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IS THERE A RELATIONSHIP BETWEEN HIP MUSCLE STRENGTH, FUNCTION AND PHYSICAL ACTIVITY LEVELS IN HIP OSTEOARTHRITIS?

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INTRODUCTION

Osteoarthritis (OA) is a common progressive musculoskeletal condition of the joint organ reportedly affecting around 1.6 million Australians (7.8% of the population) [1]. After the knee, the hip is the second joint most commonly affected by OA [2] and it is often associated with symptoms of pain, stiffness, muscle weakness [3], reduced gait speed [4] and other functional limitations. Hip OA has a higher prevalence in older adults with more than 51.4% of the people affected being over the age of 65 years old [1]. The Physical Activity Guidelines for Older Australians recommend that older adults should accumulate at least 30 minutes of moderate intensity physical activity on most and preferably all days of the week (http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-phys-act-guidelines#rec_older – accessed 09/02/2013). Physical activity is important in combating the increasing prevalence of obesity [5] which is also thought to be a risk factor for progression of hip OA [6]. Increasing age and body mass index were found to be negatively associated with physical activity levels in the end-stages of hip OA [7]. Reduced physical activity as a result of hip OA [7] may thus increase the risk of obesity and subsequently the progression of OA and leading to further functional limitations. Although lower limb muscle weakness is one of the symptoms associated with hip OA we do not know if there is a relationship to the physical activity levels in individuals with hip OA. Improving hip OA symptoms such as pain and muscle weakness may enable individuals with the disease to increase their physical activity to the recommended levels, maintain a healthy body weight and subsequently slow the progression of the disease. The purpose of this cross-sectional cohort study was to identify if there is a relationship between hip muscle strength, function and physical activity levels in individuals with hip OA and if so characterize that relationship. We hypothesized that there would be a positive relationship between strength and stair climbing ability and a positive relationship between lower-limb muscle strength and time spent in light to moderate physical activity levels in the hip OA group.

METHODS

Healthy controls and individuals with hip OA over the age of 45 years were recruited for this study through widespread advertising in the South East Queensland region. The screening criteria for the hip OA group included radiological diagnosis of hip OA with joint space narrowing of 3 mm or less in at least one hip, the presence of hip pain, the Harris Hip Score (HHS) of less than 95 points and no other major lower limb musculoskeletal or neurological conditions. To participate in the control group individuals had to be healthy with no lower limb musculoskeletal or neurological conditions and had to have radiological hip joint space width of greater than 3 mm in both hips and a score of greater than 95 points on HHS. Participants underwent hip muscle strength testing using the Biodex (System 4 Pro, Biodex Medical Systems, Shirley, NY) Isokinetic Dynamometer and data was collected using the custom Labview® (v6.1) software program. The testing order of the left or right sides was randomly selected and the order of testing of the muscle groups were: hip abductors, adductors, flexors and extensors in the hip neutral position in standing. The maximal isometric peak strength (Nm) for the highest maximum voluntary contraction (MVC) of each muscle group was selected for analysis. The functional stair climbing test (Timed Stair Test) was included to assess any limitations. The participants were timed using a stopwatch ascending and descending a flight of 13 steps, 18 cm in height. Physical Activity measures were collected with participants wearing an ActiGraph GT3X+ Physical Activity Monitor for a period of 10 consecutive days on randomly selected left or right waist. Accelerometry data was sampled at 30 Hz.
Muscle strength data was analysed using the Matlab® R2012a (The MathWorks, USA) software. From the ActiGraph data 7 consecutive days incorporating a representation of a full week were selected and analysed using the custom ActiLife v6.5.2 software, expressing the data in percentages of Sedentary, Light, Lifestyle, Moderate, Vigorous and Very Vigorous physical activity levels. These were based on the Freedson Adult (1998) [8] cutoff points https://help.theactigraph.com/entries/21452826-What-s-the-difference-among-the-Cut-Points-available-in-ActiLife- (Accessed 12/02/2013).

Statistical analysis was performed using the statistical package SPSS® v21 and incorporated independent sample t-tests to identify the effect of group on hip muscle strength and physical activity measures and Pearson Correlation to examine relationships between hip muscle strength, physical activity levels and stair climbing ability. Significance was accepted as $p < 0.05$.

Ethical approval for this study was granted by the Griffith University Human Research Ethics Committee (PES/23/08/HREC).

RESULTS AND DISCUSSION

Sixteen healthy controls (C) and 21 hip OA (H) participants were included in the study. The participant demographics are described in Table 1. The Physical Activity Levels for both the control and hip OA groups are presented in Figure 1. The mean and standard deviation of the MVC peak values for the hip muscles of both control and hip OA groups are presented in Figure 2. For the Timed Stair Test the mean and standard deviation for the hip OA group were 14.4 ±4.5 and the control group 10.7 ± 1.7 seconds. The findings indicate there was no significant difference in the physical activity levels of the control and hip OA groups at any intensity. There was however significant difference ($p = 0.004$) in the functional Timed Stair Test with the hip OA group taking longer to ascend and descend the 13 steps.

