understanding the characteristics and experiences of those who appear to do well ('resilient' individuals). [10 11] Recent studies have examined resilience to physical illness, [12] menopausal symptoms [13] and specific conditions such as diabetes, [14] epilepsy, [15] asthma [16] and chronic pain. [17-22] These studies have provided useful insights into the short-term importance of resilience. They have also indicated some of the factors accounting for why certain people appear to cope better with their condition than others, such as socio-economic factors, individual personality traits, psychological factors, spirituality, social support and general health. Little is known, however, about the long term outcomes of resilient and vulnerable individuals. Such information is needed to understand the clinical and research relevance of trying to identify both sets of individuals.

In this paper we linked information about respondents to a large community-based survey with routinely collected health service data to examine long-term (ten year) hospital use and mortality among those categorised as resilient and vulnerable to the impact of chronic pain. Our hypothesis was that those categorized as resilient would fare better than a comparison group with a similar level of chronic pain, and those categorised as vulnerable would do worse.

METHODS

Grampian cohort

The Grampian cohort, established in July 1996, [2] comprised 6,940 adults (aged 25+ years) recruited from 29 practices across Grampian, North East Scotland. These included 3,605 individuals recruited through random selection from everyone registered with the practice (essentially a general population sample) and 3,335 individuals recruited through random selection based on those receiving repeat prescriptions for analgesic use. Full details of the survey have been reported previously. [23] Briefly, participants were sent a postal questionnaire in 1996 which included questions about the presence and severity of chronic pain and a range of items regarding health and socio-demographic details. The corrected response rate was 84.3% after two reminders. Study respondents were broadly representative of the Grampian population. [7]

Chronic pain status

Individuals with chronic pain were identified by affirmative answers to two questions based on the International Study for the Association of Pain (IASP) definition [24]: (i) Are you currently troubled by pain or discomfort, either all the time or on and off? (ii) Have you had this pain or discomfort for more than three months?

Pain severity

Chronic pain severity was assessed using the Chronic Pain Grade (CPG) questionnaire. [25] This is a seven-item instrument that measures severity in two dimensions: intensity sub-scale (three visual analogue scale items: current, worst and average pain intensity in the last six

months) and disability sub-scale (three visual analogue scale items: interference with daily activities, social activities and daily work in the last six months; and one item on number of days off work). A score is generated from the three visual analogue scale items for each sub-scale, from 0 (best possible pain state) to 100 (worst possible pain state). These scores and the item on number of days off work are then used to classify chronic pain into four hierarchical grades, from Grade I (low disability-low intensity pain) to Grade IV (high disability-severely limiting pain). The CPG has been shown to be valid and reliable for use in a self-completion postal questionnaire in the UK general population. [26] Only those who gave affirmative answers to both of the chronic pain questions were asked to complete the CPG questionnaire.

General health & socio-economic details

The questionnaire included several questions about general health. For this paper we used results from a question on the presence or absence of a long-term limiting illness drawn from the National Census (http://www.gro-scotland.gov.uk/files/hseform.pdf). The questionnaire also included items regarding sex, age, marital status, education, housing, social support and employment status.

National routinely collected datasets

In Scotland, routinely collected health information and statistics are collated and stored in a national database by the Information Services Division (ISD), NHS Scotland (http://www.isdscotland.org/isd/1.html). These routinely collected national datasets can be linked with existing cohorts where adequate personal details are available. An advantage of using national datasets is the ability to follow up members of a cohort who remain in

Scotland but who move away from their recruitment location. Data (from 1996 to 2006 inclusive) about respondents to the Grampian survey was requested from four of the national datasets: the General Register Office death records; SMR00- first attendances at outpatient clinics; SMR01- inpatient and day case episodes in general and acute wards of hospitals; and SMR04- inpatient and day cases in psychiatric units and hospitals.

Record linkage

A copy of the Grampian cohort dataset was forwarded to the Medical Records Linkage Team at ISD who undertook the linkage. ISD-held data were linked using standard probability matching procedures based on common patient identifiable fields. The new linked dataset was stripped of patient identifiers by ISD and returned to the research team in an anonymised format. This approach enabled detailed analysis of the linked data, whilst maintaining patient confidentiality. The study was approved by the Privacy Advisory Committee of NHS National Services, Scotland. Grampian Research Ethics Committee approved the original questionnaire survey and subsequently confirmed that ethical approval was not required for the new linkage since no information was being collected from participants and the linked dataset was anonymised.

Identification of resilient and vulnerable individuals

Individuals were categorised into one of four groups based on their scores on the intensity and disability sub-scales of the CPG. Individuals with low pain-related disability (<50/100) despite high pain intensity (≥50/100) were categorised as 'resilient'; these individuals were compared with 'non-resilient' individuals who reported both high pain-related disability (≥50/100) and high intensity pain (≥50/100). Individuals with high pain-related disability

(≥50/100) in spite of low intensity pain (<50/100) were categorised as 'vulnerable'; these individuals were compared with 'non-vulnerable' individuals who reported low intensity pain (<50/100) and low pain-related disability (<50/100).

Grouping of hospital-related data

Routine data were available for 42 different clinical specialties and included the number of visits (as out-patient or day-case) and the total number of days spent as an in-patient, for each specialty. In order to maximise our statistical power we pooled the different visit types and collapsed the data into six categories: 1) medicine (general medicine, geriatric medicine, all major medical specialties except rheumatology), 2) surgery (general surgery, all surgical specialties e.g. ENT, gynaecology, but excluding orthopaedic surgery); 3) musculo-skeletal (rheumatology and orthopaedic surgery); 4) anaesthetics (as pain clinics are coded by this specialty); 5) oncology (including palliative care and haematology); and 6) psychiatry. Full details of the categorisation are in appendix 1. Information about use of Accident & Emergency services, which are largely accessed in an unscheduled way, was not available since the datasets requested relate to scheduled care.

Statistical analysis

Data were analysed using SPSS for Windows (version 19) and R 2.15.2. Descriptive statistics examined the proportion of people categorised as resilient or vulnerable. Binary logistic regression was then used to examine the demographic, socio-economic and health factors associated with being in each group. In each case resilient individuals were compared with those in the non-resilient comparison group and those in the vulnerable group were compared with those in the non-vulnerable comparison group.

Cox regression survival analysis was conducted to obtain unadjusted and adjusted hazard ratios (HR) with 95% confidence intervals (CI) for all-cause mortality and cause of death. Adjustments were made for factors independently associated with being vulnerable or resilient on multivariate analysis. The assumption of constant time dependent covariates was checked for each model and found to hold.

Hospital use was analysed using a two stage procedure to test for differences in both binary (any visits or none) and continuous (number of visits in those having at least one visit) components. In view of over-dispersion in the data we used negative binomial regression for the continuous component with logistic regression for the binary. Results were expressed as odds ratios (OR) for the binary and incidence rate ratios (IRR) for the continuous component.

Sensitivity analyses were conducted to explore how our findings changed if: i) pain-related disability was measured in a different way; and ii) we adjusted for additional factors with incomplete data.

RESULTS

ISD managed to link 5,858 (84.4%) of the 6,940 individuals in the original Grampian cohort. The characteristics of the linked cohort were very similar to the original complete cohort with no significant differences in demographic, socio-economic or pain factors. A total of 4139 (70.7%) of those in the linked cohort had chronic pain at baseline of which 3739

(90.3%) had detailed information on pain intensity and disability and were included in subsequent analyses (see Figure 1).

Resilience and vulnerability

Of the 2242 individuals reporting high intensity pain, 819 (36.5%) reported low pain-related disability and were categorised as resilient, while 1423 (63.5%) reported high pain-related disability and were categorised as non-resilient. Among the 1497 individuals reporting low intensity pain, 107 (7.1%) had high pain-related disability and so were categorised as vulnerable, compared with 1390 (92.9%) who reported low pain-related disability and were categorised as non-vulnerable.

Factors associated with being resilient and vulnerable

Table 1 presents the measured demographic, socio-economic and health factors associated with being in the resilient and vulnerable groups. On univariate analysis, individuals were *less* likely to be classified as resilient to their chronic pain if they were female, older, no longer married, had less than an university education, lived in rented accommodation, lived with no other adults, were not working and had a long-term limiting illness. Conversely, individuals were *more* likely to be classified as vulnerable to their chronic pain if they lived in rented council accommodation, lived with no other adults, were unable to work and had a long-term limiting illness. On multivariate analysis: sex, age, housing, employment and long-term limiting illness were identified as the factors independently associated with being vulnerable or resilient and were adjusted for in subsequent analyses.

