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Original Article

Physiotherapy Section

Impact of Knee Osteoarthritis on Physical Performance and Quality of Life in Obese Adults: A Cross-sectional Study

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ABSTRACT

Introduction: Obese subjects with Knee Osteoarthritis (KOA) demonstrate poor Physical Performance (PP) and impaired Quality Of Life (QOL). The burden of OA in obese subjects is not well understood.

Aim: To evaluate PP and QOL in obese subjects with KOA and in obese subjects without KOA.

Materials and Methods: A cross-sectional observational study was conducted at the Outpatient Physiotherapy Department, Sri Ramachandra Institute of Higher Education and Research, Chennai, Tamil Nadu, India, from July 2017 to June 2018. Twenty-four obese subjects with and without KOA were included in the current study based on their BMI and American College of Rheumatological criteria for OA knee. The subjects were randomly allocated into two groups with; Obese KOA and Obese non KOA. All subjects were evaluated for anthropometric (BMI, Waist-Hip Ratio and Fat Percentage) and PP {30 Second Chair Stand Test (SCST), Stair Climb Test (SCT), 40 m Fast-Paced Walk Test (40 m FPWT), Timed up and Go test (TUGT), 6 Minute Walk Test (6 MWT)}. Additionally, all subjects responded to self-reported disability measures (KOA Outcome Score - KOOS) and Medical Outcome Study Short Form measure (SF-36).

Results: Intergroup statistical difference was found in both PP and QOL. The PP and QOL was significantly lower in obese KOA subjects when compared with their counterparts, {mean±SD; 30 SCST (8.58±1.62 vs 17.08±3.26), SCT (36.25±13.16 vs 9.58±1.62), 40 m FPWT (64.75±14.35 vs 29.92±3.99), TUGT (17.7±2.42 vs 7.58±1.51), 6 MWT (244.25±63.03 vs 508.83±76.42), KOOS (42.52±5.73 vs 91.42±4.58), SF-36- Physical, Mental Cumulative Health Score (36.23±5.7, 45.52±9.13 ; 53.80±2.15, 53.89±2.47); ($p<0.05$)}.

Conclusion: The KOA is a predictor for reduction of PP and QOL among obese subjects. Early physiotherapy intervention of obese subjects may prevent KOA and helps to progress or maintain PP and QOL in obese subjects.

Keywords: Obesity, Physiotherapy, Six minute walk test, Timed up and go test

INTRODUCTION

Obesity increases the risk of KOA, specifically in the patellofemoral and the tibiofemoral [1]. The presence of KOA causes functional deficits, loss of independence in performing everyday Activities of Daily Living (ADL), depression, and social isolation, thereby increasing the risk of morbidity and mortality and impairing individuals' lifestyles [2].

Obesity accelerates degeneration of the knee joint, and it is related to the degree of PP and QOL. Morbidly obese KOA adults face limitations in PP and express poor QOL. PP and QOL in obese adults with KOA are comparatively poor compared to non KOA obese adults [3,4]. Increased Body Mass Index (BMI) is associated with the progression of KOA. Thus, obesity is an obvious risk factor for the development of KOA also an essential determinant for the advancement of KOA [5]. Obesity is significantly associated with arthritis and other systemic illness like diabetes, high cholesterol levels, asthma, and hypertension. More the BMI, the higher the risk for arthritis [6]. Therefore, there is a generalised decrease in physical activity in obese subjects. The novelty of this research is that this study examines the relationship of PP, QOL in obese subjects with and without KOA. The burden of KOA in morbidity obese subjects is yet to be explored. The level of PP in morbidly obese KOA subjects remains unclear [7]. It is crucial to find strategies to reduce the burden of KOA, especially in morbidly obese subjects. Obese subjects with KOA are at greater risk for mortality than obese non KOA counterparts. This study aims to evaluate the burden of KOA by measuring PP, QOL in obese subjects.

MATERIALS AND METHODS

A cross-sectional observational study was conducted at the Outpatient Physiotherapy Department, Sri Ramachandra Institute of Higher Education and Research, Chennai, Tamil Nadu, India, from July 2017 to June 2018, after obtaining approval (CSP/15/SEP/43/49) from Institutional Ethical Committee. Written informed consent was obtained from all the participants in both groups. Twenty-four obese adults with KOA and without KOA were included in the study from the rehabilitation centre of Sri Ramachandra Hospital.

Sample size calculation: G*Power 3 software was used to calculate the sample size. The sample size estimation was done with sample power (based on the PP test- 6 MWT). Considering a moderate effect size of 0.25, a power of 80%, and an alpha error of 5% (standard deviation=30 metres, clinically significant difference=60 metres). The calculations suggested that each group should contain ten participants atleast.

Inclusion criteria: Inclusion criteria for participation were as follows: obese subjects with BMI of ≥30 kg/m^2 [8], numerical pain rating scale (Score less than or equal to 3 out of 10), fulfillment of the American College of Rheumatological criteria for OA knee [9], symptomatically and radiographically verified KOA with Kellgren-Lawrence grades 1-3 were included [10], sufficient cognition and communication skills to understand the nature of the study.

