

Decreased Physical Activity Attributable to Higher Body Mass Index Influences Fibromyalgia Symptoms

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Background: Although previous studies report associations between increased body mass index (BMI) and fibromyalgia symptoms, there is uncertainty as to whether this relationship is driven by physical factors, psychological factors, or both.

Objective: To assess these relationships in a clinical sample of patients with fibromyalgia.

Design: Cross-sectional study.

Setting: Tertiary care facility.

Patients: A total of 686 patients from an existing national fibromyalgia registry.

Methods: Patients completed a demographic form and self-report questionnaires including the Fibromyalgia Impact Questionnaire—Revised (FIQ-R), the Medical Outcomes Study Short Form—36 (SF-36), the Brief Pain Inventory (BPI), and the 30-item Profile of Mood States (30-item POMS).

Main Outcome Measurements: FIQ-R overall impact subscale.

Results: BMI was significantly correlated with fibromyalgia impact ($P < .001$). The relationship between BMI and fibromyalgia impact was almost fully accounted for by physical factors and not by psychological factors.

Conclusions: Despite patient report that pain hinders physical activity, clinicians who encounter patients with fibromyalgia, particularly patients with increased BMI, should be cognizant of the need to invest time and resources to counsel patients on physical factors (ie, physical activity) that could improve the patients' symptom experience.

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INTRODUCTION

Body mass index (BMI) above the normal range is a determinant both of more severe symptoms and of worse health outcomes in patients with fibromyalgia [1-3]. Despite the association between BMI and fibromyalgia symptoms, it is unclear whether this relationship is driven by physical factors, psychological factors, or both [2,4-7]. This information is important, as the prevalence of obesity in patients with fibromyalgia is high (47%-73%) [1,5,7], and clinicians who encounter patients with fibromyalgia with an unhealthy BMI need clear guidance on the most appropriate management for this group of patients.

Many factors, including decreased physical activity, stress, depression, anxiety, and chronic sleep deprivation, have been linked with body weight in patients with fibromyalgia [4,7]. For example, previous research has demonstrated that in fibromyalgia, being obese is associated with greater pain severity, greater number of tender points, poorer sleep quality, reduced physical strength and flexibility, and higher symptom burden when compared to being of normal weight [2,5,6]. Also, women with fibromyalgia who are obese have significantly higher levels of anxiety and depression, poorer quality of life, and poorer physical performance than women with fibromyalgia who are not obese [6]. Despite this body of research, no study to date has assessed the complex association between BMI, physical, and psychological variables in the same model.

To evaluate complex relationships between variables, specific statistical techniques such as mediation models that estimate direct relationships between variables and effects of

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mediators can be used [8]. Because our aim was to examine associations among BMI, physical factors, and psychological factors in patients, we created a conceptual mediation model (Figure 1). Specifically, we evaluated whether physical factors (physical activity and physical interference related to pain) or psychological factors (depression and anxiety) arbitrated this relationship. We hypothesized that (1) BMI would be associated with overall fibromyalgia impact, and (2) this relationship would be mediated by depression and anxiety and by physical activity and physical interference from pain.

METHODS

Data for this analysis were derived from a sample of patients with fibromyalgia (N = 1303) who were randomly selected from a national fibromyalgia registry [9] and were invited to participate in a mailed survey. The overall response rate to this survey was 65.5%. This study was approved by the Mayo Clinic institutional review board.

Participants

Only those respondents who met Fibromyalgia Research Survey Criteria [10] were included in the present analyses (N = 686, 52.6% of the original sample). This is defined as a widespread pain index (WPI) of ≥ 7 and symptom severity (SS) ≥ 5 or a $3 \leq WPI \leq 6$ and $SS \geq 9$. In addition, patients who were underweight (n = 15) were excluded, as factors responsible for their symptom profiles may be different [4].

