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Chronic Pain and Obesity in the Elderly: Results from the Einstein Aging Study

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Abstract

OBJECTIVES—To determine the prevalence of chronic pain in the elderly and its relationship with obesity, associated co-morbidities and risk factors.

DESIGN—Cross-Sectional

SETTING—Community-based

PARTICIPANTS—A representative community sample of 840 elderly subjects age 70 or older.

MEASUREMENTS—We examined the prevalence of chronic pain and its relationship with obesity (categories defined by body mass index), other medical risk factors and psychiatric comorbidities. Chronic pain was defined by pain of at least moderate severity (≥ 4 on a 10-point scale) some, most or all of the time for the past three months.

RESULTS—The sample was mostly female (62.8%) and the average age was 80 years (range 70–101 years). The prevalence of chronic pain was 52% (39.7% in men; 58.9% in women). Those with chronic pain were more likely to report a diagnosis of depression (OR 2.5, 95%CI=1.40–4.55) and anxiety (OR 2.3, 95%CI=1.22–4.64). Compared to individuals with normal weight (BMI 18.5–24.9), obese subjects (BMI 30–34.9) were twice as likely (OR 2.1, 95%CI=1.33–3.28) while severely obese subjects (BMI ≥ 35) were more than four times as likely (OR 4.5, 95%CI=1.85–12.63) to have chronic pain. Obese subjects were significantly more likely to have chronic pain in the head, neck/shoulder, back, legs/feet, and abdomen/pelvis than non-obese subjects. In multivariate models, obesity (OR 2.0, 95%CI=1.27–3.26) and severe obesity (OR 4.1, 95%CI=1.57–10.82) were associated with chronic pain after adjusting for age, sex, diabetes, hypertension, depression, anxiety and education.

CONCLUSION—Chronic pain is common in this elderly population, affects women more than men and is highly associated with obesity.

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Author Contributions:

- **Lucas McCarthy**—data analysis, interpretation and manuscript writing
- **Marcelo Bigal**—study design, interpretation and manuscript preparation
- **Mindy Katz**—data acquisition, interpretation and manuscript preparation
- **Carol Derby**—study design, interpretation and manuscript preparation
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All authors meet the criteria for authorship stated in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals.

Keywords

Chronic Pain; Obesity; Elderly

INTRODUCTION

Although episodic pain is an almost universal experience, chronic pain is less common and sometimes disabling. According to the International Association for the Study of Pain, chronic pain is defined as “pain that persists beyond normal tissue healing time, which is assumed to be 3 months”.¹ Using this definition, estimates of the prevalence of chronic pain in the elderly, over the age of 60, range from 28.9% to 59.3%.^{2–7} Obesity has been recently described to be associated with pain severity in the general population,⁸ as well as with a higher prevalence of pain in the knee⁹, hip⁹, and lower back.^{9–10} Obesity is also associated with higher prevalence of frequent and severe migraine headaches^{11–12} and is a risk factor for the development of chronic daily headache.¹³ The relationship between chronic pain and obesity is of particular importance, since obesity is also associated with an increased pain-related disability and reduced physical functioning.¹⁴

The relationship between chronic pain and obesity in the elderly population has not been studied and this is of importance, since the prevalence of obesity is increasing in elderly adults¹⁵ in the United States. Furthermore, since both pain and obesity share specific comorbidities, it is important to measure the influence of these co-morbid conditions such as depression^{16–17}, anxiety¹⁷ and hypertension¹⁸ on the relationship between obesity and chronic pain. Furthermore, since chronic pain prevalence is inversely related to socioeconomic status,^{19–20} adjustments should account for demographics and should also estimate the impact of chronic pain on the health-related quality of life of the elderly.^{2–17–19}

The Einstein Aging Study, a community based study in the Bronx, provides an ideal setting for addressing the relationship between obesity, chronic pain and related comorbidities in the elderly. The study has long recruited a systematic sample of Bronx residents over the age of 70 using lists of registered voters. The Bronx community is diverse from the perspectives of socioeconomic status, race and ethnicity. Since 2004, we have screened a systematically recruited sample of Bronx residents over the age of 70 using a telephone interview with a detailed pain questionnaire reflecting pain location, duration and intensity. Herein, we use these data to assess the prevalence and distribution of chronic pain in an elderly community based sample and to evaluate the influence of obesity and other related demographic and medical covariates on the prevalence of chronic pain.