Mortality

During the ten-year follow-up period, 21.1% of the resilient group and 31.9% of the non-resilient group died (Table 2). In comparison, 32.7% of the vulnerable group and 20.9% of the non-vulnerable group died. The main causes of death were broadly similar in each group (Table 2).

Kaplan Meier survival plots (Figure 2) show a progressive divergence over time between resilient and non-resilient groups, and between vulnerable and non-vulnerable groups, with no discontinuity. Table 2 details the results of the Cox proportional hazards regression (expressed as hazard ratios). After adjusting for sex, age, housing, employment (independently associated socio-demographic factors), and long term limiting illness individuals in the resilient group were 25% less likely to die within 10 years of the survey compared with non-resilient individuals: HR 0.75, 95% CI 0.62 to 0.91. A statistically significant reduction in death from cancer among the resilient group also remained (HR 0.64, 0.44 to 0.93) after adjustment. After adjustment, vulnerable individuals were more likely to die over the ten year period than non-vulnerable individuals: HR 1.45, 1.01 to 2.11 and vulnerable individuals were significantly more likely to die from circulatory diseases than those in the non-vulnerable group (HR 1.91, 1.08 to 3.38).

Hospital use

Most individuals in each group used a hospital service at least once during the ten year follow up period. Outpatient or day-case attendance occurred in 720 (87.9%) of resilient individuals, 1211 (85.1%) of non-resilient individuals, 86 (80.4%) vulnerable individuals and 1238 (89.1%) of the non-vulnerable individuals. At least one inpatient admission occurred in

514 (62.8%) resilient individuals, 1017 (71.5%) non-resilient individuals, 82 (76.6%) vulnerable individuals and 865 (62.2%) non-vulnerable individuals.

Details of hospital use over the ten-year follow-up period are presented in table 3 (comparing resilient and non-resilient groups) and table 4 (comparing vulnerable and non-vulnerable groups). Table 3 shows that compared with non-resilient individuals, resilient individuals with chronic pain were less likely to have had an outpatient or day-case visit for anaesthetics, the specialty which hosts pain clinics: adjusted OR 0.46, 0.27 to 0.79. There were no other statistically significant differences in visits for other clinical specialities. There were no statistically significant differences in the number of outpatient or day case visits. Nor were there any statistically significant differences in inpatient days between resilient and non-resilient groups. Compared with non-vulnerable individuals, those in the vulnerable group were significantly less likely to have any outpatient or day case visits (Table 4: adjusted OR 0.43, 0.25 to 0.75); and more likely to have an outpatient or day case psychiatric visit (OR 1.96, 1.06 to 3.61). There were no statistically significant differences in the number of outpatient or day case visits. No differences were observed between vulnerable and non-vulnerable groups for likelihood of any inpatient visits, or total number of inpatient days (except for anaesthetics). However, the very small number of inpatient admissions in the vulnerable group indicates that any inference from these should be viewed with caution.

DISCUSSION

This is the first study to examine the long term effects of resilience or vulnerability to chronic pain in terms of survival and hospital use. We found that resilience to chronic pain

(as defined by low disability in spite of high intensity pain) was associated with a significantly reduced risk of death over the subsequent ten years. With the exception of pain services, resilient individuals made the same use of specialist services as the non-resilient comparator group. We also found that individuals classified as vulnerable to their chronic pain had poorer survival than those in the non-vulnerable comparison group. The few differences between vulnerable and non-vulnerable individuals in their use of hospital services related mainly to psychiatric and anaesthetic services.

A major strength of our study was its community base. Results from this study are more likely to be representative of people living in the community than those from studies using samples from healthcare settings, such as pain clinics. The prospective nature of the study meant that pain status was ascertained before outcome was measured, avoiding recall bias. Furthermore, long-term outcomes were available for analysis. We did not collect data using a formal resilience scale[27], unlike some previous studies of chronic pain [17 18 28]. The lack of standardised definitions of vulnerability and resilience and the lack of use of a formal resilience scale are limitations of our study. Instead, our analyses assume that self reported pain intensity and disability due to pain correctly differentiated respondents into those resilient or vulnerable to the effects of chronic pain. Individuals were categorised based on their scores on the intensity and disability sub-scales of the CPG. Use of the two sub-scales allowed us to use a measure of disability that was directly related to pain, rather than use of a generic measure of health that could have been influenced by other conditions. This approach meant that the two sub-scales were directly comparable. Since we did not use the 'days off work' question in the CPG questionnaire normally used to grade people, a sensitivity analysis was undertaken to examine the effect of including this additional

question. Analysis showed that the findings did not materially change, with the same overall pattern of results seen (data not shown). A strength of our approach is that it moves away from groupings based on help seeking behaviour which is known to be a poor marker of actual functioning. [29 30] Consulting a health care professional may not always identify individuals who are "resilient" or "vulnerable" to their symptoms.

Resilience and vulnerability were associated with several socio-demographic variables and we were able to adjust for these in the analysis. Some other potentially important factors were not fully available in the dataset, but were examined in an additional set of sensitivity analyses to examine the effects of smoking and mental health in relation to survival. Data on cigarette smoking was available from a follow up survey (conducted four years after baseline) for 1572 of the 3739 individuals. There were no specific measures of mental health in the original survey although it did include the SF-36 measure of health related quality of life which includes a Mental Health component. Adding both of these variables in turn into the survival models did not change the hazard ratios substantially, although incomplete data led to wider confidence intervals. While we found few differences in specialist care use between groups, our analyses did not allow for different survival between groups, which meant that resilient individuals tended to have a longer period of time in which to receive specialist treatment than non-resilient individuals; and vulnerable individuals less time than non-vulnerable individuals. These patterns of survivorship are likely to exaggerate differences between groups, rather than diminish them.

There is growing interest in the phenomenon of resilience in a range of health and social sciences. While hard to define, [11 31 32] it has been suggested that resilience describes

something more than either hardiness (for instance not becoming unwell) or coping. Instead it implies both experiencing adversity (illness) and adapting in order to bounce back and thrive, sometimes in changed ways. [33] Our finding of generally comparable healthcare use between resilient and non-resilient individuals suggests that resilience in our study was not simply measuring hardiness.

Whatever resilience is, and however it is measured, our finding of better survival among resilient people with chronic pain, suggests that resilience is a phenomenon worth researching. It was noteworthy that a larger proportion (36.5%) of individuals were resilient than vulnerable (7.1%). This suggests that important gains may be made in understanding who is likely to become resilient, why and how. We also need to understand more about how resilience changes with time and what factors influences this. While there is already some information available regarding the traits and activities that seem to influence resilience (such as family, mood, social class, socio-economic status and life events),[20 34 35] further research is needed to tease out both the internal and external factors that influence an individual's resilience. Of particular importance will be the identification of modifiable factors that could be used to help build additional resilience in individuals who could benefit.

Competing interest declaration

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Author Contribution

AME and PCH planned and designed the paper. AME and CDB conducted the analysis. AME produced the first draft of the paper. CDB and PCH read and commented on the paper. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. All authors have seen and approved the final version of the paper. AME is the guarantor of the paper. She accepts full responsibility for the conduct of the study.

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Ethical approval

The study was approved by the Privacy Advisory Committee of NHS National Services, Scotland. Grampian Research Ethics Committee approved the original questionnaire survey and subsequently confirmed that ethical approval was not required for the new linkage since no information was being collected from participants and the linked dataset was anonymised.

Data sharing

Patient level data from the linked dataset could be made available from the corresponding author when relevant. Informed consent was not obtained because the presented data are completely anonymous.

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Figure 1: Flow chart depicting study process

Figure 2: Kaplan Meier survival plots comparing: (a) resilient versus non-resilient; (b) vulnerable versus non-vulnerable groups.

Dotted lines indicate 95% confidence intervals

Table 1: Factors associated with being in the resilient or vulnerable groups.