Measures

Participants completed a questionnaire package that included the Fibromyalgia Research Survey [10], the Fibromyalgia Impact Questionnaire—Revised (FIQ-R) [11], the Medical Outcomes Study Short Form—36 (SF-36) [12], the Brief Pain Inventory (BPI) [13], and the 30-item Profile of Mood States (30-item POMS) [14]. For these analyses, we selected specific subscales (described below) to avoid overlap between predictor and outcome variables. For example, the FIQ symptom subscale was avoided, as it shared items with both the BPI and POMS.

FIQ-R. The FIQ-R is a 21-item, validated, self-report measure used to assess symptom burden in patients with fibromyalgia [11]. The FIQ-R yields 3 subscales (functioning, overall impact of fibromyalgia, and symptom severity) and a total summary score. Total scores range from 0 to 100, and higher scores are indicative of greater symptom burden. The FIQ-R has an internal consistency of 0.95 and is commonly used in clinical trials of patients with fibromyalgia [15-18]. For this analysis we selected the FIQ-R overall impact subscale, which specifically assesses patients' experiences of how overwhelmed they were by fibromyalgia and how having fibromyalgia influenced their ability to accomplish goals. This subscale was selected because it had no conceptual overlap with the predictor or mediator variables.

SF-36. The SF-36 is a 36-item, validated self-report measure that assesses quality of life and burden of disease [12]. It yields 8 subscales (physical functioning, role-physical, bodily pain, general health, vitality, social functioning,

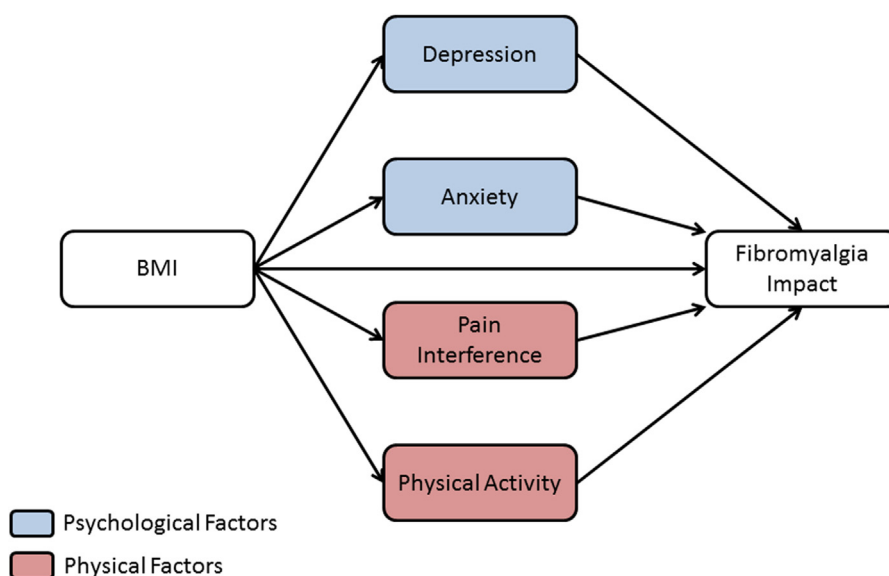


Figure 1. Conceptual model of the association between body mass index (BMI) and fibromyalgia impact, including 4 theoretically derived putative mechanisms.

role-emotional, and mental health) and 2 summary scores (physical and mental). Component scores range from 0 to 100, and higher scores are indicative of better health. The SF-36 has an internal consistency of 0.9 and has been used in clinical trials of patients with fibromyalgia [19-21]. For this analysis, we selected the SF-36 physical functioning subscale, which assesses a patient's ability to perform a variety of tasks, including vigorous and moderate activities, walking, bending/kneeling, and bathing/dressing.

BPI. The BPI is a 15-item, validated self-report measure of chronic pain that assesses the presence of pain, pain severity, and degree of pain interference [13]. The BPI yields 2 subscales: pain severity and pain interference. Scores on the pain severity and pain interference subscales range from 0 to 10, and higher scores are indicative of greater pain. Internal consistency for the pain severity score is 0.85 and for the interference scale is 0.88. The BPI has been used in fibromyalgia clinical trials, and is considered an appropriate measure of pain in fibromyalgia [16,22-25]. For this analysis we selected the pain interference subscale, which assesses the degree to which pain restricts or hinders physical activities of daily living.