METHODS

Subjects

Our sample consists of individuals systematically sampled from voter registration lists from the Board of Elections residing in areas adjacent to the clinical research center in the Bronx, New York. The target population for this current study included all elderly subjects with English language proficiency over the age of 70 who agreed to participate in the computer-assisted telephone interview conducted as a part of the Einstein Aging Study (EAS) between October 2004 and July 2007. The local institutional review board approved the study protocol.

Telephone Interview Questionnaire

Data were collected using a Computer-Assisted Telephone Interview (CATI), as previously described.²¹ On average the entire telephone interview took 20 minutes to administer and included information on demographics, health status, and pain (see below). During this interview, the telephone Blessed Information-Memory-Concentration (BIMC) score and the Memory Impairment Screen (MIS) were administered to assess cognitive status.²¹ Specific health questions had the following format: “Has a doctor ever told you that you have or have had any of the following conditions?”. This included items such as diabetes, hypertension, depression, anxiety disorder, and cancer.

Body mass index (BMI) was calculated using self-reported height and weight variables in the telephone questionnaire. BMI was categorized into five groups: underweight (< 18.5), normal weight (18.5–24.9), overweight (25–29.9), obese (30–34.9), severely obese (>35).

Pain Assessment

The pain module of the CATI included the Total Pain Index, an interview which addressed pain location, frequency, severity and duration. For each of 8 body areas, subjects were asked “in the past 3 months, how often did you have pain in the [insert 1 of 8 body areas]”. Response options included none of the time, a slight bit of time, some of the time, most of the time, and all of the time. Body areas included the head, face, neck and shoulder, back, arms and hands, legs and feet, chest, and abdomen and pelvis, and other. Subjects were then asked for each body area with pain to rate their worst pain over the last three months on a scale of 0 to 10. There were 78 subjects who coded the “other” body location category for some or all of their pain. All of those were successfully recoded to one of the pre-specified bodily pain locations; for example, pain in the elbows would be recoded as pain in the “arms and hands”. Subjects were classified as having any pain if they reported having pain of any frequency (a slight bit of the time or a higher category) in at least one of the eight body locations with a severity greater than zero.

We classified subjects as having chronic pain if pain in at least one location fulfilled the following criteria: 1) Pain in the past three months some, most or all of the time, 2) Pain of moderate or severe intensity ($\geq 4/10$). Our definition of chronic pain is similar to a recent prior report in a large scale European pain study²², where an index of chronic pain was used combining pain duration, frequency and severity.

Statistical Analysis

Analyses were performed using STATA version 10 (StataCorp LP, College Station, Texas). To estimate the univariate association of each covariate with chronic pain, unadjusted odds ratios with 95% Confidence Intervals were calculated using exact statistics. To compare comorbid conditions with chronic pain across body locations, we used a Chi-squared test for proportions of subjects with versus without the condition with chronic pain at each specific body location without adjustment for multiple comparisons. To test trend associations across BMI categories we used STATA’s non-parametric test for trend which is an extension of the Wilcoxon rank-sum test. In order to adjust for multiple variables that may affect our primary outcomes, we used an un-weighted multiple logistic regression analysis on chronic pain versus no chronic pain and included dummy variables for all BMI groups except normal BMI (18.5–24.9) which was used as a reference.

RESULTS

Prevalence and Distribution of Pain

The 840 subjects age 70 years or older who completed the CATI between October 2004 and July 2007 comprised the study sample. The majority were female (62.8%). Our total sample had an average age of 80 years with an age range from 70–101 years. A total of 628 subjects (74.6%) reported pain of any level in at least one location over the previous three months. Of those reporting pain, 210 had pain in only one location (33.5%), 159 had pain in two locations (25.4%) and 258 had pain in three or more locations (41.1%). A total of 496 subjects (59.1%) had moderate or severe pain in at least one location (4–10 out of 10) and 241 (28.7%) had pain most or all of the time over the last three months. A total of 437 subjects (52.0%) met our definition for chronic pain. The most common pain location was the legs and feet (44.8%) followed by the back (39.8%) and then the neck and shoulders (31.2%). Table 1 shows descriptive characteristics of our sample, grouped by chronic pain prevalence.

