ORIGINAL RESEARCH

The Relationship Between Musculoskeletal Pain and Picky Eating: The Role of Negative Self-Labeling

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ABSTRACT

Introduction: Picky eating appears to be associated with poor health outcomes and thus it might have a role in musculoskeletal pain in adults. However, this relationship has not been investigated yet. The aim of the present study was to determine whether the number of musculoskeletal pain regions was associated with picky eating, which was characterized by food intake balance of familiar products or self-identification.

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Electronic supplementary material The online version of this article (https://doi.org/10.1007/s40122-019-0116-2) contains supplementary material, which is available to authorized users.

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Methods: A total of 4660 adult subjects were enrolled in this study. Picky eating was assessed in two ways; a countable score and self-identification of picky eating. For the countable score, the number of food items, which the subjects usually did not consume among a list of 11 familiar products was measured. Self-identification as a picky eater was defined through a single question. The presence of musculoskeletal pain; in the neck, low back, knee, back, or arm, within 2 months of the survey was also identified.

Results: Of all subjects, 2654 (56%) had musculoskeletal pain in at least one region. The prevalence of musculoskeletal pain in every region was seen as consistently higher in subjects who self-identified as picky eaters than those who were non-picky eaters. In multiple linear regression analysis, the number of pain regions was significantly associated with older age, females, self-identification as a picky eater,

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and low body weight, not but the countable score.

Conclusions: There may be an association between musculoskeletal pain and negative beliefs about one's own eating behaviors.

Keywords: Behavior; Cross-sectional; Eating; Musculoskeletal pain; Picky; Questionnaire

INTRODUCTION

Musculoskeletal pain is an important health issue all over the world [1]. Although numerous studies have been carried out to investigate the causes of musculoskeletal pain disorders based on biopsychosocial principles [2], studies addressing the relationship between pain and food quality or eating behaviors are scarce.

Picky eating has been known as an aversion or a refusal to eat a wide variety of commonly accepted foods [3–7]. Although the findings of picky eating are many in children [3–5], picky eating appears to be quite common across all generations [6], and in one study the prevalence of adult picky eating was 35.5% [7]. Previous studies reported relationships between adult picky eating and poor health outcomes [7–9]. Adult picky eating has been characterized by the number of disliked food items among a list of familiar products [8] or self-identification [6, 7, 10], and each measure seems to assess a different aspect of picky eating. Maitre et al. [8] found a correlation between individuals with picky eating and an increase in malnutrition risk. On the other hand, Kauer et al. [7] and Ellis et al. [9] showed that self-identification as a picky eater was associated with psychological disturbances such as anxiety and depression. That is, the former one is influenced by actual food intake, while, in contrast, the latter one could be influenced not only by poor diet balance but also internal psychopathology [7]. As 'picky eating' is thought to be a form of negative labeling, self-identification as a picky eater seems to be similar to a 'self-labeled' picky eater who could be someone with mental illness having self-stigma or low self-esteem [11]. The word 'self-labeling' or 'self-stigma' is often used when people with mental illness agree with the internalized negative stereotype [12], and relationships between negative stigma and chronic pain are well known [13]. Hence, picky eating has a possible relationship with musculoskeletal pain among people with well-being through poor food quality or internal psychopathology [14–17]. Finding any information that helps us establish any relationship between them would be very helpful.

The aim of the present study was to examine retrospectively whether musculoskeletal pain was associated with picky eating in adults with well-being. In this study, we used self-reported records of food intake balance of familiar products or self-identification as a picky eater and presence or absence of pain in five musculoskeletal body regions. Then, we investigated relationships between the number of musculoskeletal pain regions and picky eating.

METHODS

Participants

We enrolled subjects, aged 20 years and older, in our physical-fitness center attached to a university in Japan. Users were usually considered to be well-being and able to perform physical exercise under supervision to promote their health, regardless of whether they had musculoskeletal disorders or not. They underwent an annual medical check-up including a daily food intake questionnaire related to familiar products as the health survey. Exclusion criteria were people who were not allowed to continue exercise alone due to cognitive disorders, suspected dementia, or severe pulmonary and heart diseases. A total of 4660 records from users between 2001 and 2012 were retrospectively enrolled in this study. All procedures performed in studies involving human participants were in accordance with Ethics Committee of Aichi Medical University and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Due to the retrospective nature of the study design, written consent form of the study was waived for patients treated during the study period unless they refused to provide the information in accordance with the opt-out strategy.