30-Item POMS. The 30-item POMS is a validated, self-report measure of mood that yields 6 subscales (depression-dejection, tension-anxiety, fatigue-inertia, vigor-activity, anger-hostility, and confusion-bewilderment) and a total mood disturbance score [14]. Scores on each subscale range from 0 to 20, and higher scores are indicative of more severe symptoms on all scales except for the vigor-activity scale, where lower scores indicate more severe symptoms. The 30-item POMS has an internal consistency of 0.69 to 0.88 and has been used in patients with fibromyalgia [26-28]. For this analysis we selected the depression-dejection and the tension-anxiety subscales to represent the symptoms of depression and anxiety, respectively.

Data Analyses

Data analyses were conducted using SPSS 19 (IBM Corp., Armonk, NY) and Amos 19 (Amos Development Corp., Crawfordville, FL). Amos 19 was used to estimate structural equation models that tested model fit and total, direct, and indirect effects. Our analyses used guidelines by Kline [29] for model fit, and guidelines by Hayes [30] for assessing direct and indirect effects. Generally accepted cutoffs for model fit in structural equation models are ≥ 0.90 for the comparative fit index (CFI) and ≤ 0.05 for the root mean square error of approximation (RMSEA) [29]. SPSS was used to estimate an initial Pearson correlation matrix, to examine individual mechanisms, and to test the statistical significance of each indirect effect using Hayes' Process Macro [30]. Before each analysis, data were examined for adherence to distributional assumptions and outliers. Statistical test results were deemed significant at the $P < .05$ alpha level.

RESULTS

Overall, 686 patients met inclusion criteria. On average, patients were 56.1 years (± 12.5 years) of age, had a BMI of 30.2 (± 7.3), were female (92.9%), and were of white ethnicity (90.8%). Patients exhibited moderate to severe symptom severity as evidenced by a total FIQ-R score of 55.5 (± 19.0 ; range, 0-100). Means and standard deviations for variables included in the mediation model are reported in Table 1.

Pearson correlations (Table 2) demonstrated expected but modest associations between BMI and pain interference ($r = 0.108$, $P = .005$), physical activity ($r = -0.280$, $P < .0001$), and overall fibromyalgia impact ($r = 0.138$, $P = .0003$) (Table 1). BMI did not correlate with depression ($r = 0.050$, $P = .20$) or anxiety ($r = -0.001$, $P = .97$) and hence were not included in mediation analyses. The model tested the mediating effects of pain interference and physical functioning on the BMI-fibromyalgia impact association. Figure 2 provides the results of this model and shows the non-standardized regression coefficients for each path. This path diagram reveals that a 1-unit increase in BMI results in a small (0.04) increase in pain interference, whereas the same 1-unit increase in BMI results in a moderate (-0.39) decrease in physical activity scores. Likewise, a 1-unit increase in pain interference scores results in a much larger (1.28) increase in fibromyalgia impact scores, and a 1-unit increase in physical activity scores results in a moderate (-0.17) decrease in fibromyalgia impact scores. There was a small, statistically significant, indirect effect of BMI through pain interference and physical functioning on fibromyalgia impact ($B = 0.11$, $P = .02$). This indicates that a 1-unit increase in BMI acts, through increased pain interference and decreased physical activity, to result in an increase in fibromyalgia impact scores of 0.11. There was no direct effect of BMI on fibromyalgia impact, and removing the direct effect had no adverse effect on model fit [$\Delta\chi^2$ (1, $N = 657$) = 0.01, $P = .97$], which continued to show overall acceptable fit [χ^2 (1, $N = 657$) = 0.03, $P = .86$; CFI = 1.00; RMSEA = 0.00]. Using the Process Macro [30,31] for SPSS 19 (SPSS Inc., Chicago, IL), a multiple mediation analysis allowed a test of each indirect effect. Small indirect effects of BMI on fibromyalgia impact acted through both pain interference ($B = 0.041$, $P < .05$) and physical functioning ($B = 0.067$, $P < .05$), and these indirect effects were equal in magnitude ($B = 0.03$, $P > .05$). Finally, a reverse mediation model was examined. In this model, BMI acted as the mechanism of action for associations between depression, anxiety, pain interference, and physical functioning with fibromyalgia impact. This model did not provide a good fit to the data [χ^2 (2, $N = 657$) = 408.19, $P < .001$; CFI = 0.45; RMSEA = 0.56].

