Factors affecting exercise self-efficacy in non-dialysis patients with chronic kidney disease: a cross-sectional study

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Abstract

Background

Chronic kidney disease (CKD) places a continuous burden on public health worldwide, partially attributable to a sedentary lifestyle. Exercise self-efficacy has emerged as a priority for improving physical activity. Here we conduct a survey to determine exercise self-efficacy and factors associated with lower exercise self-efficacy in non-dialysis patients with CKD.

Methods

A single-center cross-sectional study was performed from October 2018 to April 2019 using the Exercise Self-Efficacy Scale (ESES) to assess exercise self-efficacy. In addition to socio-demographic data, Leicester Uremic Symptom Score (LUSS) was used to evaluated symptom burden for non-dialysis CKD patients. Multiple linear regression was carried out to identify factors that were significantly associated with exercise self-efficacy.

Results

One hundred and thirty-seven patients participated in the current study. The median score on the ESES was 48.89 (interquartile range: 33.31–64.72). A significantly negative correlation with ESES and symptom burden was observed. The results of multiple linear regression showed a significantly positive association between exercise self-efficacy and higher average monthly income, higher level of daily physical activity.

Conclusion

The study reveals several important variables that can be taken into consideration when dealing with exercise self-efficacy in non-dialysis CKD patients. our findings reinforce the need to educate patients who are elderly, female, underweight, lower-income, physical inactivity, and higher symptom burden to promote their exercise self-efficacy.

Background

Chronic kidney disease (CKD) has become a worldwide public health problem, affects 13% of the world's population [1]. It is characterized by progressive irreversible structural damage and/ or kidney function, ultimately leads to end-stage kidney disease (ESKD), which necessitates treatment with renal replacement therapy such as transplant or dialysis, bring heavy burden to patients and families [2]. According to the report of China Kidney Disease Network (CK-NET), the expenditure of patients with CKD was 23,780 million RMB, accounting for 6.3% of the overall costs [3]. Besides, patients with CKD have an increased risk of mortality with a mortality rate of 2.6%, higher than non-CKD (0.8%), and diabetes mellitus (1.5%) patients in China [3].

Protein-energy wasting (PEW) is a common complication in patients with CKD, with an approximate incidence rate of about < 2% in CKD stages 1–2 and 11–54% in stages 3–5 [4]. It will decrease body protein and fat mass that potently predicts morbidity and mortality in this population [5]. Muscle atrophy is one of the major consequences of PEW affecting patients' prognosis, including physical fitness, cardiovascular events, and health-related quality of life [6].

A large number of studies have confirmed that, whether aerobic exercise or resistance training, will provide many advantages, such as improved physical functioning and performance, regulated potential mediators of cardiovascular risk, delayed a decline in renal function [7]. Nevertheless, previous studies have reported that patients with CKD generally tend to have a sedentary lifestyle, leading to physical inactivity [8, 9]. Fatigue and fear of exercise-induced proteinuria is a deterrent for engaging in an active lifestyle for non-dialysis patients with CKD [10]. Additional barriers to physical activity participation include low self-efficacy, especially exercise self-efficacy, which refers to an individual's self-confidence in performing exercise behavior [11]. It has been shown that promote exercise self-efficacy is crucial for increasing physical activity engagement.

Although several studies have reported about exercise self-efficacy in different disease populations, such as chronic obstructive pulmonary disease [12], spinal cord injury [13], no such studies were carried out among non-dialysis patients with CKD. Therefore, we performed the present study to (1) determine exercise self-efficacy, and (2) explore the factors associated with exercise self-efficacy in non-dialysis patients with CKD.

Methods

Study design

A single-center cross-sectional study was carried out from October 2018 to April 2019.

Sample and setting

Patients were recruited from the nephrology department in Shanghai, China. The sample size was determined based on the number of variables. Taking into account 10 variables in this study, a sample size should be 5-10 times of the variables according to Kendall's calculation principle, and considering the invalid questionnaire, the sample size was therefore set at 120 (10*10*1.2=120), plus the samples (n=17) included in the pre-experiment, the final sample size for this study was 137.

Data collection

Three researchers (WHZ, JL and HW) approached potential inpatients of nephrology. The inclusion criteria were as follows: (1) patients were diagnosed as CKD met the criteria of the National Kidney Foundation [14]; (2) patients who did not participate in other exercise-related clinical trials, and (3) patients who were 18 or older and able to communicate in both oral and writing the Chinese language, had no mental and conscious disorders and volunteered to participate in this study. Patients who received dialysis (ex. peritoneal dialysis, hemodialysis) or complicated with severe organic diseases were excluded.