MEASURES

Picky Eating

The present study evaluated picky eating using two different measurements; a countable score related to picky eating and a self-identification of picky eating.

The countable score related to picky eating was measured by the number of food items, which the subjects usually did not consume among a list of familiar products [8]. We used a list of eleven familiar food products, referenced from 'Dietary guidelines for Japan' by the Japanese government in 2000 [18]. The list of familiar food products was as follows; potatoes, fruit, beans (including soybeans), fish, meat, egg, milk products, vegetables with high beta-carotene, vegetables with low beta-carotene, vegetable oil, and mayonnaise. A five-point response scale (from 0, no intake, to 4, much intake) was recorded for each familiar product on the list to identify the amounts of food consumed in daily life (Supplementary Table 1). Then, the countable score was determined as the number of 0-points (no intake) on the questionnaire on the intake of 11 familiar products. The score ranges from 0 to 11 points, and the lower number indicates that subjects have more well-balanced diets, and conversely the higher number indicates that subjects are more likely to be picky eaters. Subjects were assigned into two categories based on a countable score; the subjects with a countable score of 1 and more were picky eater, or score of 0 were non-picky eater.

Self-identification as a picky eater was defined using a single question item [7, 10]. Subjects were assigned into two categories; picky eater or non-picky eater, based on their 'Yes' or 'No' responses to the simple question, *"Do you think that you are a picky eater?"*

Musculoskeletal Pain

The presence of musculoskeletal pain (neck, low back, knee, back, or arm) within 2 months of the survey was identified using the self-report questionnaires which consist of simple questions with their 'Yes' or 'No' responses to pain in each region. On the survey, the degree of pain intensity, the duration of pain, the cause of pain, and pain in specific regions were not identified, and thus pain characteristics between acute and chronic could not be distinguished. Subsequently, we calculated the number of pain regions for each subject.

Statistical Analysis

All continuous variables were expressed as median (range) and mean (standard deviation). Comparison between self-identification as a picky eater and non-picky eater was analyzed using the χ^2 test for the categorical variables, and the Mann–Whitney U test for the continuous variables, respectively. Then, further analysis using a stepwise multiple linear regression was conducted to determine which independent variables (age, sex, body weight, countable score related to picky eating, and self-identification of picky eating) accounted for the number of musculoskeletal pain regions.

The data were analyzed using SPSS (version 25.0 for Microsoft Windows; SPSS, Chicago, IL, USA). A p value < 0.05 was considered statistically significant.

RESULTS

Participants Characteristics

Among the 4660 subjects (median age, 49 years [range, 20–81; median, 47; standard deviation 16]; 2107 [45%] male), 2654 subjects (56%) had musculoskeletal pain in at least one region (Table 1). Mean countable score was 0.9 [standard deviation 1.2; median, 1; range, 0–10]. The number of subjects who self-identified as a picky eater was 894 (19%).

Table 1 Participant's characteristics

Male [n (%)]	2107 (45%)
Median (range)	49 (20–81)
Mean (standard deviation) age (years)	47 (16)
20–29 (n)	1016 (21%)
30–39 (n)	665 (14%)
40–49 (n)	655 (14%)
50–59 (n)	995 (21%)
60–69 (n)	932 (20%)
70– (n)	397 (8%)
Median (range)	62 (30–190)
Mean (standard deviation) body weight (kg)	64 (15)

All continuous variables were expressed as median (range) and mean (standard deviation)

Figure 1 showed the relationships between the countable score and self-identification as a picky eater or non-picky eater. Subjects who self-identified as a picky eater tended to have higher countable scores than those of non-picky eaters. Approximately 40% of the subjects who self-identified as a picky eater showed a countable score of '0', indicating that these subjects had labeled themselves as picky eaters, regardless of having a well-balanced food intake.

Comparison Between Self-Identifications as a Picky Eater and Non-Picky Eater

As shown in Table 2, the subjects who self-identified as picky eaters were significantly younger, with a higher prevalence of females, tended to have a higher number of pain regions, and a higher prevalence of musculoskeletal pain in each region than those of non-picky eaters.