Sociodemographic Variables and Chronic Pain

In our elderly sample, the prevalence of chronic pain did not significantly vary with age (Tables 2). Any pain was reported by 79.1% of women and 70.3% of men. Chronic pain occurred in 58.9% of women and 39.7% of men. Women were about twice as likely to have chronic pain as men (OR=2.2; 95% CI: 1.61–2.97) (Table 2).

In univariate analyses, higher levels of education were protective against chronic pain. Those with high education (more than 12 years of education) were significantly less likely to have chronic pain than those with low education (OR= 0.74; 95% CI: 0.56 – 0.98) (Table 2).

Pain, BMI and Comorbidities

Of the 840 subjects in our sample, 819 had complete self-reported data on height and weight with an average BMI of 26.5. In our sample 1.7% (n=14) were underweight, 38.5% (n=315) were normal weighted, 40.0% (n=327) were overweight, 15.6% (n=128) were obese, and 4.3% (n=35) were severely obese as previously defined. Chronic pain prevalence significantly increased with increasing BMI category with 42.9% of underweight, 46.0% of normal weighted, 49.5% of overweighted, 64.8% of obese and 80.0% of severely obese reporting chronic pain (p for trend < 0.001). In comparison with normal weighted individuals, obese individuals were twice as likely to have chronic pain (OR 2.09, 1.33 – 3.28), while severely obese individuals were more than 4 times as likely to have chronic pain (OR 4.53, 1.85 – 12.63) in unadjusted analysis (see Table 2). Those in higher BMI categories also had a significantly higher number of painful body locations, higher pain frequency, and more severe pain (for all, p for trend <0.01).

Chronic pain was also significantly associated with self-reported physician diagnosis of depression (OR = 2.48; 95% CI: 1.40 – 4.55), anxiety (OR 2.33, 1.22 – 4.64), and hypertension (OR 1.41, 1.06 – 1.88) in univariate models (see Table 2). Diabetes was not significantly associated with chronic pain (Table 2). A telephone measure of mental status (the BIMC score) was not significantly associated with chronic pain prevalence (Table 2). Thus subjects with more frequent and severe pain had a significant higher likelihood of a previous diagnosis of hypertension, depression, and anxiety disorders.

Multivariate Analyses

To determine which variables were independently associated with the prevalence of chronic pain we used a multivariate logistic regression model (Table 2). Several variables were associated with chronic pain in the multivariate model including female gender (OR 2.24,

1.63–3.08), obesity (2.03, 1.29–3.29), severe obesity (4.12, 1.57–10.82), depression (1.94, 1.03–3.66), and anxiety disorder (2.15, 1.04–4.43). Other factors including age, education, hypertension, and diabetes were not significantly associated with chronic pain after the adjustments (Table 2).

The association between higher BMI category and chronic pain showed a significant dose-response relationship; as BMI category increased so did the prevalence of chronic pain even after adjusting for a number of possible confounders including age, gender, education level, diabetes, depression, anxiety, and hypertension (Table 2).

Chronic Pain Location and Covariates

Chronic pain in specific body locations was compared between obese (BMI ≥ 30) and non-obese (BMI <30) individuals using a Chi squared test (Table 3). There were significant associations ($p < 0.05$) between the presence of chronic pain in the head, neck/shoulder, back, arms/hands, legs/feet and abdomen/pelvis with the presence of obesity.

DISCUSSION

The prevalence of chronic pain in this elderly population (52%) is comparable to previous population studies in older adults.^{2–7} The prevalence of chronic pain did not vary with age in the elderly, replicating prior reports where age trends with chronic pain have not been significant over age 60.^{6, 7, 20} As with other cross sectional epidemiologic studies, female gender had a strong association with the prevalence of chronic pain. Patterns of pain locations experienced in this study are similar to results in previous studies^{5, 6} with pain most common in the lower extremities and back.