Variable instrument

Self-administered questionnaire

For socio-demographic, age, gender, body mass index (BMI), employment status, average monthly income, education level, stage of the disease, time of diagnosis, and daily physical activity were surveyed by a self-administered questionnaire.

Leicester Uremic Symptom Score (LUSS)

LUSS was used to measure symptom burden. The LUSS has proved useful and sensitive to change in CKD patients as an outcome measure to assess symptoms in cross-sectional studies [15], which assesses the frequency (how often a patient experienced a symptom) and intrusiveness (how much a symptom affects patient’s life) of 11 symptoms, including itching, sleep disturbance, loss of appetite, excessive tiredness, pain in bones/joints, poor concentration/mental alertness, impotence/lack of sex drive, loss of muscle strength/power, shortness of breath, muscle spasm/stiffness and restless legs. The frequency was assessed using “never”, “1-2 times a week”, “several times a week” and “every day”. Intrusiveness was assessed including “not applicable”, “not at all intrusive”, “slightly intrusive”, “quite intrusive”, “very intrusive’ and “extremely intrusive”, scored from 0 to 5 [15].

Exercise Self-Efficacy Scale (ESES)

ESES was used to measured exercise self-efficacy, which was developed by Bandura, with a Cronbach`s alpha coefficient of 0.96 [16]. The scale contains 18 items, categorized into three dimensions including competing demands, internal feelings, and situation/interpersonal. Each of these targets for situations that may affect the patients engage in physical activity. For each item, individuals describe their confidence to finish the behavior on a 100-point scale comprised of 10-point increments. 0 means “not at all unconfident", 50 indicates “moderately confident”, 100 indicates “highly confident”. The overall score for the ESES was calculated by adding all of the item scores and dividing by the number of items [16].

Ethical approval

The study was approved by the Ethics Committee of Longhua Hospital. Before signing the consent form, each participant received an oral explanation of the study procedures, and the right to withdraw at any time. Using identification numbers instead of real names for the data record protected participants' confidentiality.

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences, version 21.0 (SPSS Inc., Chicago, IL, USA). Results were reported as frequencies and percentages or mean ± SDs or as median (lower quartile, upper quartile) based on normality test, which was analyzed using the Kolmogorov-Smirnov test. The Mann-Whitney U test or Kruskal-Wallis test was used to analysis non-normal data according to the number of groups. The Spearman correlation coefficient was used to assess the correlation between the ESES scores and symptom burden values. Multiple linear regression was carried out to identify factors that were significantly associated with ESES. The independent factors were including socio-demographic, and symptom burden. A dummy coding of 0 and 1 were used to enter the categorical variable into the regression model. Variables with a $p < 0.05$ in univariate analysis were entered into the regression model. Statistical significance was set at a $p < 0.05$.

Table 1
Socio-demographic and clinical characteristics of the study sample (n = 137)

Variables	Frequency (%)	Variables	Frequency (%)
Age (Year)		Stage of disease	
< 65	94 (68.6%)	CKD stage 1	30 (21.9%)
≥ 65	43 (31.4%)	CKD stage 2	34 (24.8%)
Gender		CKD stage 3	32 (23.4%)
Male	78 (56.9%)	CKD stage 4	20 (14.6%)
Female	59 (43.1%)	CKD stage 5	21 (15.3%)
BMI (kg/m^2)		Time of diagnosis (year)	
< 18.5	6 (4.4%)	< 1	33 (24.1%)
18.5 ~ 24	66 (48.2%)	1 ~ 3	19 (13.9%)
> 24	65 (47.4%)	> 3	85 (62.0%)
Employment status		Daily physical activity (min) (min)	
Employed	41 (29.9%)	< 30	60 (43.8%)
Unemployed	96 (70.1%)	30 ~ 60	50 (36.5%)
Average monthly income		> 60	27 (19.7%)
Poor	12 (8.8%)		
Moderate	88 (64.2%)		
Good	37 (27.0%)		

Abbreviations: CKD chronic kidney disease; BMI body mass index;

