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## Factors associated with physical activity in Australians with hip or knee osteoarthritis

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1 RUNNING HEAD: Physical Activity and Osteoarthritis

2

3 **Factors Associated with Physical Activity in Australians with Hip or Knee Osteoarthritis**

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**Abstract**

*Background:* Physical activity (PA) is recommended for managing osteoarthritis (OA). However, few people with OA are physically active. Understanding the factors associated with PA is necessary to increase PA in this population. This cross-sectional study examined factors associated with leisure-time PA, stretching exercises, and strengthening exercises in people with OA. *Methods:* For a mail survey, 485 individuals, aged 68.0 y ( $SD=10.6$ ) with hip or knee OA, were asked about factors that may influence PA participation, including use of non-PA OA management strategies and both psychological and physical health-related factors. Associations between factors and each PA outcome were examined in multivariable logistic regression models. *Results:* Non-PA management strategies were the main factors associated with the outcomes. Information/education courses, heat/cold treatments, and paracetamol were associated with stretching and strengthening exercises ( $P<0.05$ ). Hydrotherapy and magnet therapy were associated with leisure-time PA; using orthotics and massage therapy, with stretching exercises; and occupational therapy, with strengthening exercises ( $P<0.05$ ). Few psychological or health-related factors were associated with the outcomes. *Conclusions:* Some management strategies may make it easier for people with OA to be physically active, and could be promoted to encourage PA. Providers of strategies are potential avenues for recruiting people with OA into PA programs.

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3 1 Osteoarthritis (OA) is the most common form of arthritis. In Australia, it is the leading cause of  
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5 2 pain and disability, affecting 1.6 million adults or 8% of the population.<sup>1</sup> Total health  
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8 3 expenditure for OA was \$2.3 billion in 2007, almost half the total expenditure for all arthritis.<sup>1</sup>  
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10 4 Because the incidence and prevalence of OA increase with age,<sup>1</sup> more individuals will be at risk  
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12 5 of developing OA, and the burden of this condition will continue to increase, as the proportion of  
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14 6 older people in Australia continues to rise.

17 7 There is no known cure for OA. However, disease-related symptoms are amenable to  
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19 8 intervention,<sup>2</sup> and evidence supports a central role for physical activity (PA) in the management  
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21 9 of these symptoms.<sup>3, 4</sup> PA therapy aims to improve muscle strength, stability of joints, range of  
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23 10 movement, and aerobic fitness. PA can also help maintain a healthy body weight, normalize  
24  
25 11 metabolic consequences of obesity, and reduce the extent of other problems associated with OA-  
26  
27 12 related disability.<sup>5</sup>

31 13 Evidence-based PA guidelines for the OA population recommend stretching exercises to  
32  
33 14 improve flexibility, resistance training to improve strength, and moderate-intensity aerobic PA to  
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35 15 improve endurance.<sup>6, 7</sup> Prevalence of these activities in people with OA is unknown, but the  
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37 16 results from large cross-sectional studies in the US show low levels of PA in people diagnosed  
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39 17 with any type of arthritis.<sup>8-12</sup> Only 37% of people with self-reported doctor-diagnosed arthritis  
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41 18 are engaging in moderate-intensity PA for at least 30 min/d, 3 d/wk, in accordance with  
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43 19 guidelines for this population,<sup>6, 7</sup> and only 20% are performing PA for improving and  
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45 20 maintaining muscle strength and endurance. People with arthritis are significantly less likely to  
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47 21 be meeting PA guidelines for the general adult population than are people without arthritis.<sup>10, 13,</sup>  
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49 22 <sup>14</sup> This indicates that disease-related factors may be hindering the ability or motivation of people  
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51 23 with arthritis to meet guidelines.  
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## Correlates of Physical Activity