Of the subjects having a countable score of '0', the subjects who self-identified as picky eaters were significantly younger, with a higher prevalence of females, and had a higher number
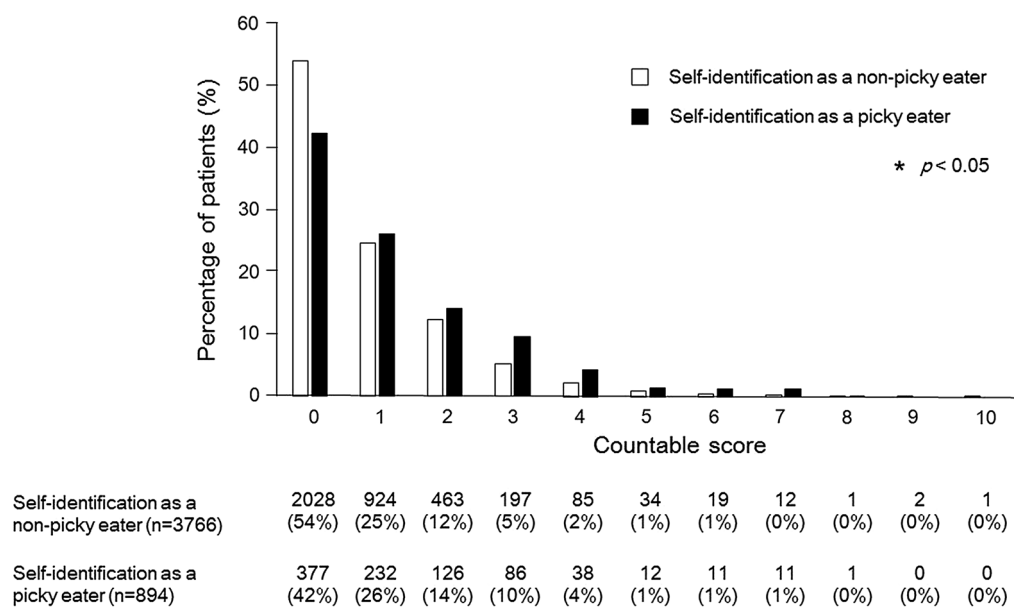

	0	1	2	3	4	5	6	7	8	9	10
Self-identification as a non-picky eater (n=3766)	2028 (54%)	924 (25%)	463 (12%)	197 (5%)	85 (2%)	34 (1%)	19 (1%)	12 (0%)	1 (0%)	2 (0%)	1 (0%)
Self-identification as a picky eater (n=894)	377 (42%)	232 (26%)	126 (14%)	86 (10%)	38 (4%)	12 (1%)	11 (1%)	11 (1%)	1 (0%)	0 (0%)	0 (0%)

Fig. 1 Association between countable scores and self-identification as a picky eater. Number of subjects who self-identified as picky eaters is expressed as a percentage of patients (%). Subjects who self-identified as a picky eater showed higher countable scores than those who self-identified as a non-picky eater. There were some subjects with discordant results between countable scores and self-identification as a picky eater. *Significant association between countable score and self-identification as a picky eater ($p < 0.05$)

Table 2 Comparison between the subjects who self-identified as picky eaters and non-picky eaters

	Self-identification as picky eater ($n = 894$)	Self-identification as non-picky eater ($n = 3766$)	p value	Effect size
Male [n (%)]	346 (38%)	1761 (47%)	< 0.001*	0.06 (small)
Median (range)	44 (20–81)	50 (20–81)	< 0.001*	0.15 (small)
Mean (standard deviation) age (years)	44 (15)	47 (16)		
20–29 (n)	213 (23%)	803 (21%)	< 0.001*	0.09 (small)
30–39 (n)	168 (18%)	497 (13%)		
40–49 (n)	144 (16%)	511 (13%)		
50–59 (n)	174 (19%)	821 (21%)		
60–69 (n)	140 (15%)	792 (21%)		
70– (n)	55 (6%)	342 (9%)		
Median (range)	62 (36–190)	62 (30–159)	0.771	
Mean (standard deviation) body weight (kg)	65 (17)	64 (14)		
Median (range)	1 (0–5)	1 (0–5)	< 0.001*	0.16 (small)
Mean (standard deviation) the number of pain regions	1.2 (1.2)	0.9 (1.0)		
No pain [n (%)]	311 (35%)	1610 (43%)		
Pain in one region [n (%)]	270 (30%)	1182 (31%)		
Pain in two regions [n (%)]	179 (20%)	630 (17%)		
Pain in three regions [n (%)]	84 (9%)	213 (6%)		
Pain in four regions [n (%)]	33 (4%)	99 (3%)		
Pain in five regions [n (%)]	17 (2%)	32 (1%)		
Pain region [n (%)]				
Neck	355 (39%)	1166 (30%)	< 0.001*	0.07 (small)
Low back	328 (36%)	1087 (28%)	< 0.001*	0.06 (small)
Knee	226 (25%)	798 (21%)	0.008*	0.03 (small)
Back	96 (10%)	322 (8%)	0.040*	0.03 (small)
Arm	92 (10%)	264 (7%)	0.001*	0.04 (small)