	Non-resilient	Resilient			Non-vulnerable	Vulnerable		
	N	N	OR	(95%CI)	N	N	OR	(95%CI)
Sex								
Male	630	402			716	52		
Female	793	417	0.82	(0.69 to 0.98)	674	55	1.12	(0.76 to 1.67)
Age group								
25-34	80	68			113	10		
35-44	198	113	0.67	(0.45 to 1.00)	187	15	0.91	(0.39 to 2.09)
45-54	301	173	0.68	(0.47 to 0.98)	255	14	0.62	(0.27 to 1.44)
55-64	323	172	0.63	(0.43 to 0.91)	299	24	0.91	(0.42 to 1.96)
65-74	266	172	0.76	(0.52 to 1.11)	325	23	0.80	(0.37 to 1.73)
75+	255	121	0.56	(0.38 to 0.82)	211	21	1.12	(0.51 to 2.47)
Marital status								
Single	126	80			113	12		
Married / cohabit	909	587	1.02	(0.75 to 1.37)	1005	65	0.61	(0.32 to 1.16)
No longer married	367	147	0.63	(0.45 to 0.89)	253	28	1.04	(0.51 to 2.12)
Education								
University	118	123			305	17		
High school	260	178	0.66	(0.48 to 0.90)	335	24	1.29	(0.68 to 2.44)
No qualifications	878	470	0.51	(0.39 to 0.68)	656	60	1.64	(0.94 to 2.86)
Housing								
Owned/mortgaged	663	547			977	59		
Rented privately/other	62	30	0.59	(0.37 to 0.92)	64	6	1.55	(0.65 to 3.73)
Rented from council	675	236	0.42	(0.35 to 0.51)	323	40	2.05	(1.35 to 3.12)
Social support								
Other adults in home	968	602			1030	68		
No other adults	368	173	0.76	(0.61 to 0.93)	271	35	1.96	(1.27 to 3.00)
Employment								
Working	271	386			657	34		
Retired	474	270	0.40	(0.32 to 0.50)	527	42	1.54	(0.97 to 2.46)
Unable to work	504	76	0.11	(0.08 to 0.14)	38	16	8.14	(4.13 to 16.03)
Unemployed	122	66	0.38	(0.27 to 0.53)	130	11	1.64	(0.81 to 3.31)
Long-term limiting illness								
No	222	420			941	23		
Yes	1182	389	0.18	(0.15 to 0.22)	420	82	7.99	(4.96 to 12.86)

Table 2: Hazard ratios (HR) and 95% confidence intervals (CI) for ten-year mortality amongst vulnerable and resilient groups

	Deaths n (%)		Resilient group			Deaths n (%)		Vulnerable group		
Cause of death	**Resilient**	**Non-resilient**	**Unadjusted HR (95% CI)**	**Adjusted HR [a] (95% CI)**	**Adjusted HR [b] (95% CI)**	**Vulnerable**	**Non-vulnerable**	**Unadjusted HR (95% CI)**	**Adjusted HR [a] (95% CI)**	**Adjusted HR [b] (95% CI)**
All cause mortality	173 (21.1)	454 (31.9)	**0.61 (0.51 to 0.73)**	**0.67 (0.55 to 0.81)**	**0.75 (0.62 to 0.91)**	35 (32.7)	290 (20.9)	**1.73 (1.22 to 2.46)**	**1.73 (1.20 to 2.49)**	**1.45 (1.01 to 2.11)**
Circulatory system	68 (9.5)	184 (16.0)	**0.57 (0.43 to 0.76)**	**0.67 (0.49 to 0.90)**	0.79 (0.58 to 1.07)	16 (18.2)	117 (9.6)	**2.05 (1.22 to 3.45)**	**2.07 (1.19 to 3.59)**	**1.91 (1.08 to 3.38)**
Neoplasm	52 (7.4)	112 (10.4)	**0.71 (0.51 to 0.98)**	**0.65 (0.46 to 0.92)**	**0.64 (0.44 to 0.93)**	7 (8.9)	98 (8.2)	1.10 (0.51 to 2.36)	1.16 (0.53 to 2.54)	0.93 (0.42 to 2.08)
All other causes	53 (6.5)	158 (11.1)	**0.53 (0.39 to 0.73)**	**0.63 (0.45 to 0.87)**	0.77 (0.55 to 1.09)	12 (11.2)	75 (5.4)	**2.31 (1.25 to 4.24)**	**2.21 (1.16 to 4.18)**	1.64 (0.85 to 3.17)

Those classified as resilient compared against non-resilient and those classified as vulnerable compared against those non-vulnerable

[a] Adjusted for sex, age group , housing, and employment

[b] Adjusted for sex, age group , housing, employment and long-term limiting illness

	Any outpatient/day case visit					Number of outpatient/day case visits (excluding pts with no visits)				
	Non-resilient N	Resilient N	Adjusted OR†	(95%CI)	p	Non-resilient median	Resilient median	Adjusted IRR†	(95%CI)	p
Medicine	840	478	1.11	(0.90 to 1.37)	0.34	3	3	1.07	(0.86 to 1.34)	0.53
Surgical	1010	593	0.97	(0.77 to 1.23)	0.82	4	4	0.96	(0.82 to 1.12)	0.61
Musculoskeletal	204	89	0.95	(0.69 to 1.30)	0.74	4	4	1.11	(0.71 to 1.75)	0.65
Oncology	147	83	1.01	(0.72 to 1.42)	0.93	5	5	1.05	(0.65 to 1.72)	0.83
Anaesthetics	107	26	**0.46**	**(0.27 to 0.79)**	**0.002**	3	2	1.07	(0.44 to 2.56)	0.89
Psychiatry	155	73	1.03	(0.72 to 1.47)	0.89	3	2	0.85	(0.42 to 1.72)	0.65
All	1211	720	1.21	(0.90 to 1.64)	0.21	9	8	0.94	(0.83 to 1.07)	0.38

	Any inpatient days					Total inpatient days (excluding pts with no visits)				
	Non-resilient N	Resilient N	Adjusted OR†	(95%CI)	p	Non-resilient median	Resilient median	Adjusted IRR†	(95%CI)	p
Medicine	755	373	1.02	(0.82 to 1.28)	0.84	19	15	1.01	(0.81 to 1.26)	0.90
Surgical	646	331	0.84	(0.68 to 1.03)	0.10	7	6	0.85	(0.64 to 1.11)	0.23
Musculoskeletal‡	53	16	0.72	(0.39 to 1.31)	0.28	12	10	0.76	(0.38 to 1.51)	0.43
Oncology	70	49	1.06	(0.67 to 1.67)	0.80	11	15	1.58	(0.44 to 5.64)	0.48
Anaesthetics‡	54	17	0.76	(0.42 to 1.36)	0.35	2	4	1.21	(0.25 to 5.88)	0.81
Psychiatry‡	53	19	0.72	(0.41 to 1.27)	0.26	47	58	1.54	(0.52 to 4.59)	0.43
All	1017	514	0.80	(0.64 to 1.01)	0.06	21	17	1.06	(0.86 to 1.30)	0.60

Table 3: Specialist (hospital) care use over 10-year follow-up: comparison of resilient and non-resilient groups

†Analysis adjusted for sex, age, housing, employment, and long term limiting illness; except where rows marked otherwise.

‡ Analysis adjusted for long term limiting illness only.

	Any outpatient/day case visit			Number of outpatient/day case visits (excluding pts with no visits)		
	Non-vulnerable	Vulnerable	Adjusted OR†	Non-vulnerable	Vulnerable	Adjusted IRR†

Table 4: Specialist (hospital) care use over 10-year follow-up: comparison of vulnerable and non-vulnerable groups

	N	N		(95%CI)	p	median	median		(95%CI)	p
Medicine	695	55	0.79	(0.51 to 1.22)	0.29	3	3	0.97	(0.58 to 1.64)	0.92
Surgical	1046	73	0.68	(0.43 to 1.09)	0.11	4	5	1.11	(0.79 to 1.56)	0.54
Musculoskeletal‡	116	7	0.56	(0.25 to 1.26)	0.16	4	13	1.48	(0.48 to 4.53)	0.50
Oncology‡	139	7	0.62	(0.28 to 1.38)	0.24	5	10	1.27	(0.46 to 3.53)	0.65
Anaesthetics‡	16	4	2.45	(0.75 to 7.96)	0.14	2	1.5	6.39	(0.73 to 55.97)	0.09
Psychiatry‡	107	16	**1.96**	**(1.06 to 3.61)**	**0.03**	2	1.5	1.45	(0.46 to 4.58)	0.52
All	1238	86	**0.43**	**(0.25 to 0.75)**	**0.003**	6	8	1.18	(0.88 to 1.58)	0.27

	Any inpatient days					**Total inpatient days (excluding pts with no visits)**				
	Non-vulnerable N	**Vulnerable N**	**Adjusted OR†**	**(95%CI)**	**p**	**Non-vulnerable median**	**Vulnerable median**	**Adjusted IRR†**	**(95%CI)**	**p**
Medicine	579	56	1.1	(0.68 to 1.77)	0.70	12	21	1.32	(0.84 to 2.07)	0.24
Surgical	569	54	1.37	(0.89 to 2.12)	0.16	6	7	1.07	(0.68 to 1.69)	0.76
Musculoskeletal‡	14	2	1.05	(0.23 to 4.86)	0.95	7.5	9	0.68	(0.24 to 1.94)	0.47
Oncology‡	65	5	0.92	(0.35 to 2.40)	0.86	13	18	0.71	(0.24 to 2.04)	0.52
Anaesthetics‡	28	2	0.82	(0.18 to 3.65)	0.80	3	2	**0.06**	**(0.00 to 0.93)**	**0.04**
Psychiatry‡	27	4	1.54	(0.50 to 4.70)	0.45	123	11.5	0.29	(0.09 to 0.98)	0.05
All	865	82	1.56	(0.92 to 2.67)	0.10	13	19	1.13	(0.76 to 1.68)	0.56

†Adjusted for sex, age, housing, employment, and long term limiting illness; except where rows marked otherwise.
‡ Adjusted for long term limiting illness only.

