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Are Women More Likely Than Their Male Counterparts to Seek Treatment for Chronic Pain?

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ABSTRACT

Chronic pain is a prevalent condition in the US, and can inhibit people from conducting daily activities. There has been debate regarding whether women are more likely to be diagnosed with chronic pain, due to a higher sensitivity to pain. Based on previous suggestive findings, we hypothesized that women from the NIH AllofUs dataset would seek chronic pain treatment at lower levels of functional impairment than men in similar health. Contrary to our expectations, gender did not correlate with chronic pain incidence. For every 1000 fewer daily steps, hazard ratios for incident pain were approximately 1.2 for both men and women. These results suggest that gender may not significantly influence pain perception in this context, but a higher step count is correlated with lower chronic pain incidence.

Introduction

Chronic pain can be a debilitating condition that can inhibit one from doing daily activities, a condition that 20.9% of US adults have[1]. Notably, chronic pain incidence varies in different groups because of demographic factors like age, sex, and education level[2]. There has been recent debate as to whether women are more likely to be diagnosed with chronic pain because they have a higher sensitivity to pain. Previous studies, including one by Umeda et al. have concluded that there is a higher prevalence of chronic pain in women[3]. It has been hypothesized that one reason that higher prevalence of pain-related diagnoses in women is due to lower thresholds or higher subjective experience of pain, seeking women to seek out treatment at higher rates[4].

Secondly, functional status is defined by Wang as, "the level of activities performed by an individual to realize needs of daily living,"[5]. Functional status can be used as an alternative measurement to self-reported pain, as McGorry et. al finds there are significant correlations between pain and functional status[6]. Ergo, we expect changes in functional status to also be associated with pain incidence reports and diagnoses. Functional status can be used as an alternative measurement to self-reported pain; Baril et al. demonstrated significant correlations between pain and functional status, with step count as a proxy for functional status[7]. Thus step count can serve as an easily measurable proxy for functional status and subjective measures of pain.

If it is true that women have a higher sensitivity to pain, we expect there will be a higher incidence of pain-related diagnosis for women than men at similar levels of functional impairment. This study aims to use Fitbit data from patients, in conjunction with their electronic health records (EHR) data to determine the relationship between step count, gender, and its relationship with incidence of pain-related diagnoses.

Based on prior findings, including a study done by Umeda et al. we hypothesize that women will have higher rates of chronic pain incidence in comparison to their male counterparts with comparable health and functional status[3].

About the *AllofUs* Research Program

This study utilizes the National Institutes of Health *AllofUs* researcher workbench and data. The *AllofUs* program is an effort by the NIH to gather more than one million participants' healthcare data. Patients can opt-in to the program and to have their data shared with researchers. This data can then be accessed by the researchers through the Researcher Workbench. Currently on the workbench there are 694,000 participants, and 388,000 unique EHR records. 6,042 people from these participants also shared their Fitbit data. One of the benefits of this dataset is its diverse population, which is one of the aims of the program; 77% of the participants are from underrepresented communities, and 46% are from underrepresented racial minorities. The *AllofUs* workbench was used to conduct phenome-wide association studies in this project because it contains EHR and wearable data for patients, that can be analyzed in conjunction with each other.

Methods

In this study, we utilized the NIH *AllofUs* research database and workbench to access and analyze Fitbit and Electronic Health Record (EHR) data from patients that participated in FitBit data sharing[3]. We used R to manipulate and clean this dataset.

We followed data preparation and analysis code from Master et al[8.] We pulled all users that had Fitbit data. Fitbit data was recorded as daily steps, and days with less than 100 steps, days with over 45,000 steps, or days with less than 10 hours of Fitbit wear were excluded. Additionally, we excluded participants that were under 18, or had less than 180 days of Fitbit data. Then we excluded participants who didn't have EHR data as well. We also calculated the monitoring period for each participant. The monitoring period spanned from the first to the last EHR entry.

Then, we pulled user data to measure covariates. The list of covariates were as follows: smoking over 100 cigarettes, highest grade level, drinking over 1 drink of alcohol, BMI, cancer, coronary artery disease, age, race, gender, and systolic blood pressure. BMI was calculated by taking the weight of a patient in kilograms, and dividing it by the height of the patient in meters squared. Then, we compiled demographic statistics including factors like gender, race, and education level

Then, we indicated whether each patient had chronic pain. Chronic pain status was determined using an ICD-to-phecode mapping by Zheng et al[9]. Patients with chronic pain diagnosed prior to the observation period were excluded. Chronic pain incidence was identified in patients diagnosed six months after their monitoring period began. After cleaning the data, we used multiple imputation to account for missing values.

Then, we conducted a survival analysis for chronic pain using a Cox proportional hazard model. A Cox model is a multiple regression model that is used for medical research, and in our case it examined the risk of one getting chronic pain based on their step count. We included the covariates we calculated earlier in this model as well. For each covariate, the modeling software estimates the coefficient β, for each covariate. The β coefficient reflects the effect of each variable on the hazard of developing chronic pain.