All continuous variables were expressed as median (range) and mean (standard deviation). Differences between patients who self-identified as a picky eater and those who did not were analyzed using the χ^2 test for the categorical variables, and the Mann–Whitney U test for the continuous variables, respectively

*Significantly different between patients with self-identifications as a picky eater and those without ($p < 0.05$)

Table 3 Comparison between self-identifications as a picky eater and non-picky eater in the subjects with a countable score of 0

	Self-identification as picky eater ($n = 377$)	Self-identification as non-picky eater ($n = 2028$)	p value	Effect size
Male [n (%)]	133 (35%)	848 (42%)	0.018*	0.05 (small)
Median (range)	46 (20–77)	52 (20–81)	< 0.001*	0.08 (small)
Mean (standard deviation) age (years)	45 (15)	48 (16)		
20–29 (n)	81 (21%)	383 (19%)	< 0.001*	0.11 (small)
30–39 (n)	68 (18%)	247 (12%)		
40–49 (n)	70 (19%)	287 (14%)		
50–59 (n)	86 (23%)	499 (25%)		
60–69 (n)	47 (12%)	434 (21%)		
70– (n)	25 (7%)	178 (9%)		
Median (range)	62 (38–190)	61 (33–157)	0.075	
Mean (standard deviation) body weight (kg)	65 (18)	63 (14)		
Median (range)	1 (0–5)	1 (0–5)	< 0.001*	0.09 (small)
Mean (standard deviation) the number of pain regions	1.2 (1.2)	0.9 (1.1)		
No pain [n (%)]	125 (33%)	853 (42%)		
Pain in one region [n (%)]	115 (31%)	638 (31%)		
Pain in two regions [n (%)]	78 (21%)	340 (17%)		
Pain in three regions [n (%)]	35 (9%)	115 (6%)		
Pain in four regions [n (%)]	17 (5%)	63 (3%)		
Pain in five regions [n (%)]	7 (2%)	19 (1%)		
Pain region [n (%)]				
Neck	158 (42%)	650 (32%)	< 0.001*	0.08 (small)
Low back	132 (35%)	584 (29%)	0.015*	0.05 (small)
Knee	100 (27%)	435 (21%)	0.030*	0.04 (small)
Back	43 (11%)	186 (9%)	0.175	
Arm	46 (12%)	155 (8%)	0.003*	0.06 (small)

All continuous variables were expressed as median (range) and mean (standard deviation). Differences between patients who self-identified as a picky eater and those who did not were analyzed using the χ^2 test for the categorical variables, and the Mann–Whitney U test for the continuous variables, respectively. *Significantly different between patients with self-identifications as a picky eater and those without ($p < 0.05$)

Table 4 Multiple linear regression analysis for number of pain regions

Dependent variables	Independent variables	B	SE	β	p value	R^2
Number of pain regions	Older age	0.014	0.001	0.210	< 0.001*	0.092
	Female	0.482	0.035	0.213	< 0.001*	
	Self-identification as a picky eater	0.264	0.040	0.092	< 0.001*	
	Low body weight	0.006	0.001	0.078	< 0.001*	
	Countable scores related to picky eating				0.473	

All five variables were entered into the multiple regression analysis. Older age, female gender, self-identification as a picky eater, and low body weight were selected as independent variables in a multiple regression model for the number of pain regions

B nonstandard regression coefficient, SE standard error, β standardized regression coefficient, R^2 multiple correlation coefficient adjusted for the degrees of freedom

of pain regions than those of non-picky eaters (Table 3). Although the effect size of each of the associations was small (effect size < 0.3), the relationships in the presence of pain between the two groups were almost consistent in every pain region.