There was positive relationship between hip adductor strength for light ($r = .404$, $p < .05$) and moderate ($r = .402$, $p < .05$) physical activity levels in the hip OA group. There was a negative correlation between the strength of all hip muscle groups and the time to complete the Stair Test ($r < -.540$, $p < .014$) in the hip OA group.

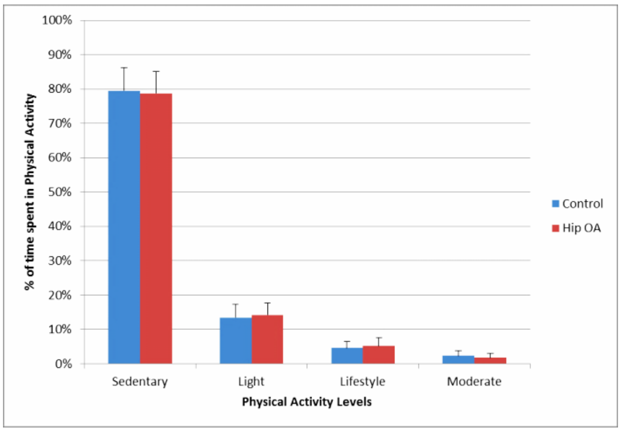

Figure 1: Physical Activity Levels in % time for Control and Hip OA Groups.

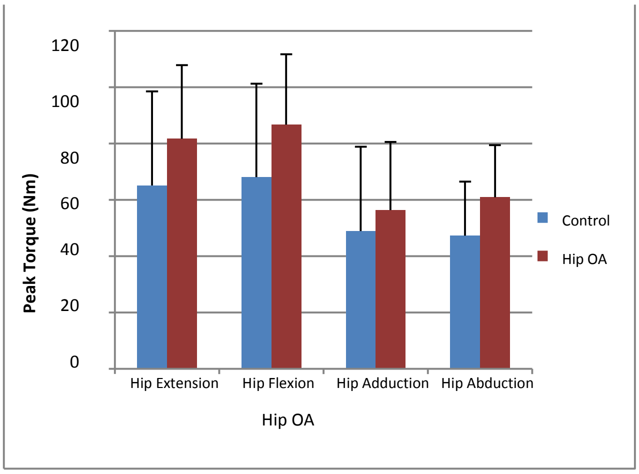

Figure 2: Peak Torque for Hip Muscle Groups for Control and Hip OA Groups.

Table 1: Participant Group Characteristics

Group	Number	M:F*	Age (years)	Height (cm)	Weight (kg)	BMI**	HHS***
Control (C)	**16**	**6:10**	**59.5 ± 9**	**170.5 ± 8.9**	**72 ± 10.5**	**24.7 ± 2.7**	**99.9 ± 0.8**
Hip OA (H)	**21**	**4:17**	**64.3 ± 7.5**	**164.8 ± 9.1**	**70.7 ± 10.6**	**26 ± 2.9**	**73.5 ± 12.8**

**BMI = Body Mass Index = Weight (kg) /(Height^2 (m)), ***HHS = Harris Hip Score, *M = Male; F = Female
Age, Height, Weight, BMI and HHS are presented as Mean ± Standard Deviation

CONCLUSIONS

The findings of this study indicate that there is a positive relationship between hip adductor muscle strength and light and moderate physical activity levels and a negative relationship between hip muscle strength and the time to complete the functional task of ascending and descending stairs in hip OA. Further research is required to identify the extent of these relationships and the impact on hip OA function and management.

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REFERENCES

1. Access Economics Arthritis Australia. Painful realities: The economic impact of arthritis in Australia in 2007. 2007; Available from: http://www.arthritisaustralia.com.au/.
2. Cimmino, M.A., et al., Clinical presentation of osteoarthritis in general practice: determinants of pain in Italian patients in the AMICA study. *Seminars in Arthritis & Rheumatism*, 2005. **35**(1 Suppl 1): p. 17-23.
3. Loureiro, A., P.M. Mills, and R.S. Barrett, Muscle weakness in hip osteoarthritis: A systematic review. *Arthritis Care and Research*, 2012. **In press**.
4. Constantinou, M., et al., The spatial-temporal gait characteristics of hip joint osteoarthritis: A systematic review and meta-analysis. *Journal of Science and Medicine in Sport / Sports Medicine Australia*, 2012. **15**: p. S135.
5. de Silva-Sanigorski, A.M., et al., Scaling up community-based obesity prevention in Australia: background and evaluation design of the Health Promoting Communities: Being Active Eating Well initiative. *BMC Public Health*, 2010. **10**: p. 65.
6. Tepper, S. and M.C. Hochberg, Factors Associated with Hip Osteoarthritis: Data from the First National Health and Nutrition Examination Survey (NHANES-1). *American Journal of Epidemiology*, 1993. **137**(10): p. 1081-1088.
7. de Groot, I.B., et al., Actual everyday physical activity in patients with end-stage hip or knee osteoarthritis compared with healthy controls. Osteoarthritis & Cartilage, 2008. **16**(4): p. 436-42.
8. Freedson, P.S., E. Melanson, and J. Sirard, Calibration of the Computer Science and Applications, Inc. accelerometer. *Journal of Medicine and Science in Sports and Exercise*, 1998. **30**(5): p. 777-81.