Resilience does matter: evidence from a ten-year cohort record linkage study

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ABSTRACT

Objectives To examine ten-year mortality and hospital use among individuals categorised as resilient and vulnerable to the impact of chronic pain.

Design A cohort record linkage study.

Setting Grampian, Scotland

Participants 5858 individuals from the Grampian Pain Cohort, established in 1996, were linked, by probability matching, with national routinely collected datasets.

Main outcome measures Hazard ratios for subsequent ten-year mortality and odds ratios/incidence rate ratios for subsequent ten-year hospital use, each with adjustment for potential confounding variables.

Results 36.5% of those with high pain intensity reported low pain-related disability (categorised resilient) and 7.1% of those reporting low pain intensity reported high pain-related disability (categorised vulnerable). Sex, age, housing, employment and long-term limiting illness were independently associated with being vulnerable or resilient. After adjustment for these variables, individuals in the resilient group were 25% less likely to die within 10 years of the survey compared with non-resilient individuals: Hazard Ratio (HR) 0.75, 95% Confidence Interval (CI) 0.62 to 0.91 and vulnerable individuals were 45% more likely to die than non-vulnerable individuals: HR 1.45, 95%CI 1.01 to 2.11. Resilient

individuals were less likely to have had an outpatient or day-case visit for anaesthetics: Odds Ratio (OR) 0.46, 95% CI 0.27 to 0.79, but no other clinical specialities. Vulnerable individuals were significantly less likely to have had any outpatient or day case visit (OR 0.43, 0.25 to 0.75); but more likely to have had a psychiatric visit (OR 1.96, 1.06 to 3.61). No significant differences in likelihood of any inpatient visits were found.

Conclusions Resilient individuals have better ten-year survival than non-resilient individuals indicating that resilience is a phenomenon worth researching. Further research is needed to explore who is likely to become resilient, why and how, as well as to tease out the internal and external factors that influence resilience.

ARTICLE SUMMARY

Article focus

- Little is known about the long term outcomes of resilient and vulnerable individuals.
- We examined long-term hospital use and mortality among those categorised as resilient and those categorised as vulnerable to the impact of chronic pain.
- Our hypotheses were that individual's categorized as resilient would fare better than a comparison group with a similar level of chronic pain, and individuals categorised as vulnerable would do worse.

Key messages

- Resilient individuals were 25% less likely to die within 10 years than non-resilient individuals and vulnerable individuals were 45% more likely to die than non-vulnerable individuals.
- There were few differences in the use of hospital services over the ten years between the groups.
- Our findings suggest that the concept of resilience is a phenomenon worth researching. Important gains may be made in understanding who is likely to become resilient, why and how.

Strengths and limitations of this study

- This is the first study to examine the long term effects of resilience or vulnerability to chronic pain in terms of survival and hospital use.

- A major strength of our study was its community base, meaning results from this study are more likely to be representative of people living in the community than those from studies using samples from healthcare settings, such as pain clinics.
- The prospective nature of the study meant that pain status was ascertained before outcome was measured, avoiding recall bias.
- We did not use a formal resilience measurement scale. Instead we categorised individuals on the basis of their scores on the intensity and disability sub-scales of a chronic pain measure.
- Although we were able to adjust for several socio-demographic variables in the analysis, some other potentially important factors were not fully available in the dataset (e.g. smoking).

INTRODUCTION

Chronic pain is common. [1-3] It has wide reaching physical, psychological, and social consequences [3-7] and places a heavy burden on individuals, society and healthcare services. [8, 9] While much clinical practice and research focuses on those who do badly with a condition ('vulnerable' individuals), interest is growing in understanding the characteristics and experiences of those who appear to do well ('resilient' individuals). [10 11] Recent studies have examined resilience to physical illness, [12] menopausal symptoms [13] and specific conditions such as diabetes, [14] epilepsy, [15] asthma [16] and chronic pain. [17-22] These studies have provided useful insights into the short-term importance of resilience. They have also indicated some of the factors accounting for why certain people appear to cope better with their condition than others, such as socio-economic factors, individual personality traits, psychological factors, spirituality, social support and general health. Little is known, however, about the long term outcomes of resilient and vulnerable individuals. Such information is needed to understand the clinical and research relevance of trying to identify both sets of individuals.

In this paper we linked information about respondents to a large community-based survey with routinely collected health service data to examine long-term (ten year) hospital use and mortality among those categorised as resilient and vulnerable to the impact of chronic pain. Our hypothesis was that those categorized as resilient would fare better than a comparison group with a similar level of chronic pain, and those categorised as vulnerable would do worse.

METHODS

Grampian cohort

The Grampian cohort, established in July 1996, [2] comprised 6,940 adults (aged 25+ years) recruited from 29 practices across Grampian, North East Scotland. These included 3,605 individuals recruited through random selection from everyone registered with the practice (essentially a general population sample) and 3,335 individuals recruited through random selection based on those receiving repeat prescriptions for analgesic use. Full details of the survey have been reported previously. [23] Briefly, participants were sent a postal questionnaire in 1996 which included questions about the presence and severity of chronic pain and a range of items regarding health and socio-demographic details. The corrected response rate was 84.3% after two reminders. Study respondents were broadly representative of the Grampian population. [7]

Chronic pain status

Individuals with chronic pain were identified by affirmative answers to two questions based on the International Study for the Association of Pain (IASP) definition [24]: (i) Are you currently troubled by pain or discomfort, either all the time or on and off? (ii) Have you had this pain or discomfort for more than three months?

Pain severity

Chronic pain severity was assessed using the Chronic Pain Grade (CPG) questionnaire. [25] This is a seven-item instrument that measures severity in two dimensions: intensity sub-scale (three visual analogue scale items: current, worst and average pain intensity in the last six months) and disability sub-scale (three visual analogue scale items: interference with daily

activities, social activities and daily work in the last six months; and one item on number of days off work). A score is generated from the three visual analogue scale items for each sub-scale, from 0 (best possible pain state) to 100 (worst possible pain state). These scores and the item on number of days off work are then used to classify chronic pain into four hierarchical grades, from Grade I (low disability-low intensity pain) to Grade IV (high disability-severely limiting pain). The CPG has been shown to be valid and reliable for use in a self-completion postal questionnaire in the UK general population. [26] Only those who gave affirmative answers to both of the chronic pain questions were asked to complete the CPG questionnaire.

General health & socio-economic details

The questionnaire included several questions about general health. For this paper we used results from a question on the presence or absence of a long-term limiting illness drawn from the National Census (http://www.gro-scotland.gov.uk/files/hseform.pdf). The questionnaire also included items regarding sex, age, marital status, education, housing, social support and employment status.

National routinely collected datasets

In Scotland, routinely collected health information and statistics are collated and stored in a national database by the Information Services Division (ISD), NHS Scotland (http://www.isdscotland.org/isd/1.html). These routinely collected national datasets can be linked with existing cohorts where adequate personal details are available. An advantage of using national datasets is the ability to follow up members of a cohort who remain in Scotland but who move away from their recruitment location. Data (from 1996 to 2006

inclusive) about respondents to the Grampian survey was requested from four of the national datasets: the General Register Office death records; SMR00- first attendances at outpatient clinics; SMR01- inpatient and day case episodes in general and acute wards of hospitals; and SMR04- inpatient and day cases in psychiatric units and hospitals.

Record linkage

A copy of the Grampian cohort dataset was forwarded to the Medical Records Linkage Team at ISD who undertook the linkage. ISD-held data were linked using standard probability matching procedures based on common patient identifiable fields. The new linked dataset was stripped of patient identifiers by ISD and returned to the research team in an anonymised format. This approach enabled detailed analysis of the linked data, whilst maintaining patient confidentiality. The study was approved by the Privacy Advisory Committee of NHS National Services, Scotland. Grampian Research Ethics Committee approved the original questionnaire survey and subsequently confirmed that ethical approval was not required for the new linkage since no information was being collected from participants and the linked dataset was anonymised.