Variables	Frequency (%)	Variables	Frequency (%)
Education level			
Primary school and below	21 (15.3%)		
Junior middle school	46 (33.6%)		
Senior school or technical secondary school	31 (22.6%)		
College and above	39 (28.5%)		
Abbreviations: CKD chronic kidney disease; BMI body mass index;			

Table 2
ESES total score by socio-demographic and clinical variables (n = 137)

Variables	ESES index score		*P*-value
	Mean ± SD	**Median [interquartile range]**	
Age (Year)			
< 65	50.94 ± 19.07	51.67[34.44, 69.72]	0.040[a]
≥ 65	44.28 ± 16.18	42.78[30.56, 54.44]	
Gender			
Male	51.96 ± 18.96	50.84[34.44, 67.92]	0.030[a]
Female	44.74 ± 16.97	42.78[30.56, 60.56]	
BMI (kg/m^2)			
Underweight (< 18.5)	32.31 ± 15.99	29.17[23.89, 41.11]	0.048[b]
Normal (18.5 ~ 24)	50.93 ± 17.67	50.56[33.75, 66.95]	
Overweight (> 24)	48.27 ± 18.79	46.11[34.17, 62.78]	
Employment status			
Employed	47.93 ± 18.07	49.44[30.56, 63.06]	0.769[a]
Unemployed	49.24 ± 18.64	48.89[33.47, 66.11]	
Average monthly income			
Poor	45.70 ± 16.20	46.39[30.97, 57.64]	0.005[b]
Moderate	45.68 ± 17.84	45.84[30.84, 61.11]	
Good	57.41 ± 18.13	61.11[39.45, 71.95]	
Education level			
Primary school and below	47.28 ± 16.22	48.89[31.67, 57.50]	0.547[b]
Junior middle school	45.71 ± 16.40	44.73[33.32, 57.64]	

Abbreviations: ESES Exercise Self-efficacy Scale, CKD chronic kidney disease; BMI body mass index;

[a]Statistical significance of differences calculated using the Kruskal-Wallis test

[b]Statistical significance of differences calculated using the Mann-Whitney U test

Variables	ESES index score		*P*-value
	Mean ± SD	Median [interquartile range]	
Senior school or technical secondary school	51.58 ± 20.40	51.11[33.89,63.33]	
College and above	51.23 ± 20.08	53.33[30.56, 68.33]	
Stage of disease			
CKD stage 1	55.06 ± 18.28	55.28[40.56, 70.56]	0.027[b]
CKD stage 2	53.09 ± 17.16	53.34[37.64, 68.06]	
CKD stage 3	44.77 ± 17.92	39.17[29.72, 62.22]	
CKD stage 4	46.28 ± 18.08	43.34[32.91, 61.81]	
CKD stage 5	41.77 ± 18.80	37.78[28.62, 51.39]	
Time of diagnosis (year)			
< 1	47.70 ± 18.69	42.78[32.50, 66.67]	0.930[b]
1 ~ 3	48.68 ± 16.94	49.44[30.00, 60.11]	
> 3	49.33 ± 18.81	50.00[33.31, 64.17]	
Daily physical activity (min)			
< 30	33.39 ± 10.86	33.03[25.00, 38.75]	< 0.001[b]
30 ~ 60	57.36 ± 13.16	54.17[49.86, 66.67]	
> 60	67.46 ± 11.39	68.89[62.22, 72.78]	

Abbreviations: ESES Exercise Self-efficacy Scale, CKD chronic kidney disease; BMI body mass index;

[a]Statistical significance of differences calculated using the Kruskal-Wallis test

[b]Statistical significance of differences calculated using the Mann-Whitney U test

Table 3
Multiple linear regression analysis of association between factors and ESES score

Variables	Unstandardised coefficients (B)	Standardised coefficients (Beta)	*P*-value	95% CI for B
Age (Year)				
< 65	Reference			
≥ 65	0.313	0.008	0.899	−4.562–5.189
Gender				
Male	Reference			
Female	−2.489	−0.067	0.262	−6.864–1.886
BMI (kg/m^2)				
Underweight	−3.083	−0.034	0.563	−13.594–7.428
Normal	Reference			
Overweight	−1.061	−0.029	0.624	−5.328–3.206
Income (month)				
Poor	−0.836	−0.013	0.830	−8.544–6.872
Moderate	Reference			
Good	5.449	0.132	0.036	0.357–10.541
Stage of disease				
CKD stage 1	Reference			
CKD stage 2	−0.648	−0.015	0.831	−6.643–5.346
CKD stage 3	−1.451	−0.033	0.642	−7.616–4.713
CKD stage 4	1.252	0.024	0.723	−5.712–8.216
CKD stage 5	−3.847	−0.076	0.285	−10.936–3.242
Daily PA (min)				
< 30	Reference			
30 ~ 60	22.348	0.586	< 0.001	17.605–27.091