DISCUSSION

Our results demonstrate that physical factors such as physical impairment related to pain and being physically active

Table 1. Demographic characteristics and descriptive statistics for questionnaires

	Mean (SD) or n (%)	Range	Interpretation
Age, y	56.1 (12.5)		
BMI	30.2 (7.3)		<18.5 Underweight, 18.5 to <25.0 normal, 25.0 to <30 overweight, >30 obese
Gender			
Male	49 (7.1)		
Female	637 (92.9)		
Race/ethnicity			
White	623 (90.8)		
Other	63 (9.2)		
BPI			
Pain interference	5.7 (2.3)	0-10	Higher scores indicate more severe pain interference
SF-36			
Physical functioning	33.4 (10.3)	0-100	Higher scores indicate better health
Physical component	30.1 (8.7)	0-100	Higher scores indicate better health
Mental component	40.2 (12.5)	0-100	Higher scores indicate better health
FIQ-R			
Overall impact	11.0 (5.8)	0-20	Higher scores indicate more severe impact of fibromyalgia on life and activities
Total	55.5 (19.0)	0-100	Higher scores indicate more severe impact of fibromyalgia on life and activities
POMS			
Depression-dejection	6.7 (5.1)	0-20	Higher scores indicate more severe symptoms
Tension-anxiety	7.2 (4.8)		Higher scores indicate more severe symptoms

BMI = body mass index; BPI = Brief Pain Inventory; SF-36 = Short Form-36; FIQ = Fibromyalgia Impact Questionnaire; POMS = Profile of Mood States.

mediate the modest impact of BMI on fibromyalgia symptoms. Depression and anxiety were not correlated with BMI, so they could not explain the relationship between BMI and fibromyalgia impact. Our results are particularly noteworthy, given that ours was a tertiary care population with higher medical and psychological comorbidities, as indicated by SF-36 scores that were significantly lower than those of the general population in the United States [12].

Our findings indicate that as BMI increases, it becomes more difficult for a patient to physically function and to be active, which in turn influences the impact of fibromyalgia. Although patients attempt to mitigate the effects of pain by being less physically active, based on our results, lower physical activity actually worsens the impact of the illness. Although vigorous physical activity may not be feasible for patients with chronic pain, physical activity can be increased in multiple ways. For example, Fontaine and Clauw have demonstrated that accumulating 30 minutes per day of

lifestyle physical activities (such as walking, using the stairs, gardening) was feasible for previously inactive patients with fibromyalgia, and that this increased physical activity decreased pain [32]. In addition, Levine et al demonstrated that modifying simple lifestyle activities (for example, walking and talking on the telephone instead of sitting, having walking instead of sitting meetings in daily encounters, engaging in purposeful housekeeping, increasing stair climbing) increased non-exercise activity thermogenesis and decreased BMI [33]. Such activities may be pragmatic alternatives to aerobic exercise, and may help patients with fibromyalgia and high BMI to start moving.