Identification of resilient and vulnerable individuals

Individuals were categorised into one of four groups based on their scores on the intensity and disability sub-scales of the CPG. Individuals with low pain-related disability (<50/100) despite high pain intensity (≥50/100) were categorised as 'resilient'; these individuals were compared with 'non-resilient' individuals who reported both high pain-related disability (≥50/100) and high intensity pain (≥50/100). Individuals with high pain-related disability (≥50/100) in spite of low intensity pain (<50/100) were categorised as 'vulnerable'; these

individuals were compared with 'non-vulnerable' individuals who reported low intensity pain (<50/100) and low pain-related disability (<50/100).

Grouping of hospital-related data

Routine data were available for 42 different clinical specialties and included the number of visits (as out-patient or day-case) and the total number of days spent as an in-patient, for each specialty. In order to maximise our statistical power we pooled the different visit types and collapsed the data into six categories: 1) medicine (general medicine, geriatric medicine, all major medical specialties except rheumatology), 2) surgery (general surgery, all surgical specialties e.g. ENT, gynaecology, but excluding orthopaedic surgery); 3) musculo-skeletal (rheumatology and orthopaedic surgery); 4) anaesthetics (as pain clinics are coded by this specialty); 5) oncology (including palliative care and haematology); and 6) psychiatry. Full details of the categorisation are in appendix 1. Information about use of Accident & Emergency services, which are largely accessed in an unscheduled way, was not available since the datasets requested relate to scheduled care.

Statistical analysis

Data were analysed using SPSS for Windows (version 19) and R 2.15.2. Descriptive statistics examined the proportion of people categorised as resilient or vulnerable. Binary logistic regression was then used to examine the demographic, socio-economic and health factors associated with being in each group. In each case resilient individuals were compared with those in the non-resilient comparison group and those in the vulnerable group were compared with those in the non-vulnerable comparison group.

Cox regression survival analysis was conducted to obtain unadjusted and adjusted hazard ratios (HR) with 95% confidence intervals (CI) for all-cause mortality and cause of death. Adjustments were made for factors independently associated with being vulnerable or resilient on multivariate analysis. The assumption of constant time dependent covariates was checked for each model and found to hold.

Hospital use was analysed using a two stage procedure to test for differences in both binary (any visits or none) and continuous (number of visits in those having at least one visit) components. In view of over-dispersion in the data we used negative binomial regression for the continuous component with logistic regression for the binary. Results were expressed as odds ratios (OR) for the binary and incidence rate ratios (IRR) for the continuous component.

Sensitivity analyses were conducted to explore how our findings changed if: i) pain-related disability was measured in a different way; and ii) we adjusted for additional factors with incomplete data.

RESULTS

ISD managed to link 5,858 (84.4%) of the 6,940 individuals in the original Grampian cohort. The characteristics of the linked cohort were very similar to the original complete cohort with no significant differences in demographic, socio-economic or pain factors. A total of 4139 (70.7%) of those in the linked cohort had chronic pain at baseline of which 3739 (90.3%) had detailed information on pain intensity and disability and were included in subsequent analyses (see Figure 1).

Resilience and vulnerability

Of the 2242 individuals reporting high intensity pain, 819 (36.5%) reported low pain-related disability and were categorised as resilient, while 1423 (63.5%) reported high pain-related disability and were categorised as non-resilient. Among the 1497 individuals reporting low intensity pain, 107 (7.1%) had high pain-related disability and so were categorised as vulnerable, compared with 1390 (92.9%) who reported low pain-related disability and were categorised as non-vulnerable.

Factors associated with being resilient and vulnerable

Table 1 presents the measured demographic, socio-economic and health factors associated with being in the resilient and vulnerable groups. On univariate analysis, individuals were *less* likely to be classified as resilient to their chronic pain if they were female, older, no longer married, had less than an university education, lived in rented accommodation, lived with no other adults, were not working and had a long-term limiting illness. Conversely, individuals were *more* likely to be classified as vulnerable to their chronic pain if they lived in rented council accommodation, lived with no other adults, were unable to work and had a long-term limiting illness. On multivariate analysis: sex, age, housing, employment and long-term limiting illness were identified as the factors independently associated with being vulnerable or resilient and were adjusted for in subsequent analyses.

Mortality

During the ten-year follow-up period, 21.1% of the resilient group and 31.9% of the non-resilient group died (Table 2). In comparison, 32.7% of the vulnerable group and 20.9% of

the non-vulnerable group died. The main causes of death were broadly similar in each group (Table 2).

Kaplan Meier survival plots (Figure 2) show a progressive divergence over time between resilient and non-resilient groups, and between vulnerable and non-vulnerable groups, with no discontinuity. Table 2 details the results of the Cox proportional hazards regression (expressed as hazard ratios). After adjusting for sex, age, housing, employment (independently associated socio-demographic factors), and long term limiting illness individuals in the resilient group were 25% less likely to die within 10 years of the survey compared with non-resilient individuals: HR 0.75, 95% CI 0.62 to 0.91. A statistically significant reduction in death from cancer among the resilient group also remained (HR 0.64, 0.44 to 0.93) after adjustment. After adjustment, vulnerable individuals were more likely to die over the ten year period than non-vulnerable individuals: HR 1.45, 1.01 to 2.11 and vulnerable individuals were significantly more likely to die from circulatory diseases than those in the non-vulnerable group (HR 1.91, 1.08 to 3.38).

Hospital use

Most individuals in each group used a hospital service at least once during the ten year follow up period. Outpatient or day-case attendance occurred in 720 (87.9%) of resilient individuals, 1211 (85.1%) of non-resilient individuals, 86 (80.4%) vulnerable individuals and 1238 (89.1%) of the non-vulnerable individuals. At least one inpatient admission occurred in 514 (62.8%) resilient individuals, 1017 (71.5%) non-resilient individuals, 82 (76.6%) vulnerable individuals and 865 (62.2%) non-vulnerable individuals.

Details of hospital use over the ten-year follow-up period are presented in table 3 (comparing resilient and non-resilient groups) and table 4 (comparing vulnerable and non-vulnerable groups). Table 3 shows that compared with non-resilient individuals, resilient individuals with chronic pain were less likely to have had an outpatient or day-case visit for anaesthetics, the specialty which hosts pain clinics: adjusted OR 0.46, 0.27 to 0.79. There were no other statistically significant differences in visits for other clinical specialities. There were no statistically significant differences in the number of outpatient or day case visits. Nor were there any statistically significant differences in inpatient days between resilient and non-resilient groups. Compared with non-vulnerable individuals, those in the vulnerable group were significantly less likely to have any outpatient or day case visits (Table 4: adjusted OR 0.43, 0.25 to 0.75); and more likely to have an outpatient or day case psychiatric visit (OR 1.96, 1.06 to 3.61). There were no statistically significant differences in the number of outpatient or day case visits. No differences were observed between vulnerable and non-vulnerable groups for likelihood of any inpatient visits, or total number of inpatient days (except for anaesthetics). However, the very small number of inpatient admissions in the vulnerable group indicates that any inference from these should be viewed with caution.

DISCUSSION

This is the first study to examine the long term effects of resilience or vulnerability to chronic pain in terms of survival and hospital use. We found that resilience to chronic pain (as defined by low disability in spite of high intensity pain) was associated with a significantly reduced risk of death over the subsequent ten years. With the exception of pain services, resilient individuals made the same use of specialist services as the non-

resilient comparator group. We also found that individuals classified as vulnerable to their chronic pain had poorer survival than those in the non-vulnerable comparison group. The few differences between vulnerable and non-vulnerable individuals in their use of hospital services related mainly to psychiatric and anaesthetic services.

A major strength of our study was its community base. Results from this study are more likely to be representative of people living in the community than those from studies using samples from healthcare settings, such as pain clinics. The prospective nature of the study meant that pain status was ascertained before outcome was measured, avoiding recall bias. Furthermore, long-term outcomes were available for analysis. We did not use a formal resilience measurement scale~~.~~ [27] unlike some previous studies of chronic pain [17 18 28]. The lack of standardised definitions of vulnerability and resilience and the lack of use of a formal resilience scale are limitations of our study. Instead, ~~O~~our analyses assume that self reported pain intensity and disability due to pain correctly differentiated respondents into those resilient or vulnerable to the effects of chronic pain. Individuals were categorised based on their scores on the intensity and disability sub-scales of the CPG. Use of the two sub-scales allowed us to use a measure of disability that was directly related to pain, rather than use of a generic measure of health that could have been influenced by other conditions. This approach meant that the two sub-scales were directly comparable. Since we did not use the 'days off work' question in the CPG questionnaire normally used to grade people, a sensitivity analysis was undertaken to examine the effect of including this additional question. Analysis showed that the findings did not materially change, with the same overall pattern of results seen (data not shown). A strength of our approach is that it moves away from groupings based on help seeking behaviour which is known to be a poor

marker of actual functioning. [29830] Consulting a health care professional may not always identify individuals who are "resilient" or "vulnerable" to their symptoms.