BMI category had a significant dose-dependent relationship with chronic pain. In comparison with the normal weighted, obese individuals were twice as likely to have chronic pain and severely obese individuals were more than four times as likely to have chronic pain, even after adjusting for other risk factors. Individuals in higher BMI categories also had more frequent and more severe pain, along with a higher number of painful bodily locations than those in lower BMI categories. We are not aware of other studies that have explored these relationships in the elderly. Previous studies have suggested an association between obesity and pain in the adult population. Obesity in previous studies has been associated with chronic migraine, with increased frequency and severity of episodic migraine attacks^{11, 12}, and pain in the knee, hip and back.^{9, 10} Furthermore, co-morbid factors such as depression, anxiety, diabetes and hypertension may influence the obesity/chronic pain relationship, although many of these studies have not adjusted for them. Herein, we show that even after adjusting for depression, anxiety, diabetes, hypertension and demographic covariates, obesity is strongly associated with chronic pain at cross section.

The link between obesity and chronic pain is likely due, in part, to an increased mechanical load on weight bearing joints as seen by strong associations with obesity and chronic lower limb and low back pain. In addition to mechanical load, obesity likely has other important relationships with pain development as indicated by our findings of significant associations between chronic pain and obesity in non-weight bearing areas including chronic head, neck and shoulder and abdominal pain. Obesity is a pro-inflammatory state, associated with increased levels of inflammatory markers including C-reactive protein,²³ Interleukin-6,²³ and TNF-alpha²⁴. The relationship between obesity and chronic pain may be mediated, at least in part, by inflammation. The link between obesity and chronic pain may also be explained in part by the painful consequences of obesity related illnesses such as diabetes, peripheral artery disease, and osteoarthritis. Additionally, decreased physical activity is related to both obesity and chronic painful conditions and may be involved in their related

etiology. Finally, obesity is a part of the metabolic syndrome which may play a part in this relationship.

Depression and anxiety disorders have been associated with chronic pain in many previous cross sectional studies.^{17, 25} Herein, a previous diagnosis of depression or anxiety was significantly related to chronic pain prevalence. While previous studies have shown this relationship, they have not adjusted for BMI, a factor also associated with depression and anxiety. The relationships among depression, anxiety and chronic pain are likely to be multifactorial and bidirectional.^{26, 27.}

In our study, we found an association between hypertension and chronic pain in univariate analysis but not a significant association in the multivariate models. The association between hypertension and pain may arise, at least in part, due to the confounding influence of obesity or metabolic syndrome. Other studies have reported a relationship between hypertension and chronic pain¹⁸ at cross section. Because we relied on self-report, we may have underestimated the association. Possible mechanisms for the relationship between hypertension and chronic pain include overactivity of the sympathetic nervous system, baroreceptor hypersensitivity, and alpha-2 adrenergic inhibition.¹⁸

Because cancer associated pain may have a different relationship with the comorbid factors measured, we tested for a relationship between a cancer diagnosis and pain prevalence and severity and found no significant association. Nor did adjusting for cancer significantly influence our multivariate analyses (results not shown).

Although our study finds a relationship between obesity, pain and other co-morbidities, we cannot determine a direct causal relationship since we analyzed the data at cross-section. Longitudinal studies must be performed to assess the directionality of the relationship between obesity and chronic pain. It is plausible that obesity might increase the prevalence of pain if pro-inflammatory cytokines increase pain susceptibility or if obesity increases the risk of osteoarthritis or low back pain. Pain could increase the risk of obesity through reduced physical activity or hormonal influences. Our study is also limited by its use of self-reported data, including self-reported diagnosis of medical conditions such as diabetes, depression, hypertension and anxiety. We also used self-reported height and weight to calculate BMI; self-reports in the elderly have been shown to validly approximate measured height and weight.²⁸ Comparisons of our chronic pain prevalence estimates to other studies is limited by variation in definition from study to study.

We analyzed survey results from a relatively large sample of elderly persons residing in the Bronx. Though our estimates of pain prevalence rates and demographic characteristics resemble other elderly population samples, results may not be generalizable outside the Bronx. Our study shows relationships between several common pain co-morbidities after adjusting for many possible confounders. Unlike previous studies, we also have shown associations with specific chronic pain bodily locations and obesity, diabetes, depression, anxiety, and hypertension. We also adjust for multiple co-morbid factors related to both obesity and pain including psychiatric (depression and anxiety) and vascular (hypertension and diabetes) covariates. Our sample is also well suited for further longitudinal follow-up and re-evaluation of the risk factors for and the impact of chronic pain on this population.