We estimated three Cox models for incident chronic pain with average daily step counts represented as cubic splines: one for the entire dataset and two separated by gender. The cubic spline accommodated for the flexible, non-linear relationship between step counts and the hazard of developing chronic pain, and gave more accurate results than a simple linear model. We used these Cox models to calculate the chronic pain hazard ratio, based on step count. The hazard ratio indicates the risk increase in getting diagnosed with chronic pain if one had 1000 fewer steps per day. For example, if the hazard ratio was 2, that means the chance of being diagnosed with chronic pain doubles if one walked 1000 fewer steps per day.

Results

In total, 6,042 participants were included, 73% of which were female, and 27% of which were male. 89% of the total population observed were white, 6% were black or african american, and 5% were other races. 76% of the population observed did not have cancer, 67% had smoked more than 100 cigarettes, 72% had a college degree, and 97% had drunk alcohol. Additionally the median age was 50.9, the median systolic blood pressure was 121, and the median BMI was 28.1. The median monitoring duration was about 4 years.

We found that step count was inversely associated with chronic pain: for every 1000 fewer daily steps, the hazard ratio (HR) for incident chronic pain was 1.21 (95% CI). This is not a new finding, other studies. like one done by Ogawa et. al, have come to this conclusion as well[10].

However, in an analysis of the entire population, there was no significant impact of gender on chronic pain incidence after controlling for step count and other health factors (hazard ratio for males vs. females was 1.14 with a .95 confidence interval of (0.93-1.39)) . Additionally, when comparing Cox models separately estimated by gender, for every 1000 fewer steps, the hazard ratio for incident chronic pain diagnosis for both men and women was approximately 1.2, with no significant difference observed in a fully interacted Cox regression. This means we can conclude that step count is inversely correlated with chronic pain incidence, but there is no significant different between genders, using data from the AllOfUs dataset.

Discussion

Taken together, this brings into question the claim that women are more likely to be diagnosed with chronic pain or seek out chronic pain treatment, contradicting our original hypothesis and other findings. Given the same step count, women were not more likely to seek out chronic pain treatment, and hence be diagnosed with chronic pain, as compared to their male counterparts.

However the study did confirm that step count can be protective against chronic pain, which also means that exercise could be explored as a potential avenue for chronic pain prevention and mitigation., as Geneen et. al states that exercise can be used as a way to mitigate chronic pain in adults[11]. Lima et. al furthers that exercise can reduce pain perception and also improve mental health, which also can decrease the amount of pain one feels[12]. More research should be done on this.

A number of biases must be considered in interpretation of these results, including access to healthcare, selection bias in participation in the AllofUs study itself as well as the AllofUs Fitbit study. The demographics of this study were primarily white (72% white), educated, women, which means it would be valuable to pursue future studies with a more diverse sample, in order to see if these results hold true.

Future Research

Future studies using *AllofUs* program data might also take into account genomics, different treatments patients with these conditions have received, and the effectiveness within the context of step count and demographic factors. Additionally future research should look at trends in steps over time, and see if there are any explanations for disturbances in those trends like drops in step count. Future research should also include a larger sample size, and participants from many different backgrounds, to see if the results are similar to the ones obtained in this study.

Additionally, different types of exercise should be considered as mitigation strategies for chronic pain. Step count does not specify the type of exercise, so specifically trying out different types of exercise like aerobic exercise or cardio exercise and seeing their efficacy in reducing chronic pain would be beneficial.

Figures and Tables

Table 1. Population Characteristics

	Men (N=1579)	**Women (N=4379)**	**Overall (N=6042)**
Chronic Pain Incidence	9.5%	11.0%	10.4%
Median Monitoring Duration (Days)	1439 (1439 ± 782)	1473 (1470 ± 772)	1457.5 (1458 ± 774)
Median Steps (IQR)	8580 (8820 ± 3322)	7436 (7757 ± 3001)	7731 (8034 ± 3126)
Median Age (IQR)	56.0 (53.0 ± 15.3)	49.4 (47.9 ± 15.2)	50.9 (49.2 ± 15.4)
Median SBP (IQR)	126.5 (127.4 ± 14.4)	120.0 (121.2 ± 15.6)	121 (122.8 ± 15.5)
BMI	28.4 (29.12 ± 6.22)	27.96 (29.22 ± 7.53)	28.1 (29.2 ± 7.2)
Race			
Black (%)	4	6	6
White (%)	89	89	89
Other (%)	7	5	5
Cancer (%)	22	24	24
Coronary Artery Disease (%)	6	2	3
Smoking (100 cigs/lifetime) (%)	35	32	33
Education			
College Degree (%)	77	70	72
No College (%)	5	6	6
Some College (%)	18	24	22
Alcohol (%)	97	97	97

Table 2. Incident Pain Hazard Ratios for Men, Women, and All Participants

	Men Only	**Women Only**	**All Participants**
Mean Daily Steps Hazard Ratio (95% CI)	1.21 (.96-1.51)	1.23 (1.08-1.40)	1.21 (1.08-1.36)