Resilience and vulnerability were associated with several socio-demographic variables and we were able to adjust for these in the analysis. Some other potentially important factors were not fully available in the dataset, but were examined in an additional set of sensitivity analyses to examine the effects of smoking and mental health in relation to survival. Data on cigarette smoking was available from a follow up survey (conducted four years after baseline) for 1572 of the 3739 individuals. There were no specific measures of mental health in the original survey although it did include the SF-36 measure of health related quality of life which includes a Mental Health component. Adding both of these variables in turn into the survival models did not change the hazard ratios substantially, although incomplete data led to wider confidence intervals. While we found few differences in specialist care use between groups, our analyses did not allow for different survival between groups, which meant that resilient individuals tended to have a longer period of time in which to receive specialist treatment than non-resilient individuals; and vulnerable individuals less time than non-vulnerable individuals. These patterns of survivorship are likely to exaggerate differences between groups, rather than diminish them.

There is growing interest in the phenomenon of resilience in a range of health and social sciences. While hard to define, [11 3012 3112] it has been suggested that resilience describes something more than either hardiness (for instance not becoming unwell) or coping. Instead it implies both experiencing adversity (illness) and adapting in order to bounce back and thrive, sometimes in changed ways. [3213] Our finding of generally comparable healthcare use

between resilient and non-resilient individuals suggests that resilience in our study was not simply measuring hardiness.

Whatever resilience is, and however it is measured, our finding of better survival among resilient people with chronic pain, suggests that resilience is a phenomenon worth researching. It was noteworthy that a larger proportion (36.5%) of individuals were resilient than vulnerable (7.1%). This suggests that important gains may be made in understanding who is likely to become resilient, why and how. We also need to understand more about how resilience changes with time and what factors influences this. While there is already some information available regarding the traits and activities that seem to influence resilience (such as family, mood, social class, socio-economic status and life events), [20 34 35] ~~F~~further research is ~~now~~ needed to tease out both the internal ~~(e.g. personality traits, self-efficacy)~~ and external ~~(e.g. social support)~~ factors that influence an individual's resilience. Of particular importance will be the identification of modifiable factors that could be used to help build additional resilience in individuals who could benefit.

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Figure 1: Flow chart depicting study process

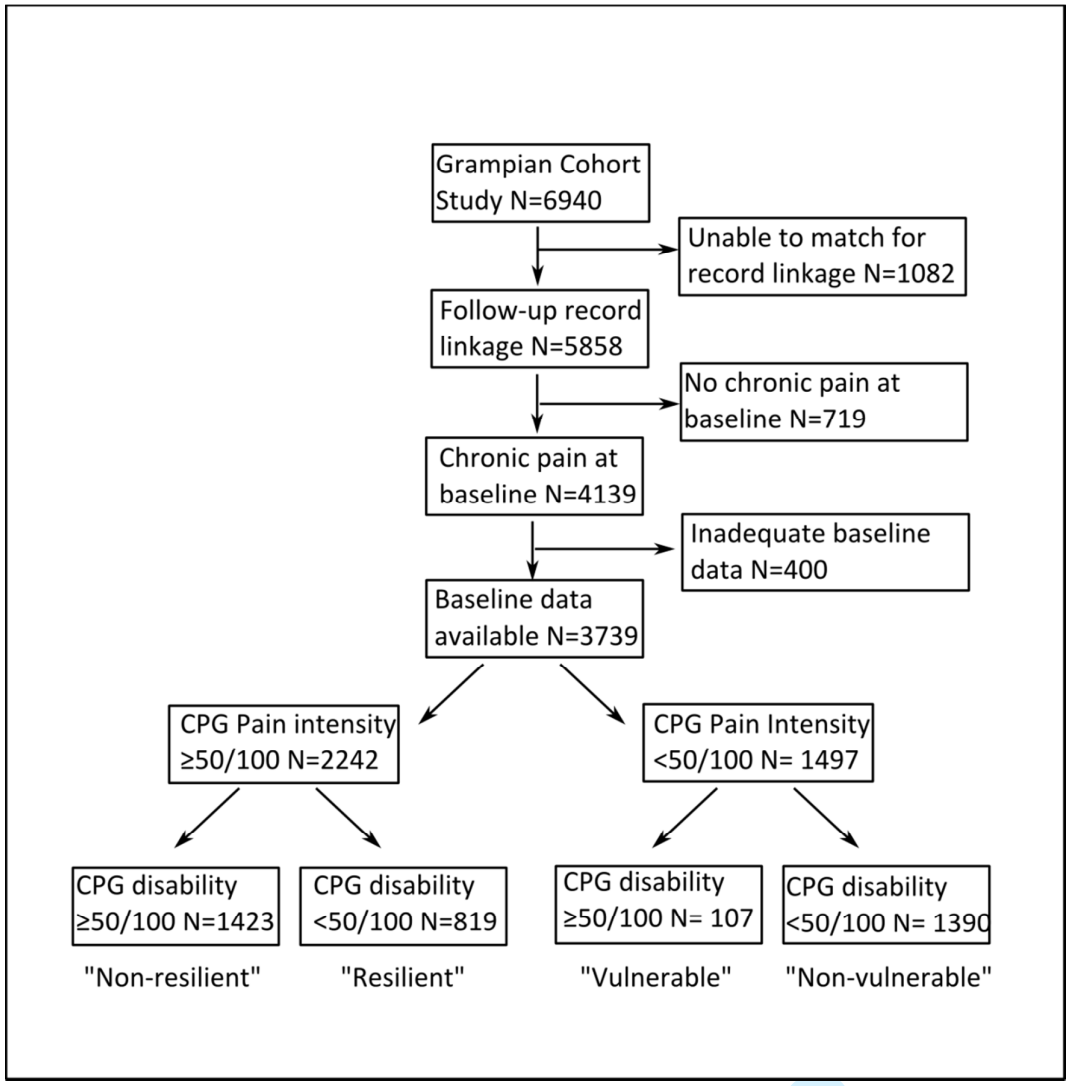
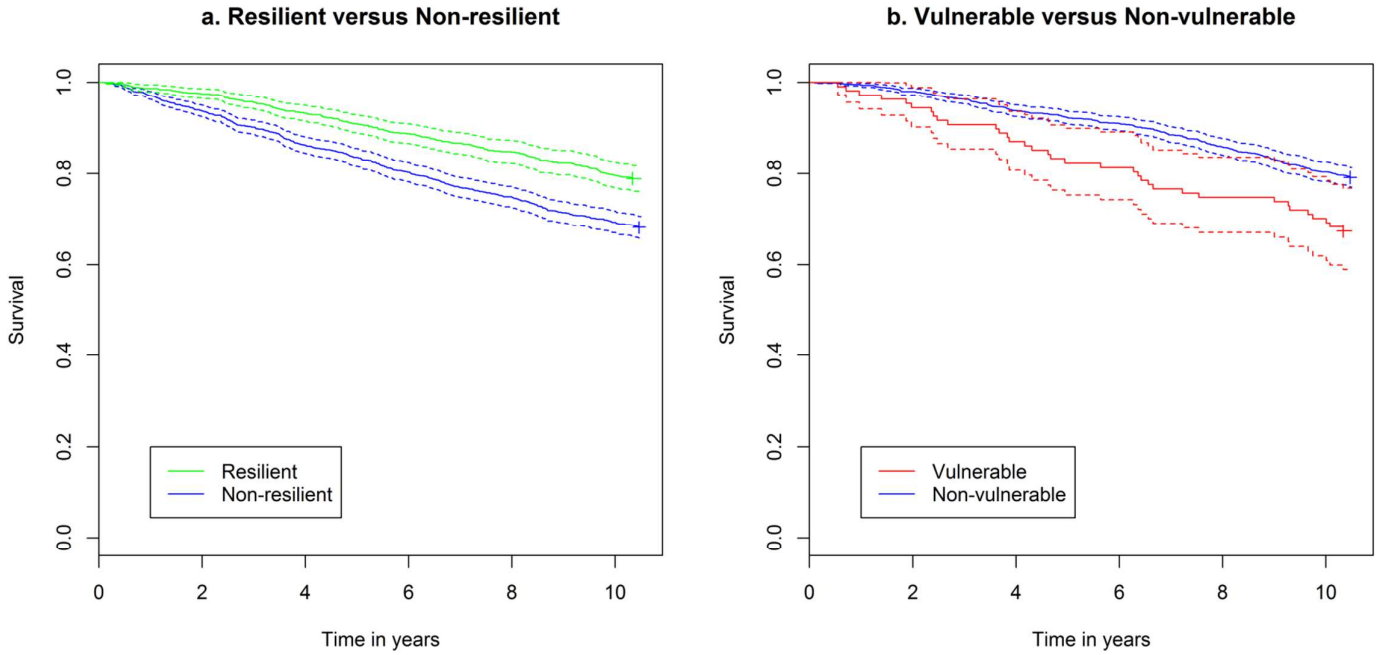


Table 1: Factors associated with being in the resilient or vulnerable groups.