The prevalence of chronic pain in the elderly is high and associated with many other medical conditions that effect quality of life. Obesity's association with chronic pain in the elderly in this sample is independent of the effects of age, sex, education, and many concurrent medical and psychological conditions. Chronic pain conditions in almost all bodily locations in this elderly population are significantly higher in those who are female, are obese, or have

depressive and anxiety disorders. Additional research is required to understand the etiology and causal relationships of these associations.

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Table 1

Demographic and Health Characteristics of Participants with and without Chronic Pain: EAS Telephone Cohort 2004–2007

Variable	Without Chronic Pain (n = 404)	With Chronic Pain (n = 436)
Age (mean):	80.5	80.6
> 80 years	180 (48.0)	205 (50.7)
Female	209 (53.6)	315 (71.6)
BMI (mean):	25.8	27.2
Underweight (<18.5)	8 (2.0)	6 (1.4)
Normal weight (18.5 – 24.9)	170 (43.0)	145 (34.2)
Overweight (25 – 29.9)	165 (41.8)	162 (38.2)
Obese (30 – 34.9)	45 (11.4)	83 (19.6)
Severely Obese (≥ 35)	7 (1.8)	28 (6.6)
Years of Education (mean):	14.2	13.6
> 12 years	230 (57.8)	216 (50.4)
Depression	19 (4.7)	48 (11.0)
Anxiety	15 (3.7)	36 (8.3)
Diabetes	70 (17.4)	95 (21.8)
Hypertension	219 (54.5)	272 (62.8)
BIMC Score (mean):	1.8	2.1
BIMC ≥ 4	58 (18.1)	64 (19.1)
BIMC ≥ 8	8 (2.5)	13 (3.9)

Data presented as means or N (% of group).

Abbreviations: BMI–Body Mass Index, BIMC–Blessed Information-Memory-Concentration test, EAS–Einstein Aging Study.

Table 2

Univariate analysis and Multiple Logistic Regression Model on Chronic Pain: EAS Telephone Cohort 2004–2007

Independent Variable:	Univariate Logistic Regression		Multiple Logistic Regression:	
	<i>Odds Ratio (95% CI)</i>	<i>P Value</i>	<i>Odds Ratio (95% CI)</i>	<i>P Value</i>
Age (years)	1.12 (0.83–1.49)	.446	1.02 (0.99–1.05)	.106
Female Gender	2.18 (1.61–2.97)	< .001	2.24 (1.63–3.08)	<.001
BMI:				
Underweight (<18.5)	0.88 (0.25–2.97)	.817	0.56 (0.17–1.85)	.294
Normal weight (18.5–24.9)	Reference		Reference	
Overweight (25–29.9)	1.17 (0.84–1.61)	.333	1.32 (0.94–1.85)	.108
Obese (30–34.9)	2.09 (1.33–3.28)	< .001	2.03 (1.27–3.26)	.002
Severely Obese (≥ 35)	4.53 (1.85–12.63)	< .001	4.12 (1.57–10.82)	.004
>12 years Education	0.74 (0.56–0.98)	.032	0.85 (0.63–1.16)	.337
Depression	2.48 (1.40–4.55)	<.001	1.94 (1.03–3.66)	.041
Anxiety	2.33 (1.22–4.64)	.006	2.15 (1.04–4.43)	.039
Diabetes	1.32 (0.92–1.89)	.111	1.38 (0.92–2.05)	.141
Hypertension	1.41 (1.06–1.88)	.014	1.26 (0.92–1.72)	.123

Abbreviations: BMI–Body Mass Index, EAS–Einstein Aging Study

Table 3

Chronic Pain Location and Obesity: EAS Telephone Cohort 2004- 2007

Chronic Pain Location	Obesity (BMI $\geq$ 30)		P Value
	No	Yes	
Head %	3.7	9.4	.003
Face %	1.5	0.0	.113
Neck/Shoulder %	14.9	22.6	.020
Back %	21.7	35.9	< .001
Arms/Hands %	12.9	19.5	.036
Legs/Feet %	24.1	44.7	< .001
Chest %	2.3	5.0	.066
Abdomen/Pelvis %	6.9	14.5	.002

Abbreviations: BMI–Body Mass Index, EAS–Einstein Aging Study