Abbreviations: ESES Exercise Self-efficacy Scale, CKD chronic kidney disease; BMI, body mass index; PA physical activity; LUSS Leicester Uremic Symptom Score; CI confidence interval

Variables	Unstandardised coefficients (B)	Standardised coefficients (Beta)	*P*-value	95% CI for B
> 60	31.257	0.678	< 0.001	25.413–37.101
LUSS				
Continuous	−0.165	−0.058	0.365	−0.524−0.194
Abbreviations: ESES Exercise Self-efficacy Scale, CKD chronic kidney disease; BMI, body mass index; PA physical activity; LUSS Leicester Uremic Symptom Score; CI confidence interval				

Results

Socio-demographic and clinical characteristics

Overall, 94 (68.6%) were less than 65 years and there were 78 (56.9%) males and 59 (43.1%) females. 66 (48.2%) participants were normal weight. Only 41 (29.9%) were still in business, and 37 (27.0%) considered their monthly average income is good. The rest of the socio-demographic and clinical characteristics of the study participants are presented in Table 1.

Symptom burden

Figure 1 shows the symptoms reported and their frequency and intrusiveness. The majority of patients (82%) reported at least one symptom. On the aspect of frequency, excessive tiredness was the symptom reported most often, with 82% of patients, the second was the loss of muscle strength/power, with 73% of patients experienced it. The third is the poor concentration/mental alertness, with 61% of patients described. For intrusiveness, excessive tiredness and loss of muscle strength/power were still the first two, and the third is the loss of appetite, there were 60% of patients reported slightly intrusive at least.

Figure 1 Frequency and intrusiveness of symptoms patients reported

Legends: 1 is itching, 2 is sleep disturbance, 3 is loss of appetite, 4 is excessive tiredness, 5 is pain in bones/joints, 6 is poor concentration/mental alertness, 7 is impotence/lack of sex drive, 8 is loss of muscle strength/power, 9 is shortness of breath, 10 is muscle spasm/stiffness, 11 is restless legs.

Exercise self-efficacy

The median score on the ESES was 48.89 (interquartile range: 33.31-64.72) and had higher scores on dimensions of the competing demands with 56.67 (interquartile range: 40.00-71.67), the second higher score was internal feeling with 50.00 (interquartile range: 30.00-65.00), and the third was situation/interpersonal with 40.00 (interquartile range: 30.00-60.84), see Figure 2.

Figure 2 Score of Exercise Self-Efficacy Scale

Legends: Figure 2a is box-plot of the scores of three dimensions of the ESES; Figure 2b-2g is the ESES scores of different characteristics with statistical significance. * means p=0.01-0.05, ** means p=0.001-0.01, *** means p<0.001.

As shown in Table 2, there were significant differences between participant groups according to age, gender, BMI, average monthly income, and stage of the disease, as well as daily physical activity (p < 0.05). Patients young than 65 years showed significantly higher ESES scores than those 65 years and older (p = 0.040). When exploring gender differences, males had a significantly higher score of ESES than did females (p = 0.030). The score of ESES increased as daily physical activity level rose from less than 30 min to 30~60 min (p < 0.001) to more than 60 min (p < 0.001), see Figure 2. Meanwhile, the results showed that symptom burden had a significantly negative correlation with exercise self-efficacy as expected as shown in Figure 3 (r =-0.32, p < 0.001).

Figure 3 Relation between value of LUSS and scores of ESES

Legends: There is a negative correlation between value of LUSS and scores of ESES, r =-0.32, p < 0.001.

After adjustment for covariates, regression coefficients indicated significant associations between income, daily physical activity, and ESES score in comparison to a reference category. This model explained about 63.4% of the variance in ESES. As shown in Table 3, patients in the good income group were more likely to have a higher score of ESES, besides, patients who engage in more physical activity, the more score of ESES were observed.