Multiple Linear Regression Analysis

The results of the multiple regression analysis for the number of pain regions are shown in Table 4. All five independent variables were entered in the multiple regression analysis. Multi-collinearity was checked in variables (r < 0.700). Older age, female gender, self-identification as a picky eater, and low body weight were selected as independent variables in the multiple regression model for the number of pain regions. The countable score related to picky eating was not significantly associated with the objective variable in the model.

DISCUSSION

The present study revealed that the number of the musculoskeletal pain regions was associated with picky eating which was characterized by self-identification as a picky eater regardless of actual food intake, suggesting that negative self-labeling for eating behavior is likely to be associated with the presence of musculoskeletal pain.

Picky eating has the potential to increase the risk of malnutrition in the elderly [8]. Nutrition is also very important for healing and supporting the musculoskeletal system (bones, muscles, cartilage, tendons, and other connective tissues) to stay strong and healthy. Latent malnutrition could be associated with the presence of musculoskeletal pain in elderly people [14, 15]. On the contrary, the present study did not show the relationship between the countable score and the number of pain regions, although our study included young- and middle-aged subjects (median age, 49 years) and the countable score only reflected food selectivity of familiar products. As the countable score in this study implies food intake balance and not malnutrition, further study is necessary to investigate the relationship between musculoskeletal pain and malnutrition in picky eating.

The negative self-assessment has an important role in psychological disturbances, which are known to be associated with pain perception [19, 20]. It is proposed that pain can have a negative effect on emotions and on cognitive function and conversely a negative emotional state can lead to increased pain [21], and thus a bidirectional relationship between pain and psychological disturbances often leads to a vicious cycle [22, 23]. Psychological disturbances such as symptoms of anxiety and depression are associated with an increase in the number of pain regions [16, 17], and self-identification as a picky eater has been reported to have an association with anxiety and

depression [7]. Although we did not investigate the degree of anxiety and depression in the study subjects, the results directly showed an association between subjects with negative self-labeling as picky eaters and the presence of musculoskeletal pain regardless of actual balanced food intake, suggesting that internalized 'picky eaters', which may be characterized by negative feelings (about one's self), has a potential relationship with the presence of musculoskeletal pain. These findings also caution about interpreting a picky eating scale in general settings for patients with pain [7]. Amending maladaptive thought rather than well-balanced food intake may be helpful to reduce the presence of musculoskeletal pain in the non-pharmacological treatment of chronic pain.

The prevalence of chronic pain lasting 3 months or more is approximately 40% according to a previous epidemiological survey conducted in Japan [24]. Although the presence of musculoskeletal pain in the present study included acute and sub-acute pain as well as chronic pain conditions, 56% of individuals showed pain in at least one region within 2 months, and the number of pain regions was associated with older age and females in the multiple regression model. These results are consistent with the previous report that being an older female was one of the risk factors for chronic musculoskeletal pain [24], which could be explained by the effect of ovarian hormone on pain [25].

There are several limitations to this study. Firstly, psychiatric disorders (e.g., depression) or general illnesses of the participants could influence picky eating and musculoskeletal pain, although it was not investigated in the present study. Secondly, since musculoskeletal pain in the subjects was assessed by only a single self-report questionnaire, the characteristics in the subjects between acute pain and chronic pain could not be distinguished. Thirdly, the countable score related to picky eating was assessed by food intake of familiar products using a self-report questionnaire, suggesting that there remains some inaccuracy. Fourthly, self-identification as a picky eater was defined using a single question. Other psychological

states including anxiety and depression should be assessed together in future research. Finally, our sample of the only academic gym in this early study suggests generalizations to other gyms or other settings should be made with caution. The findings need to be supported by detailed future studies in other settings.

CONCLUSIONS

The number of musculoskeletal pain regions is associated with self-identification as a picky eater, regardless of actual food intake among people with well-being. The results suggest that there may be an association between musculoskeletal pain and negative beliefs about one's own eating behaviors which is based on a single question of self-identification as a picky eater.

ACKNOWLEDGEMENTS

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