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4 1 To better enable and support people with OA to do PA, an understanding of the factors  
5  
6 2 that are associated with PA participation in this population is critical. A framework that can help  
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8 3 in identifying these factors is the Chronic Care Model (CCM), which proposes that people with a  
9  
10 4 chronic illness should develop a set of strategies to manage their illness and those who do so are  
11  
12 5 more likely to adopt healthy behaviors, such as PA.<sup>15</sup> These strategies include support from both  
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14 6 within the health care system (e.g., occupational therapists) and external to it (e.g., arthritis  
15  
16 7 education courses), as well as therapies that people undertake as a result of these supportive  
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18 8 relationships (e.g., non-pharmacological therapies, such as heat/cold treatments, and  
19  
20 9 pharmacological therapies, such as oral analgesics). Although people with OA tend to try a  
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22 10 number of strategies for managing OA symptoms,<sup>16, 17</sup> the relationships between PA as a  
23  
24 11 management strategy and the use of other OA management strategies have not been explored.  
25  
26 12 An examination of these relationships may uncover strategies that make PA more tolerable for  
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28 13 people with OA symptoms, strategies that could be promoted to encourage people with OA to be  
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30 14 physically active. This examination could also reveal potential sources of support for managing  
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32 15 OA with PA and indicate avenues for recruiting people with OA into PA programs.

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38 16 CCM also recognizes the influence of physical and psychological factors on illness-  
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40 17 related behavior.<sup>15</sup> Understanding which of these are associated with PA behavior is important  
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42 18 for developing PA programs tailored to people with OA. Physical symptoms, such as pain and  
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44 19 stiffness, may deter people with OA from adopting or maintaining regular PA. A review of the  
45  
46 20 correlates of PA in people with arthritis concluded that disease-related pain is a commonly-  
47  
48 21 reported barrier to PA among people with OA, but the associations between physical factors,  
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50 22 including pain, and PA have been inconsistent.<sup>18</sup> Findings from some of the reviewed studies  
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52 23 indicate that disease-related pain decreases PA adherence; others have found no association or  
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3 1 that greater pain is associated with more frequent PA in people with OA.<sup>18</sup> More recent studies  
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5 2 provide further evidence that OA-related pain, as well as disease severity and longer disease  
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7 3 duration, can negatively impact on PA participation.<sup>19-21</sup> The authors of the review noted that  
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9 4 psychological factors, namely mental well-being, perceived benefits and barriers to PA, and self-  
10  
11 5 efficacy toward PA, were the most commonly examined correlates of PA in people with arthritis,  
12  
13 6 and most studies found these to be significant correlates of PA in people with OA.<sup>18</sup> Even so,  
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15 7 findings of no association were common, and a more recent study found the only psychological  
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17 8 factor to be associated with PA in people with arthritis was self-efficacy.<sup>22</sup>

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22 9 As others have indicated,<sup>18, 22</sup> the inconsistency in findings across studies with arthritis  
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24 10 populations can be explained in part by the use of different measurement tools, the lack of  
25  
26 11 statistical power, and variations in the covariates included in modeling. In studies of people with  
27  
28 12 OA specifically, samples have tended to be homogeneous, mostly older adults and mostly  
29  
30 13 female, thereby increasing the possibility that a restriction in range could explain null findings.<sup>18,</sup>  
31  
32 14 <sup>22</sup> Studies have also varied in how they define PA, and no study has examined factors separately  
33  
34 15 for leisure-time physical activity (LTPA), stretching exercises, and strength training exercises.

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39 16 The primary aim of this study, therefore, was to examine OA management strategies and  
40  
41 17 other modifiable factors associated with (1) meeting moderate-intensity LTPA recommendations  
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43 18 for people with arthritis, (2) muscle strengthening exercises, and (3) stretching exercises, in men  
44  
45 19 and women, across a broad age range, with hip or knee OA. Consistent with a CCM framework,  
46  
47 20 the modifiable factors included physical and psychological factors that previous studies indicate  
48  
49 21 may be correlates of PA in people with OA.<sup>18</sup> To understand the types of LTPA that are enjoyed  
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51 22 by people with OA and thus to consider in promoting PA to this population, the secondary aim  
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53 23 was to describe the PA of the sample.  
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## Methods