Discussion

Self-efficacy-based interventions must describe the process through which exercise self-efficacy is expected to support non-dialysis patients to achieve adherence to engage in physical activity. The key findings of this study are: (1) we found that elderly, female, lower-income, underweight, physical inactivity, and stage of CKD significantly correlated with lower exercise self-efficacy in non-dialysis patients with CKD by univariate analysis; (2) after multiple regression analysis, it found that higher income and a higher level of physical activity are associated with better exercise self-efficacy.

In the current study, we found that the median score of ESES among non-dialysis patients with CKD was 48.89 (33.31-64.72), which was slightly higher in patients with hemodialysis in China [17]. Several socio-demographic related factors may affect exercise self-efficacy in non-dialysis patients with CKD. The reason why the study differs from Xue's research could be explained by differences in the main socio-demographic and disease-related factors of recruited participants such as; age, treatment modality, and daily physical activity [17]. Furthermore, once a patient receives dialysis treat, who often complain of dialysis-related fatigue, which may indeed prevent patients from participating in physical activity. Thus, to better understand the exercise self-efficacy in non-dialysis patients with CKD, an understanding of the factors would influence exercise self-efficacy is need.

Epidemiological investigations have shown that the level of physical activity in the population decreases with age [18], we found the score of ESES in elderly patients (≥ 65 years) was lower than that of non-elderly patients (< 65 years) probably because the muscle strength, muscle endurance, and motivation of elderly patients are worse than those of non-elderly patients, besides, decreased renal function exacerbates these factors [19]. Recently, a large cross-sectional study from the United Kingdom, non-dialysis patients with CKD among males were approximately three times more likely to engage in physical activity than females [20]. Similar results were observed in the present study, which showed that the male in the study scored higher than female. This may be due to differences in family and social roles, psychological issues, and living conditions in this area [21]. Interestingly, we also found that non-dialysis patients with CKD in the low- and moderate-income groups had a lower score compared to the high-income counterparts. This finding was also supported by multiple linear regression analysis. We interpret it as potentially owing to patients of high-income pay enough attention to health management. Few studies have been focusing on income and exercise self-efficacy, and future studies are of value.

In line with our findings, the normal BMI group had a slightly higher score of ESES than overweight, and significantly higher than underweight. A normal BMI is often correlated with a healthy lifestyle [22], of which, physical activity is an important component, which might indicate that at a higher BMI, the patients’ health allows them to be more physically active.

From the stage of disease perspective, this study also found that the patients’ exercise self-efficacy gradually decreased as the progress of the renal function. A similar result was found by Wilkinson et al, whose study used the General Practice Physical Activity Questionnaire to evaluate CKD patients’ physical activity, the result showed that 34% patients in CKD stage 1-2 were sufficiently active, but decreased from stage 3 (17% active), through to stage 4-5 (11% active), and reaching a nadir in patients received dialysis (only 6%-8%) [20]. It is perhaps unsurprising that physical activity levels worsen as CKD progresses given the increasing symptom burden and reductions in physical function aggravated by anemia, metabolic acidosis, inflammation, and malnutrition [23]. It is interesting to find that significantly negative correlations were found between the symptoms burden and exercise self-efficacy in our study (r =-0.32, $p < 0.001$).

Also, in our univariate analysis, daily physical activity was strongly associated with exercise self-efficacy and was also significant in multiple regression models. From a psychological perspective, engaging in the long-term maintenance of physical activity is a key factor to promote exercise self-efficacy [24]. Thus, it can be seen that physical inactivity leads to lower exercise self-efficacy, which in turn diminishes physical activity, meanwhile, an increase in kidney-related symptom burden has attributed to reductions in physical activity. There is a significantly negative correlation between symptom burden and exercise self-efficacy thus forms a vicious cycle. The lack of physical activity is both a cause and a result, which shows that physical activity is a changeable goal. The dual role of exercise self-efficacy shows that future research could focus on more fully understanding the mechanisms underlying the exercise self-efficacy so that they can be optimized for clinical use.

Strengths And Limitations

This study has several limitations. First, the data were collected cross-sectionally, which makes it difficult to interpret any cause-effect relationship. Second, we enrolled patients in a single-center that could decrease the generalisability of the results to other non-dialysis patients with CKD. Third, caution is needed when expanding and interpreting our research results due to insufficient sample size. Despite these limitations, our study is the first study assessing exercise self-efficacy among non-dialysis patients with CKD in Shanghai, China. The results of this study may provide a theoretical basis for the future interventions of physical activity in non-dialysis patients with CKD.