Our study has several limitations. First, this is a cross-sectional analysis, and correlations do not imply causality; therefore, our results must be interpreted with caution. Only a longitudinal study that assesses temporal relationships of variables over time can shed light on causation. In this study, in addition to correlations, we evaluated the

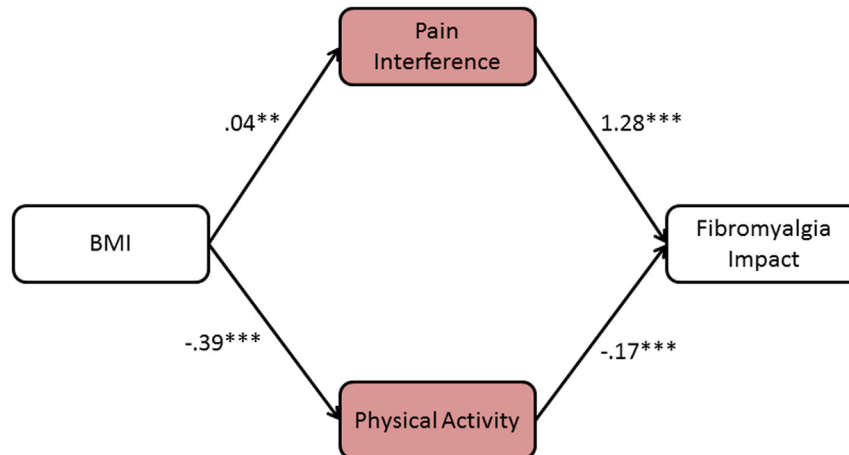
Table 2. Pearson correlations of body mass index and physical and psychological factors

	BMI	BPI Pain Interference	SF-36 Physical Functioning	FIQ Overall Impact	POMS Depression-Dejection	POMS Tension-Anxiety
BMI	1					
BPI pain interference	0.108*	1				
SF-36 physical functioning	-0.280†	-0.492†	1			
FIQ overall impact	0.138†	0.642†	-0.522†	1		
POMS depression-dejection	0.050	0.481†	-0.255†	0.471†	1	
POMS tension-anxiety	-0.001	0.444†	-0.168†	0.413†	0.732†	1

BMI = body mass index; BPI = Brief Pain Inventory; SF-36 = Short Form-36; FIQ = Fibromyalgia Impact Questionnaire; POMS = Profile of Mood States.

* $P < .01$.

† $P < .001$.



Unstandardized path coefficients. ** $p < .01$, *** $p < .001$

Figure 2. Empirically derived model of body mass index (BMI), mechanisms, and fibromyalgia impact.

interrelationships of variables through mediation modeling. This strengthens our understanding of potential mechanisms. Second, the generalizability of our results is limited, given our clinical sample consisting of patients with moderate to severe symptoms. Our model will need to be validated in other clinical and community samples. Third, although anxiety and depression were not significant mediators in this model, it is important to point out that patients with fibromyalgia have a high prevalence of comorbid mood and anxiety disorders. These results were surprising, as literature suggests an association between mood and obesity [34,35] and will need further study. Fourth, given that duration of symptoms was not assessed, we were unable to determine whether this could have influenced symptom burden. Fifth, because not all patients invited to participate returned completed surveys, participation bias could limit the generalizability of our findings. Finally, our sample size was large, as is necessary to obtain reliable results from structural equation modeling; however, large samples also have copious statistical power and hence can detect small associations that may not always be clinically meaningful. The present findings offer theoretical support for influence of BMI on fibromyalgia impact and putative mechanisms of action, but the clinical utility and meaningfulness of these modest interrelationships has yet to be determined in applied clinical settings.

CONCLUSIONS

To conclude, although a higher BMI increases pain and often serves as a barrier to physical activity, transcending this challenge even through the simplest of activities may

translate to decreased pain. Obese and overweight patients with other chronic conditions are routinely told that they will help themselves if they move a little [36]. Our study is in consonance with these reports. Clinicians who encounter patients with fibromyalgia, particularly those with increased BMI, should invest time and resources in counseling patients to increase physical activity.

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CME Question

Which is considered the most challenging symptom to treat with fibromyalgia patients?

- a. sleep
- b. depression
- c. activity
- d. anxiety

Answer online at me.aapmr.org