### 1 *The Sample*

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8 Data were collected from 485 people who participated in the Osteoarthritis in Queensland Study.  
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10 This cross-sectional study collected demographic, physical health, and psychological data from  
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12 members of Arthritis Queensland with hip or knee OA. In total, 2200 Arthritis Queensland  
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14 members who reported to Arthritis Queensland that they had OA and whose residence was  
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16 within a 100-km radius of Brisbane, Australia, were mailed the study questionnaire with a self-  
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18 addressed reply paid envelope. Because there were more women than men in the database and  
19  
20 because we wanted to receive a similar number of responses from men and women, slightly  
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22 different methods of recruitment were used for men and women. The 1100 Brisbane-based  
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24 women who were the most recent additions to the database were selected by Arthritis  
25  
26 Queensland to receive the questionnaire. These newest members were more likely to be younger,  
27  
28 to be in better health, and to have mild to moderate OA symptoms, than other Arthritis  
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30 Queensland members; hence, they were more likely to participate in the study and to represent a  
31  
32 range of PA levels. In order to recruit an equal number of men, Arthritis Queensland selected *all*  
33  
34 its male members living in Brisbane and the newest male members living in the suburbs from  
35  
36 which the women were selected. Three weeks after receiving the mailing, respondents were sent  
37  
38 a reminder letter. Of the 658 who returned completed questionnaires (31% response rate), 80%  
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40 reported hip or knee OA and thus were eligible for inclusion in these analyses. Fifteen  
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42 respondents were excluded because they did not report their gender, and another 26 were  
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44 excluded because they did not indicate that they had received a diagnosis of OA by a health  
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46 professional. Questionnaire completion designated informed consent. The study was approved by  
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48 The University of Queensland Medical Research Ethics Committee.  
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3 1 *Physical Activity Measures*

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5 2 **Physical Activities.** Respondents were asked whether they had participated in 14 activities at  
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8 3 least monthly over the previous year. The list included the most popular activities in the state.<sup>23</sup>  
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10 4 Respondents could also list other activities performed at least monthly over the previous year.  
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12 5 **Meeting Arthritis-Specific Leisure-Time Physical Activity Recommendations.** LTPA was  
13  
14 6 measured with the Active Australia questions, which are used in Australia for surveillance and  
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16 7 have been found to be valid and reliable.<sup>24, 25</sup> Respondents reported frequency (times) and  
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18 8 duration (min) in the previous week of walking briskly (*for recreation or exercise or to get to or*  
19  
20 9 *from places*), of moderate-intensity LTPA (*like golf, social tennis, moderate exercise classes,*  
21  
22 10 *recreational swimming, line dancing*), and of vigorous-intensity LTPA (*that makes you breathe*  
23  
24 11 *harder or puff and pant, like aerobics, competitive sport, vigorous cycling, running, swimming*).  
25  
26 12 Respondents were asked to report only activities lasting  $\geq 10$  min/session. To account for  
27  
28 13 differences in energy expenditure of the three types of LTPA, a total score was calculated by  
29  
30 14 multiplying min/wk in each LTPA by an assigned metabolic equivalent (MET) value (walking =  
31  
32 15 3.0 METs; moderate-intensity = 4.0 METs; vigorous-intensity = 7.5 METs), and summing the  
33  
34 16 products to give a total min/wk score.<sup>26</sup> Due to the highly skewed distribution of the data,  
35  
36 17 responses were dichotomized in accordance with recommendations calling for people with  
37  
38 18 arthritis to participate in 30 min of moderate-intensity LTPA, at least 3 d/wk.<sup>6, 7</sup> The  
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40 19 dichotomized categories were meeting recommendations (score  $\geq 360$  METs/wk; computed as  
41  
42 20  $\geq 30$  min x 4 METs x 3 times/wk) and not meeting recommendations (score  $< 360$  METs/wk).  
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44 21 **Stretching and Strength Training.** Respondents were asked about their current participation  
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46 22 (*yes, no*) in (1) range of motion (stretching exercises) and (2) muscle strengthening exercises.  
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55 23 *Measures of Physical Health, Psychological and Confounding Factors*  
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## Correlates of Physical Activity