Conclusions

Our survey study reveals several important variables that can be taken into consideration when dealing with exercise self-efficacy in non-dialysis CKD patients. Elderly patients, females, underweight, lower-income, physical inactivity, and higher symptom burden were all associated with lower exercise self-efficacy. In addition, this study showed that lower exercise self-efficacy was associated with lower income as well as physical inactivity. Therefore, our findings reinforce the need to educate patients who live a sedentary lifestyle with lower income, to promote their exercise self-efficacy.

Abbreviations

CKD: Chronic Kidney Disease; ESRD: End-Stage Renal Disease; CK-NET: China Kidney Disease Network; BMI: Body Mass Index; ESES: Exercise Self-Efficacy Scale; LUSS: Leicester Uremic Symptom Score; SD: standard deviation.

Declarations

Ethical approval and consent to participate

The study was approved by the Ethics Committee of Longhua Hospital. The interview content was described to potential participants, and informed verbal consent was obtained before the start of the interview.

Consent for publication

Not applicable.

Availability of data and materials

All data supporting the study is presented in the manuscript or available upon request from the corresponding author of this manuscript, Fan Zhang.

Competing interests

The authors declare there were no conflicts of interest.

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Author’s contributions

FZ implemented statistical analysis, and drafting of the manuscript; WHZ, JL and HW involved in data collection, and revised the article; LYH and QYS was responsible for recruiting patients; QYS led study design. All authors had read and approved the final manuscript and agreed on its submission.

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Figures

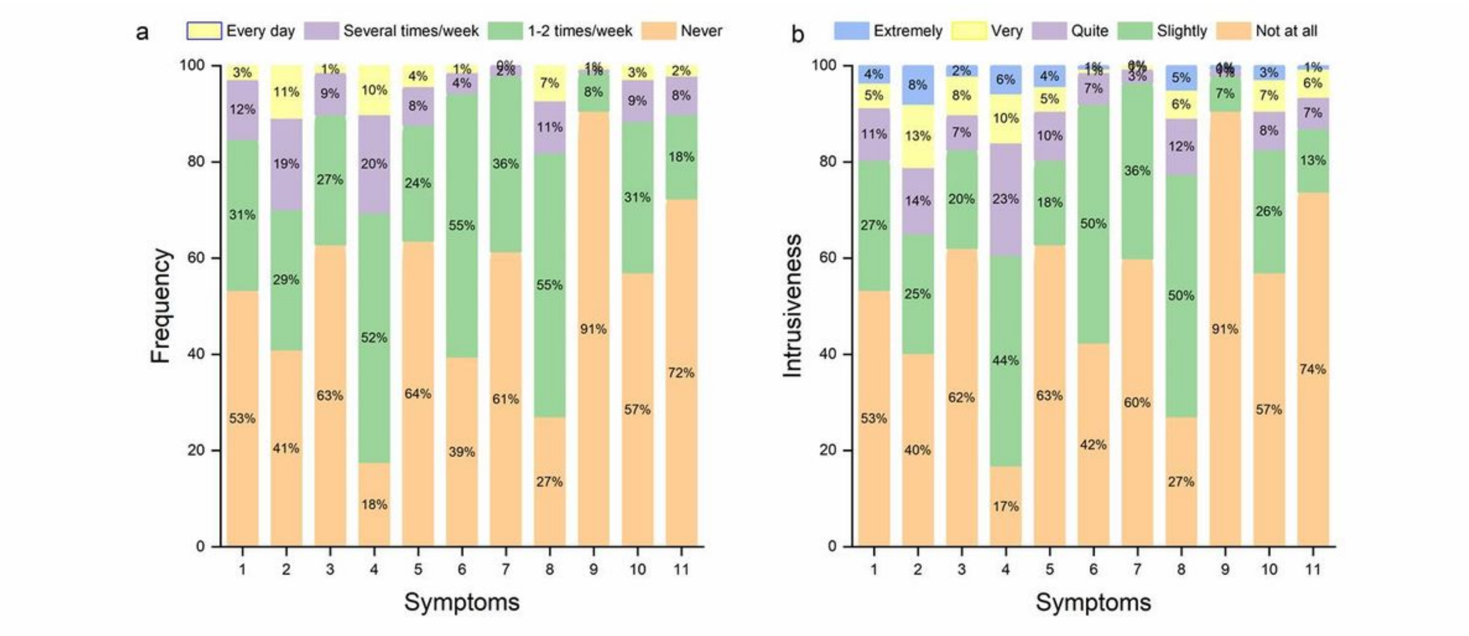

Figure 1

Frequency and intrusiveness of symptoms patients reported Legends: 1 is itching, 2 is sleep disturbance, 3 is loss of appetite, 4 is excessive tiredness, 5 is pain in bones/joints, 6 is poor concentration/mental alertness, 7 is impotence/lack of sex drive, 8 is loss of muscle strength/power, 9 is shortness of breath, 10 is muscle spasm/stiffness, 11 is restless legs.