	Non-resilient	Resilient			Non-vulnerable	Vulnerable		
	N	N	OR	(95%CI)	N	N	OR	(95%CI)
Sex								
Male	630	402			716	52		
Female	793	417	0.82	(0.69 to 0.98)	674	55	1.12	(0.76 to 1.67)
Age group								
25-34	80	68			113	10		
35-44	198	113	0.67	(0.45 to 1.00)	187	15	0.91	(0.39 to 2.09)
45-54	301	173	0.68	(0.47 to 0.98)	255	14	0.62	(0.27 to 1.44)
55-64	323	172	0.63	(0.43 to 0.91)	299	24	0.91	(0.42 to 1.96)
65-74	266	172	0.76	(0.52 to 1.11)	325	23	0.80	(0.37 to 1.73)
75+	255	121	0.56	(0.38 to 0.82)	211	21	1.12	(0.51 to 2.47)
Marital status								
Single	126	80			113	12		
Married / cohabit	909	587	1.02	(0.75 to 1.37)	1005	65	0.61	(0.32 to 1.16)
No longer married	367	147	0.63	(0.45 to 0.89)	253	28	1.04	(0.51 to 2.12)
Education								
University	118	123			305	17		
High school	260	178	0.66	(0.48 to 0.90)	335	24	1.29	(0.68 to 2.44)
No qualifications	878	470	0.51	(0.39 to 0.68)	656	60	1.64	(0.94 to 2.86)
Housing								
Owned/mortgaged	663	547			977	59		
Rented privately/other	62	30	0.59	(0.37 to 0.92)	64	6	1.55	(0.65 to 3.73)
Rented from council	675	236	0.42	(0.35 to 0.51)	323	40	2.05	(1.35 to 3.12)
Social support								
Other adults in home	968	602			1030	68		
No other adults	368	173	0.76	(0.61 to 0.93)	271	35	1.96	(1.27 to 3.00)
Employment								
Working	271	386			657	34		
Retired	474	270	0.40	(0.32 to 0.50)	527	42	1.54	(0.97 to 2.46)
Unable to work	504	76	0.11	(0.08 to 0.14)	38	16	8.14	(4.13 to 16.03)
Unemployed	122	66	0.38	(0.27 to 0.53)	130	11	1.64	(0.81 to 3.31)
Long-term limiting illness								
No	222	420			941	23		
Yes	1182	389	0.18	(0.15 to 0.22)	420	82	7.99	(4.96 to 12.86)

Figure 2: Kaplan Meier survival plots comparing: (a) resilient versus non-resilient; (b) vulnerable versus non-vulnerable groups.



Dotted lines indicate 95% confidence intervals

Table 2: Hazard ratios (HR) and 95% confidence intervals (CI) for ten-year mortality amongst vulnerable and resilient groups

	Deaths n (%)		Resilient group			Deaths n (%)		Vulnerable group		
Cause of death	**Resilient**	**Non-resilient**	**Unadjusted HR (95% CI)**	**Adjusted HR [a] (95% CI)**	**Adjusted HR [b] (95% CI)**	**Vulnerable**	**Non-vulnerable**	**Unadjusted HR (95% CI)**	**Adjusted HR [a] (95% CI)**	**Adjusted HR [b] (95% CI)**
All cause mortality	173 (21.1)	454 (31.9)	**0.61 (0.51 to 0.73)**	**0.67 (0.55 to 0.81)**	**0.75 (0.62 to 0.91)**	35 (32.7)	290 (20.9)	**1.73 (1.22 to 2.46)**	**1.73 (1.20 to 2.49)**	**1.45 (1.01 to 2.11)**
Circulatory system	68 (9.5)	184 (16.0)	**0.57 (0.43 to 0.76)**	**0.67 (0.49 to 0.90)**	0.79 (0.58 to 1.07)	16 (18.2)	117 (9.6)	**2.05 (1.22 to 3.45)**	**2.07 (1.19 to 3.59)**	**1.91 (1.08 to 3.38)**
Neoplasm	52 (7.4)	112 (10.4)	**0.71 (0.51 to 0.98)**	**0.65 (0.46 to 0.92)**	**0.64 (0.44 to 0.93)**	7 (8.9)	98 (8.2)	1.10 (0.51 to 2.36)	1.16 (0.53 to 2.54)	0.93 (0.42 to 2.08)
All other causes	53 (6.5)	158 (11.1)	**0.53 (0.39 to 0.73)**	**0.63 (0.45 to 0.87)**	0.77 (0.55 to 1.09)	12 (11.2)	75 (5.4)	**2.31 (1.25 to 4.24)**	**2.21 (1.16 to 4.18)**	1.64 (0.85 to 3.17)

Those classified as resilient compared against non-resilient and those classified as vulnerable compared against those non-vulnerable

[a] Adjusted for sex, age group , housing, and employment

[b] Adjusted for sex, age group , housing, employment and long-term limiting illness

Table 3: Specialist (hospital) care use over 10-year follow-up: comparison of resilient and non-resilient groups

	Any outpatient/day case visit					Number of outpatient/day case visits (excluding pts with no visits)				
	Non-resilient N	Resilient N	Adjusted OR†	(95%CI)	p	Non-resilient median	Resilient median	Adjusted IRR†	(95%CI)	p
Medicine	840	478	1.11	(0.90 to 1.37)	0.34	3	3	1.07	(0.86 to 1.34)	0.53
Surgical	1010	593	0.97	(0.77 to 1.23)	0.82	4	4	0.96	(0.82 to 1.12)	0.61
Musculoskeletal	204	89	0.95	(0.69 to 1.30)	0.74	4	4	1.11	(0.71 to 1.75)	0.65
Oncology	147	83	1.01	(0.72 to 1.42)	0.93	5	5	1.05	(0.65 to 1.72)	0.83
Anaesthetics	107	26	**0.46**	**(0.27 to 0.79)**	**0.002**	3	2	1.07	(0.44 to 2.56)	0.89
Psychiatry	155	73	1.03	(0.72 to 1.47)	0.89	3	2	0.85	(0.42 to 1.72)	0.65
All	1211	720	1.21	(0.90 to 1.64)	0.21	9	8	0.94	(0.83 to 1.07)	0.38

	Any inpatient days					Total inpatient days (excluding pts with no visits)				
	Non-resilient N	Resilient N	Adjusted OR†	(95%CI)	p	Non-resilient median	Resilient median	Adjusted IRR†	(95%CI)	p
Medicine	755	373	1.02	(0.82 to 1.28)	0.84	19	15	1.01	(0.81 to 1.26)	0.90
Surgical	646	331	0.84	(0.68 to 1.03)	0.10	7	6	0.85	(0.64 to 1.11)	0.23
Musculoskeletal‡	53	16	0.72	(0.39 to 1.31)	0.28	12	10	0.76	(0.38 to 1.51)	0.43
Oncology	70	49	1.06	(0.67 to 1.67)	0.80	11	15	1.58	(0.44 to 5.64)	0.48
Anaesthetics‡	54	17	0.76	(0.42 to 1.36)	0.35	2	4	1.21	(0.25 to 5.88)	0.81
Psychiatry‡	53	19	0.72	(0.41 to 1.27)	0.26	47	58	1.54	(0.52 to 4.59)	0.43
All	1017	514	0.80	(0.64 to 1.01)	0.06	21	17	1.06	(0.86 to 1.30)	0.60

†Analysis adjusted for sex, age, housing, employment, and long term limiting illness; except where rows marked otherwise.
‡ Analysis adjusted for long term limiting illness only.