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3 1 **Physical Health Factors.** BMI (weight [kg]/height [m<sup>2</sup>]) was computed from self-reported height  
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5 2 and weight and was categorized in accordance with World Health Organization guidelines.<sup>27</sup> The  
6  
7 3 WOMAC Osteoarthritis Index Likert 3.1<sup>28</sup> was used to measure pain (5 items), stiffness (2  
8  
9 4 items), and physical function (17 items) associated with hip or knee OA. Response options were  
10  
11 5 on a Likert scale (1=*none*, 2=*mild*, 3=*moderate*, 4=*severe*, 5=*extreme*). Subscale items were  
12  
13 6 summed to created index scores. Higher scores indicated more pain, stiffness, or difficulty with  
14  
15 7 daily activities, respectively. The index has been extensively validated internationally and widely  
16  
17 8 used in studies of people with knee or hip OA.<sup>29, 30</sup>  
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22 9 **Psychological Factors.** Symptoms of anxiety and depression were measured with the 18-item  
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24 10 Goldberg Anxiety and Depression Scale,<sup>31</sup> for which higher scores (possible scores=0–18)  
25  
26 11 indicated more symptoms. The 5-item *Self-Efficacy for Physical Activity Scale* evaluated  
27  
28 12 confidence in ability to participate in PA.<sup>32</sup> The 14-item *Benefits of Physical Activity Scale*  
29  
30 13 determined whether participants were aware of the benefits of PA, and the 23-item *Barriers to*  
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32 14 *Physical Activity Scale* identified factors that made PA participation difficult.<sup>33</sup>  
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36 15 **Confounders.** Factors that are not modifiable but that were hypothesized to confound the  
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38 16 association between the predictor variables of interest in this study and PA were included in  
39  
40 17 these analyses. These included demographic factors that had been previously associated with  
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42 18 PA:<sup>34</sup> sex, age, country of birth (a measure of ethnicity), and highest educational level attained.  
43  
44 19 Other variables examined were area of residence (*urban*; *suburban*), employment status, marital  
45  
46 20 status, and health conditions other than OA. Respondents were asked whether they had been told  
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48 21 by a doctor in the previous 3 y that they had any of 13 conditions, from a list adapted from the  
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50 22 Australian 1989–1990 National Health Survey.<sup>35</sup> The conditions were arthritis other than OA,  
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52 23 diabetes or impaired glucose tolerance, heart disease, hypertension, stroke, thrombosis, low iron  
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1 level, asthma, bronchitis or emphysema, fibromyalgia, chronic fatigue syndrome, osteoporosis,  
2 and cancer. Categories of conditions (cardiovascular disease, respiratory disease) were also  
3 created. Last, respondents reported the number of years since their OA diagnosis ( $\leq 1$  y; 2-3 y; 4-  
4 5 y;  $>5$  y).

### 5 *Measures of Osteoarthritis Management Strategies*

6 Respondents were asked about their use of 21 non-pharmacological and 11 pharmacological  
7 therapies other than PA for managing OA. Although there is no generally-accepted core set of  
8 therapies recommended for people with OA,<sup>36</sup> those listed were commonly reported in the  
9 literature for managing hip and knee OA.<sup>3, 16, 37-40</sup> The non-pharmacological therapies included  
10 support and treatment from professionals within and external to the health care system  
11 (information/educational courses, phone counseling, occupational therapy, low-level laser  
12 therapy, transcutaneous electrical nerve stimulation, viscosupplementation, hydrotherapy,  
13 massage therapy, acupuncture, magnet therapy) and other therapies possibly resulting from  
14 supportive relationships (making efforts to lose weight; using walking sticks, canes, walkers or  
15 other objects to help with walking; taping of the patella, wearing shoes with shock-absorbing  
16 properties or with orthotics; using objects to help with daily living [e.g., sock aids, zipper pulls,  
17 elevated toilet seat, shower seat, non-slip mats]; herbal therapies [e.g., celery seeds, ginger,  
18 willow bark, avocado, soybean, turmeric]; megavitamins; heat/cold treatments). Response  
19 categories were *using* and *not using*. Composite variables were also created to indicate classes of  
20 therapies that could be examined together (hands-on care by a health practitioner, supportive  
21 counseling).

22 The pharmacological therapies were anti-inflammatory tablets or capsules; paracetamol  
23 (acetaminophen); paracetamol and codeine combinations; tramadol; topical anti-inflammatory

## Correlates of Physical Activity

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3 1 gels or creams; glucosamine or chondroitin; steroid injections into joints; oral corticosteroids,  
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5 2 hyaluronan injections; topical liniment rubs; and opioid oral medication. Response categories  
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7  
8 3 were *never tried*; *taking as needed*; *usually taking 1-3 days per week*; *usually taking 4-6 days per*  
9  
10 4 *week*; and *usually taking every day*. Based on the distribution of responses and the researchers'  
11  
12 5 interest in therapies taken regularly, responses were dichotomized as frequent use ( $\geq 4$  d/wk) and  
13  
14 6 infrequent/no use ( $< 4$  d/wk). Composite variables were created to indicate the use of classes of  
15  
16 7 medications (oral analgesics, creams).