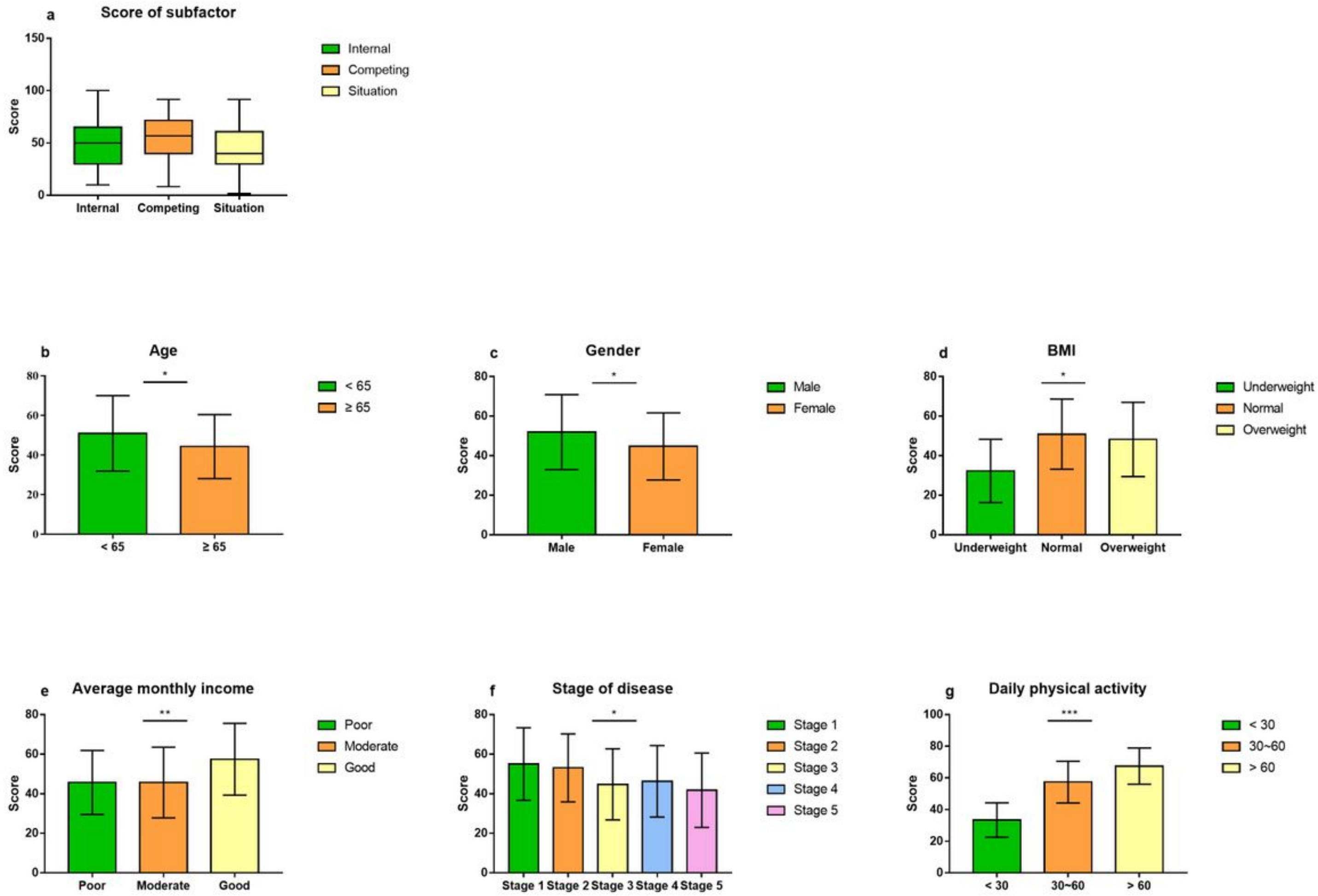

Figure 2

Score of Exercise Self-Efficacy Scale Legends: Figure 2a is box-plot of the scores of three dimensions of the ESES; Figure 2b-2g is the ESES scores of different characteristics with statistical significance. * means p=0.01-0.05, ** means p=0.001-0.01, *** means p<0.001.