Exclusion criteria: The participants were excluded if they had: chronic, acute cardiac and pulmonary problems, acute and chronic systemic conditions, recent musculoskeletal lower extremity injuries and infections, any former orthopaedic surgeries or patients awaiting joint replacement surgery, neurological disorders that have a potential effect on ambulation, insulin-dependent diabetes, drug-induced fatigability and drowsiness [11].

Twelve obese non KOA subjects were included in the control group with a BMI ≥30 kg/m^2 and age of 57.08±8.028 (Mean±SD) years. The groups were matched for gender, age, and BMI.

Measurements

Anthropometrics: Measurement of height was made using a clinical stadiometer, and body weight was measured using a calibrated scale. Using this method, BMI was derived [12]. Waist-Hip ratio was measured using a measuring tape. According to the World Health Organisation (WHO), abdominal obesity is defined as a waist-to-hip ratio of at least 0.90 in men. For women, the ratio is at least 0.85. For either sex, a ratio greater than 1.0 indicates a substantially higher risk of health problems [13].

Minimal abdominal circumference was measured between the lower edge of the ribcage. Hip circumference was measured around the gluteal muscle below the iliac crest. Fat percentage was calculated using Omron Body Fat analyser [14]. For all values, three mean readings were taken, and the average value was documented.

Physical Performance (PP)

The OARSI-recommended performance-based test was used to measure PP in both participant groups. [Table/Fig-1] describes the tests [15-21].

Test	Description	Procedure
30 Seconds Chair Stand Test (30 SCST)	To assess sit-to-stand activity, lower body strength and dynamic balance.	On the command "Start", the subject gets up, stands erect with equally weight-bearing on both feet and sits back on the chair. The total number of complete sit-to-stand activity in 30 seconds is noted down [15].
Stair Climb Test (SCT)	To assess lower limb strength and balance	On the command "Go", the subject ascends and descends the flight of stairs on his comfortable speed; and the time duration is noted. The subject may use walking aids, if needed [16].
Timed Up and Go Test (TUGT)	To assess lower limb strength, agility and dynamic balance.	On the command "GO" and the patient gets up from the seated position, walks 3 metres, turns around the cone and comes back to seated position. The time is noted down. Initially a practice trial can be performed for better understanding of the subject [17,18].
40 m Fast Paced Walk Test (40 m FPWT)	To assess walking spend over short distance and changing direction during walking	On the command "Go", the subject should walk quickly at a fast pace to cover the distance, then around the cone and complete two laps (20 m×2 laps=40 m). The total time to complete the distance is recorded [19].
6 Minute Walk Test (6 MWT)	To analyse the long-distance walking capacity and aerobic capacity.	On the command "Go", the subject shall start walking from one cone to the other, turn back and walk back, covering as many as lapses possible at their usual walking speed. This continues till the stop clock stops rings at the 6th minute. Rest period is allowed in between the Test. Chair may be provided if the subject needed rest. At the end of the test, the distance covered in 6 minutes is noted down [20,21].

[Table/Fig-1]: Description of the Physical Performance (PP) tests used in the study [15-21].

Osteoarthritis Related Disability

The KOOS questionnaire is a self-administered tool to assess the physical functioning of the individuals. The KOOS consist of five sub-categories- Pain, Symptoms, ADL, Sports and Recreational activities, Knee-related QOL [22].

Quality of Life (QOL): The SF-36 (Short Form-36) is a generic measure of health status, multipurpose with 36 questions. The SF-36 consists of questions based on both physical and mental health, categories under eight sub-scales. It is a self-administered questionnaire with questions targeting functional health and well-being. There are four sub-scales under physical and mental health each. The scores are calculated using Health Outcomes Scoring Software 5.1 (Quality Metric) [23].

STATISTICAL ANALYSIS

All statistical tests were performed using SPSS 10.0 Statistical Software. Results were presented as mean±standard deviation as appropriate. Normally distributed parametric variables (Performance tests and QOL) were compared using "independent t-test". For all tests, statistical significance was set at 0.05 (two-tailed).

RESULTS

There was no difference between groups with regards to age, gender, height, weight, BMI, waist-hip ratio, fat percentage. [Table/Fig-2]. There was significant difference between two groups with regards to 30 SCST, SCT, 40 m FPWT, TUGT, 6MWT. In addition, a significant difference was noted in SF-36 and KOOS [Table/Fig-3].