8 *Statistical Analysis*

9 With patterns of PA known to differ between the sexes,<sup>34</sup> the chi-square test was used to  
10  
11 10 compare the percentage of men and women who were participating in each PA reported. To  
12  
13 11 examine the factors associated with PA, binomial logistic regression models were computed  
14  
15 12 using a three-stage process. All models included sex, age, country of birth (as a marker of  
16  
17 13 ethnicity), and education (as a marker of socioeconomic status), given their consistent  
18  
19 14 association with PA previously.<sup>34</sup> For the first stage, a series of models was computed to  
20  
21 15 separately examine the association between each physical health, psychological and confounder  
22  
23 16 factor and each PA variable. Significant factors ( $P < .05$ ) were included in the next series of  
24  
25 17 models, which were computed to separately examine the association between each non-PA  
26  
27 18 management strategy and each PA outcome. For the third and final stage, a full model was  
28  
29 19 computed to examine the association between all factors found to be significant during the  
30  
31 20 previous two stages and each PA outcome. All factors were entered simultaneously as  
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33 21 categorical variables except scores on the WOMAC Index, the Goldberg Anxiety and Depression  
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35 22 Scale, the Self-Efficacy Scale, and the Perceived Benefits and Perceived Barriers Scales, which  
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1 were entered as continuous variables. The referent group in each model was the less active  
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1 were entered as continuous variables. The referent group in each model was the less active  
2 group.

### Results

4 Characteristics of the sample are reported in Table 1. Overall, 63% of respondents were aged  
5  $\geq 65$  y ( $M$  age=68 y,  $SD=11$ , range 27-95). Mean WOMAC pain scores ( $=11.4$ ,  $SD=4.3$ ), stiffness  
6 scores ( $=4.8$ ,  $SD=1.9$ ), and physical function scores ( $=38.2$ ,  $SD=14.5$ ) indicated mild to moderate  
7 symptoms of hip or knee OA. Scores on the Goldberg Anxiety and Depression Scale ( $M=8.5$ ,  
8  $SD=4.5$ ) indicated a moderate level of anxiety and depressive symptoms, on average.

9 The most prevalent activities were low-impact (see Table 2) with walking being the most  
10 popular (63%). Fewer than 20% of respondents participated in any other single PA. Participation  
11 rates were similar between men and women, except that more women than men participated in  
12 aqua-aerobics classes/warm water exercises ( $P<0.001$ ), aerobic/fitness classes ( $P=0.033$ ),  
13 dancing ( $P=0.004$ ), and yoga ( $P=0.002$ ), and more men than women played golf ( $P=0.012$ ).

14 Table 3 shows the results of modeling the factors associated with meeting arthritis-  
15 specific LTPA recommendations. In the final model, BMI and cardiovascular disease were  
16 significantly associated with meeting the recommendations. Four OA management strategies  
17 were also significant. Making efforts to lose weight, using hydrotherapy, and using magnet  
18 therapy were positively associated with meeting the recommendation, whereas using walking  
19 aids was negatively associated with meeting the recommendation.

20 Table 4 shows the final model of the factors associated with doing stretching exercises.  
21 Age, education, hypertension, and perceived benefits of PA were significant in the model, as  
22 were six OA management strategies: information/education courses, making efforts to lose

## Correlates of Physical Activity

1 weight, shoes with shock-absorbing properties or with orthotics, heat/cold treatments, massage  
2 therapy, and oral paracetamol medication.

3 Table 5 displays the final modeling of the factors associated with doing strengthening  
4 exercises. Country of birth, osteoporosis, and perceived barriers to PA were significantly  
5 associated with the outcome, as were five OA management strategies: information/education  
6 course; making efforts to lose weight; occupational therapy; heat/cold treatment, and oral  
7 paracetamol medication.