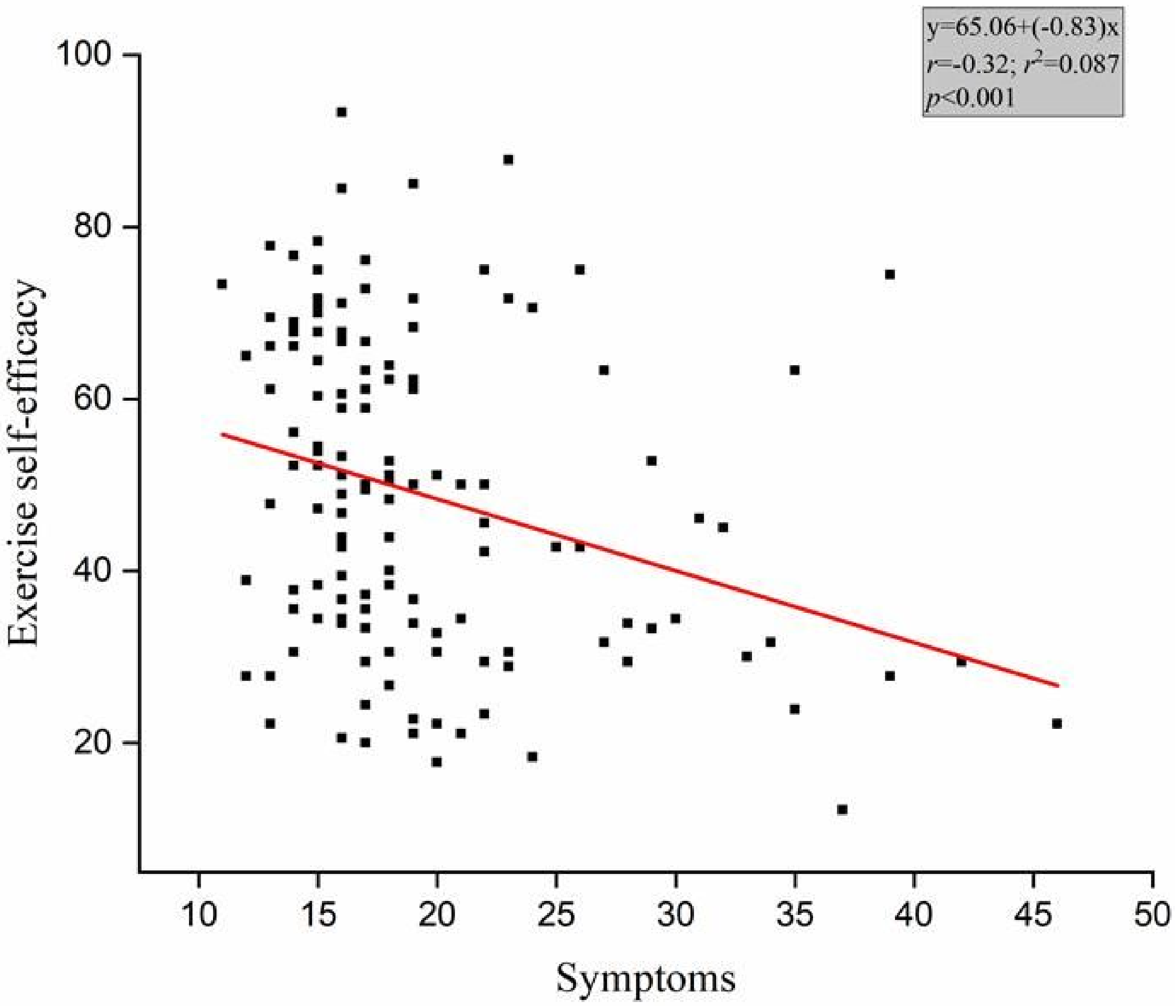

Figure 3

Relation between value of LUSS and scores of ESES Legends: There is a negative correlation between value of LUSS and scores of ESES, r =-0.32, p < 0.001.