Table 4: Specialist (hospital) care use over 10-year follow-up: comparison of vulnerable and non-vulnerable groups

	Any outpatient/day case visit					Number of outpatient/day case visits (excluding pts with no visits)				
	Non-vulnerable N	Vulnerable N	Adjusted OR†	(95%CI)	p	Non-vulnerable median	Vulnerable median	Adjusted IRR†	(95%CI)	p
Medicine	695	55	0.79	(0.51 to 1.22)	0.29	3	3	0.97	(0.58 to 1.64)	0.92
Surgical	1046	73	0.68	(0.43 to 1.09)	0.11	4	5	1.11	(0.79 to 1.56)	0.54
Musculoskeletal‡	116	7	0.56	(0.25 to 1.26)	0.16	4	13	1.48	(0.48 to 4.53)	0.50
Oncology‡	139	7	0.62	(0.28 to 1.38)	0.24	5	10	1.27	(0.46 to 3.53)	0.65
Anaesthetics‡	16	4	2.45	(0.75 to 7.96)	0.14	2	1.5	6.39	(0.73 to 55.97)	0.09
Psychiatry‡	107	16	**1.96**	**(1.06 to 3.61)**	**0.03**	2	1.5	1.45	(0.46 to 4.58)	0.52
All	1238	86	**0.43**	**(0.25 to 0.75)**	**0.003**	6	8	1.18	(0.88 to 1.58)	0.27

	Any inpatient days					Total inpatient days (excluding pts with no visits)				
	Non-vulnerable N	Vulnerable N	Adjusted OR†	(95%CI)	p	Non-vulnerable median	Vulnerable median	Adjusted IRR†	(95%CI)	p
Medicine	579	56	1.1	(0.68 to 1.77)	0.70	12	21	1.32	(0.84 to 2.07)	0.24
Surgical	569	54	1.37	(0.89 to 2.12)	0.16	6	7	1.07	(0.68 to 1.69)	0.76
Musculoskeletal‡	14	2	1.05	(0.23 to 4.86)	0.95	7.5	9	0.68	(0.24 to 1.94)	0.47
Oncology‡	65	5	0.92	(0.35 to 2.40)	0.86	13	18	0.71	(0.24 to 2.04)	0.52
Anaesthetics‡	28	2	0.82	(0.18 to 3.65)	0.80	3	2	**0.06**	**(0.00 to 0.93)**	**0.04**
Psychiatry‡	27	4	1.54	(0.50 to 4.70)	0.45	123	11.5	0.29	(0.09 to 0.98)	0.05
All	865	82	1.56	(0.92 to 2.67)	0.10	13	19	1.13	(0.76 to 1.68)	0.56

†Adjusted for sex, age, housing, employment, and long term limiting illness; except where rows marked otherwise.
‡ Adjusted for long term limiting illness only.

Appendix 1: Grouping of hospital activity categories

Pooled categories analysed	Original specialty group (ISD coding)
Medicine	General medicine (A1)
	Geriatric medicine (AB)
	Cardiology (A2)
	Endocrinology and diabetes (A8)
	Endocrinology (A81)
	Diabetes (A82)
	Gastroenterology (A9)
	Renal medicine (AG)
	Respiratory medicine (AQ)
	Clinical genetics (A3)
	Infectious diseases (A6)
	Dermatology (A7)
	Homeopathy (AC)
	Neurology (AH)
	Rehabilitation medicine (AP)
	GP other than obstetrics (E12)
Surgical	General surgery (C1)
	General surgery excluding vasc & max (C11)
	Vascular surgery (C12)
	ENT (C5)
	Gynaecology (F2)
	Cardiac surgery (C41)
	Thoracic surgery (C42)
	Neurosurgery (C6)
	Plastic surgery (C9)
	Opthalmology (C7)
	Urology (CB)
	Oral surgery (D3)
	Oral medicine (D4)
	Orthodontics (D5)
	Restorative dentistry (D6)
Musculoskeletal	Rheumatology (AR)
	Orthopaedic surgery (C8)
Oncology	Medical oncology (AD)
	Clinical oncology (H2)
	Haematology (J4)
	Palliative medicine (AM)
Anaesthetics	Anaesthetics (C3)
Psychiatry	General psychiatry (G1)
	Forensic psychiatry (G3)
	Psychiatry of old age (G4)
	Learning disability (G5)

Competing interest declaration

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Author Contribution

AME and PCH planned and designed the paper. AME and CDB conducted the analysis. AME produced the first draft of the paper. CDB and PCH read and commented on the paper. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. All authors have seen and approved the final version of the paper. AME is the guarantor of the paper. She accepts full responsibility for the conduct of the study.

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Ethical approval

The study was approved by the Privacy Advisory Committee of NHS National Services, Scotland. Grampian Research Ethics Committee approved the original questionnaire survey and

subsequently confirmed that ethical approval was not required for the new linkage since no information was being collected from participants and the linked dataset was anonymised.

Data sharing

Patient level data from the linked dataset could be made available from the corresponding author when relevant. Informed consent was not obtained because the presented data are completely anonymous.

Copyright

Corresponding author statement

Figure 1: Flow chart depicting study process

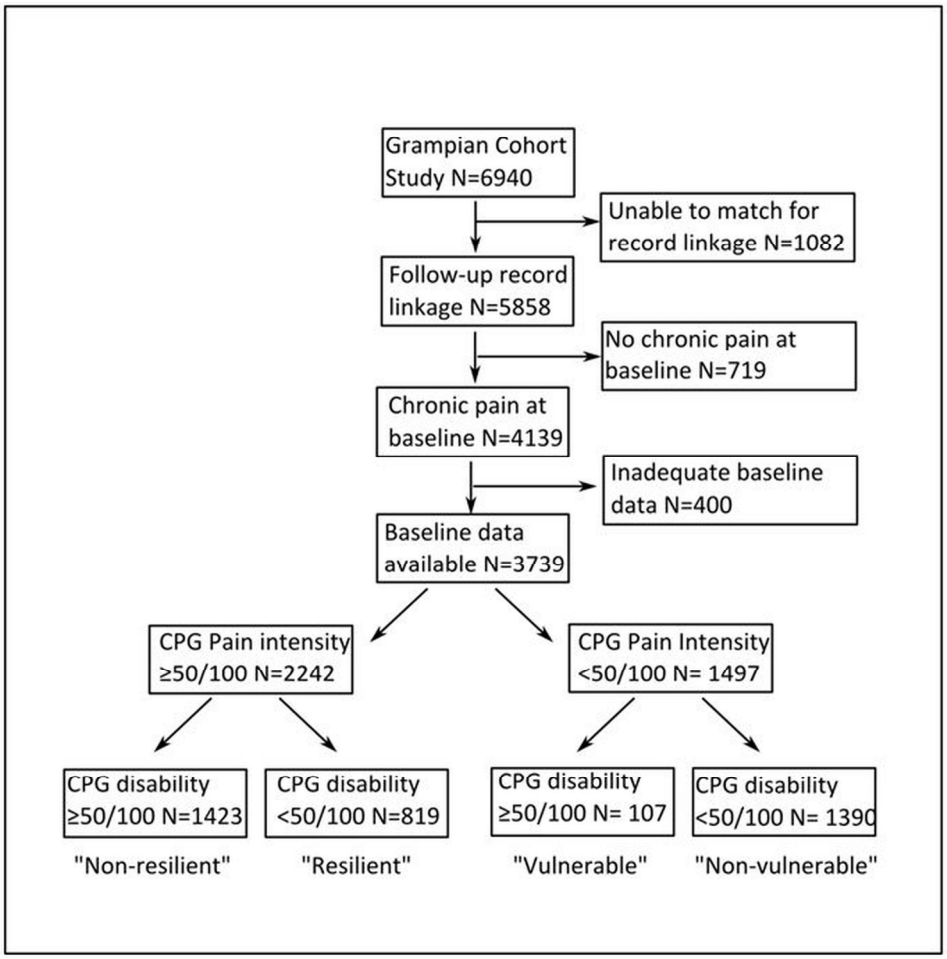

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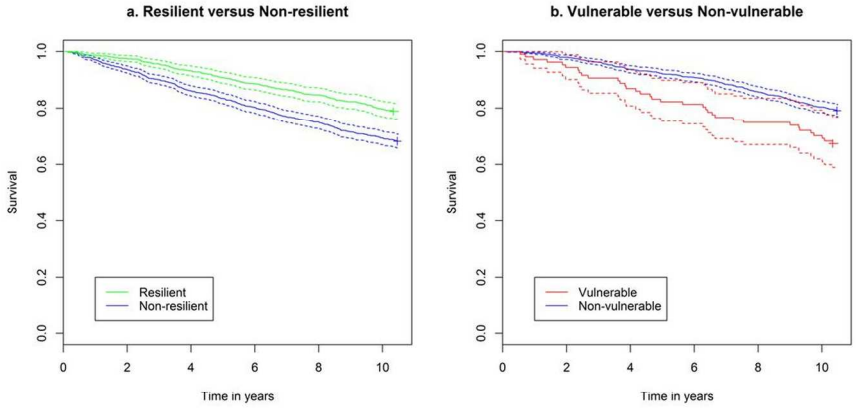
Figure 2: Kaplan Meier survival plots comparing: (a) resilient versus non-resilient; (b) vulnerable versus non-vulnerable groups.



Dotted lines indicate 95% confidence intervals

318x172mm (300 x 300 DPI)

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