S. No.	Clinical features	Obese KOA	Obese Non KOA	p-value
1	Gender (Male/Female)	4 (33%)/8 (67%)	7 (58%)/5 (42%)	NA
2	Age (years)	56.83±7.3	57.08±8.02	0.9319
3	Side (Right, Left)	6 (50%)/6 (50%)	NA	NA
4	Symptom duration (months)	28.25±17.48	NA	NA
5	Height (centimetres)	158.96±7.39	161.17±8.84	0.4794
6	Weight (kilograms)	76.75±6.53	81.52±9.92	0.1449
7	Body mass index	32.378±2.24	31.35±0.97	0.1300
8	Waist-hip ratio	0.99±0.037	0.94±0.085	0.0540
9	Fat percentage	36.23±5.64	35.88±5.03	0.8638

[Table/Fig-2]: Characteristics of the participants.
Independent t-test was used

S. No.	Physical Performance (PP) and Quality of Life (QOL)	Obese KOA	Obese Non KOA	p-value
1	30 second chair stand test (repetitions)	8.58±1.62	17.08±3.26	0.0001*
2	Stair climb test (seconds)	36.25±13.16	9.58±1.62	0.0001*
3	40 m fast pace walk test (seconds)	64.75±14.35	29.92±3.99	0.0001*
4	Timed up and go test (seconds)	17.7±2.42	7.58±1.51	0.0001*
5	6 minute walk test (metres)	244.25±63.03	508.83±76.42	0.0001*
6	KOOS	42.52±5.73	91.42±4.58	0.0001*
7	SF-36- physical cumulative health score	36.23±5.7	53.80±2.15	0.0001*
8	SF-36- mental cumulative health score	45.52±9.13	53.89±2.47	0.0057*

[Table/Fig-3]: Comparison of Physical Performance (PP), Quality Of Life (QOL) between obese KOA group and obese non KOA group.
p<0.05*, unpaired t-test

DISCUSSION

The study results showed that obese KOA subjects had lower PP and impaired QOL compared with their counterparts. Lower PP was associated with age, gender, BMI, hip-waist ratio, and fat percentage. The present study proves that KOA was related to low PP in obese subjects. Thirty SCST was used to measure lower extremity muscle strength and power. Obese KOA subjects demonstrated low repetitions in 30 SCST. One of the reasons for low repetition may be poor lower extremity muscle strength and degenerative changes [24].

The SCT was used to assess lower limb strength and dynamic balance. The statistical intergroup difference was found that the time taken to complete the test was higher in obese KOA than obese counterparts. Intergroup statistical difference was found in both SCT and 40 m FPWT. This is in accordance with the study findings of Khan SJ et al., 2020 [25]. Khan SJ et al., demonstrated in their study that twenty KOA subjects have significantly higher SCT and 40 m FPWT than healthy normal subjects. There was an increase in time taken to ascend and descend stairs in obese KOA subjects with SCT. This may be because more muscle force was required in ascending/descending stairs than level walking [25]. The TUG is a test for lower limb strength, agility, and dynamic

balance that involves a series of transition phases-sitting-to-stand, walking a shorter distance, and changing direction. Obese KOA subjects took above 17 seconds to complete TUG than obese non KOA subjects. These results were similar to a study done by Shumway Cook A et al., which showed that adults who take longer than 14 s to complete the TUG have low dynamic balance [19].

In the present study, a statistical intergroup difference was found in 6 MWT. A 6 MWT was used to estimate the long-distance walking capacity of the subjects. It was significantly lower for obese KOA subjects. Walking was often affected as a direct result of obesity through excess weight-bearing. Walking capacity may be reduced due to mechanical complications such as KOA or lower extremity joint pain. Our obese healthy subjects walked a significantly longer distance in 6 MWT than obese patients with knee OA; this was in accordance with a study published by Sutbeyaz ST et al., 2007 [26].

The KOOS is a knee-specific instrument developed to measure patients' opinions about their knees and related problems. In this study, obese KOA subjects showed lower scores than obese subjects. Results imply that the KOOS scores vary significantly with obese KOA than their counterparts [21,27]. Many studies have shown that obese KOA has poor QOL [27-32]. They conclude that KOA has a substantial impact on QOL. In KOA patients, QOL is also influenced by specific individual factors, including gender, body weight, physical activity, mental health, and education [32]. Moreover, obese patients with KOA had significantly impaired health-related QOL, compared with obese counterparts, especially regarding the physical aspects of daily life, suggesting that obesity plus KOA might lead to further impaired QOL. The findings in the present study tend to confirm previous study findings that have shown the same [33,34].

Several studies [19, 25-34] have demonstrated that obese subjects have a low QOL. Moreover, the obese KOA subjects in the present study had significantly impaired physical and mental health compared to obese subjects. Hence, we conclude that obesity along KOA will lead to a further reduction in QOL. In summary, the present study proves that obesity with KOA will lead to PP deficits and reduce the QOL.

Limitation(s)

Smaller sample size, extensive age group range (subject age more than 55 years), physical activity, and occupational differences of subjects not considered.

CONCLUSION(S)

Obese subjects with KOA show poor PP and QOL. The present study demonstrated that KOA further reduces PP and QOL in obese subjects. The current evidence points that KOA is a predictor for the reduction of PP and QOL among obese subjects.

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