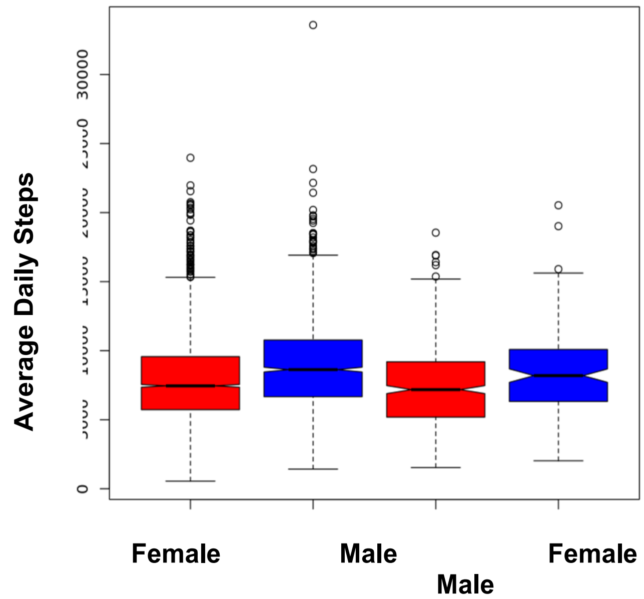

Figure 1. Average Daily Steps vs. Gender and Incident Pain Diagnosis

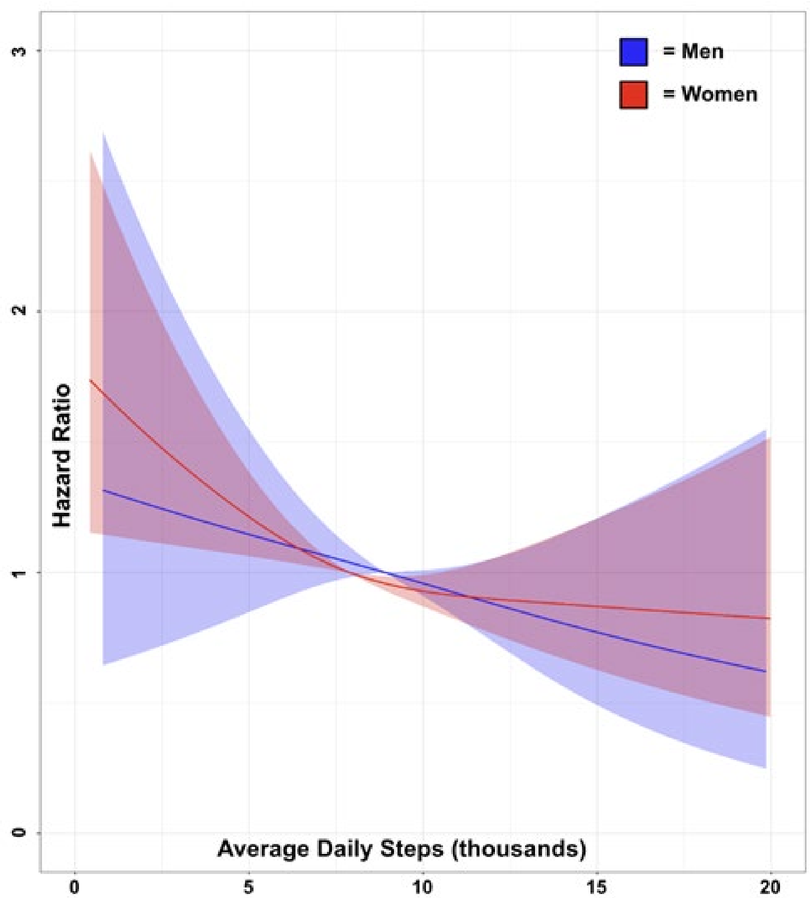

Figure 2. Average Daily Steps vs. Hazard Ratio by Gender

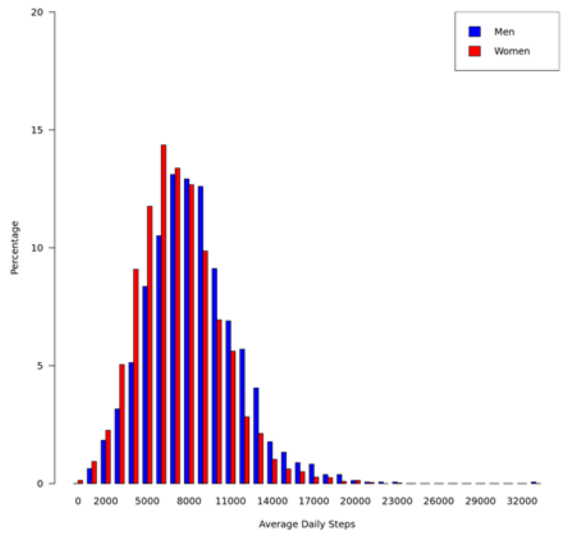

Figure 3. Distribution of Average Daily Step Counts by Gender

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