### 8 Discussion

9 This study used CCM as a theoretical framework to examine factors associated with PA for  
10 people with hip or knee OA. LTPA, stretching exercises, and strengthening exercises were  
11 examined separately. The main factors associated with the PA outcomes were OA management  
12 strategies, which supports the CCM proposition that use of chronic illness management strategies  
13 are associated with health behaviors like PA.<sup>15</sup> Some of the strategies may make it easier for  
14 people with OA to be physically active, and could be promoted to encourage PA participation.  
15 Moreover, providers of these strategies are potential avenues for recruiting people with OA into  
16 PA programs. A few physical health and psychological factors were associated with the PA  
17 outcomes, and were also consistent with CCM. An understanding of these factors is essential for  
18 tailoring PA programs to the target population.

19 Only one strategy was associated with all three outcomes: *making efforts to lose weight*.  
20 Respondents who were making efforts to lose weight were more likely to be meeting arthritis-  
21 specific LTPA recommendations and to be performing stretching and strengthening exercises,  
22 than those who were not making these efforts. Weight loss is recommended for people with hip  
23 or knee OA as it can decrease the forces across the weight-bearing joints and thus improve OA

1 symptoms.<sup>36, 41</sup> The current findings may suggest that professional advice to lose weight is acting  
2 as an incentive for people with knee or hip OA to participate in PA that meets recommendations.  
3 Therefore, health professionals who encourage weight loss may be good avenues for recruiting  
4 people into PA programs.

5 Another finding was that respondents who were obese were less likely to be engaging in  
6 sufficient LTPA to meet recommendations, compared with normal-weight respondents. Findings  
7 from previous studies of an association between BMI and PA in people with arthritis have been  
8 inconsistent.<sup>18</sup> Some studies have failed to find an association between BMI and PA in arthritis  
9 patients,<sup>12, 22</sup> although in a population of patients with severe hip or knee OA, higher BMI was  
10 associated with greater PA.<sup>19</sup> Differences across studies may reflect differences in types of  
11 arthritis assessed, in the severity of the arthritis symptoms or in the measurement of PA. Our  
12 results may indicate that those most in need of losing weight are not doing sufficient PA to  
13 impact upon their OA symptoms. Thus, health professionals should be encouraged to counsel  
14 people with hip or knee OA who are obese on activities that meet PA guidelines.

15 Two other non-pharmacological therapies were positively associated with participation in  
16 sufficient LTPA: hydrotherapy and magnet therapy. Evidence from randomized trials indicates  
17 symptom relief from hydrotherapy and good compliance with this therapy.<sup>38</sup> This relief may  
18 make it tolerable for people with OA to perform moderate-intensity PA often and long enough to  
19 meet LTPA guidelines. Magnet therapy is not included in current recommendations for people  
20 with OA,<sup>4</sup> but a randomized controlled trial<sup>42</sup> provided evidence of this therapy's potential role  
21 in pain reduction. While the present study is only cross-sectional, our findings may suggest that  
22 encouraging the use of hydrotherapy, or possibly magnet therapy (given sufficient evidence of its  
23 effectiveness), could be helpful in efforts to promote LTPA to people with hip or knee OA.

## Correlates of Physical Activity

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3 1 Providers of these therapies may be good avenues for promoting LTPA and thus efforts to  
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5 2 encourage more of these providers to counsel clients on strategies for meeting PA  
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8 3 recommendations may be warranted.  
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10 4 Three other therapies were positively associated with participation in stretching and  
11  
12 5 strengthening exercises: information/education courses, heat/cold treatments, and paracetamol  
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14 6 (acetaminophen) preparations. Patient education, thermal treatments, and paracetamol are  
15  
16 7 included in recent recommendations for symptom relief in people with hip or knee OA.<sup>36</sup> The  
17  
18 8 findings may indicate that information/education courses are supporting stretching and  
19  
20 9 strengthening exercises and thus should be considered good avenues for recruiting people with  
21  
22 10 hip or knee OA into stretching and strengthening programs. Heat/cold treatments and  
23  
24 11 paracetamol preparations may be making participation in stretching and strengthening exercises  
25  
26 12 tolerable and thus under appropriate health professional supervision, should be encouraged to  
27  
28 13 help people with hip or knee OA engage in these exercises.  
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34 14 Shoes with shock-absorbing properties or with orthotics and massage therapy were only  
35  
36 15 associated with stretching exercises, and occupational therapy was only associated with  
37  
38 16 strengthening exercises. Corrective footwear is recommended for symptom relief in people with  
39  
40 17 hip or knee OA<sup>36</sup> while evidence supporting massage therapy for OA management has not been  
41  
42 18 strong enough for inclusion in the recommendations.<sup>4</sup> Occupational therapy is not included in  
43  
44 19 these recommendations,<sup>36, 41</sup> although it is usually warranted for people with significantly  
45  
46 20 lowered levels of functioning or with joint deformity.<sup>43</sup> Acknowledging the cross-sectional  
47  
48 21 nature of the study, our findings may suggest that these therapies ease OA symptoms enough to  
49  
50 22 allow for participation in stretching or strengthening exercises. They may also indicate that those  
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52 23 who provide or recommend special shoes or orthotics, such as podiatrists, and those who provide  
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3 1 massage or occupational therapy could be appropriate avenues for recruiting people with hip or  
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6 2 knee OA into exercise programs.

7  
8 3 The only significant psychological factors in this study were the perceived benefits of  
9  
10 4 PA, associated with participation in stretching exercises, and the perceived barriers to PA,  
11  
12 5 negatively associated with strengthening exercises. These findings indicate the need to promote  
13  
14 6 PA benefits to encourage people with hip or knee OA to do stretching exercises and to help  
15  
16 7 people with hip or knee OA strategize ways to overcome difficulties they have with doing  
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18 8 strengthening exercises. No physical health factor was significant in any full model. In their  
19  
20 9 review, Wilcox et al.<sup>18</sup> concluded that three psychological factors, self-efficacy, perceived  
21  
22 10 benefits, and perceived barriers, and one physical health factor, arthritis-related pain, garner the  
23  
24 11 most consistent support as PA correlates for people with arthritis, although a number of studies  
25  
26 12 have found no association between these factors and PA. Additional support for self-efficacy was  
27  
28 13 found in a more recent study of adults with arthritis.<sup>22</sup> Differences between our findings and  
29  
30 14 those of the review could reflect differences in PA outcomes, in measurement of factors, or in the  
31  
32 15 other factors included in multivariable modeling. The current study's finding that pain and other  
33  
34 16 symptoms of OA were not associated with the PA outcomes in multivariable modeling does not  
35  
36 17 support the conclusions of the review authors. However, two more recent studies<sup>19, 22</sup> also found  
37  
38 18 no association between arthritis symptoms and PA. A third<sup>12</sup> found that severe, but not moderate,  
39  
40 19 joint pain was associated with physical inactivity. With few of our respondents reporting severe  
41  
42 20 symptoms, the current study was not likely to be able to detect such a difference. Also of note is  
43  
44 21 that only one other study<sup>19</sup> used the WOMAC as a measure of OA symptoms, as done in the  
45  
46 22 current study, and differences among studies could reflect differences in measures of OA  
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48 23 symptoms.  
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## Correlates of Physical Activity

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3 1 Another finding was that almost two-thirds of respondents were meeting the PA  
4  
5 2 recommendation calling for people with arthritis to participate in at least 30 min of moderate-  
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7 3 intensity LTPA on at least 3 d/wk.<sup>6, 7</sup> Over half were engaging in stretching exercises or muscle  
8  
9 4 strengthening exercises. The most popular PA was walking for exercise. This finding supports  
10  
11 5 national data from adults aged 55+ y in Australia, for whom walking is the most popular sport  
12  
13 6 and recreational activity.<sup>44</sup> Likewise, the top 10 activities of respondents were within the top 15  
14  
15 7 for Australians in this age range.<sup>44</sup> These findings suggest that people with mild to moderate  
16  
17 8 symptoms of hip or knee OA are still participating in activities enjoyed by the general population  
18  
19 9 of adults of the same age and thus these activities are appropriate to promote to this population.  
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21 10 Few differences were found between men and women, with exceptions reflecting meaningful  
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23 11 differences between the sexes in participation of these activities nationally.<sup>44</sup>  
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29 12 The primary limitations of this study were the cross-sectional design and the reliance on  
30  
31 13 self-reported data. However, standard measures with acceptable measurement properties were  
32  
33 14 used whenever possible. The use of a self-report survey to ascertain the diagnosis of OA is of  
34  
35 15 particular note. Members of Arthritis Queensland who had reported to that organization that they  
36  
37 16 had OA were eligible to receive the survey. To decrease potential misclassification, we excluded  
38  
39 17 from analyses data from respondents who did not specify that they had OA of the hip or knee,  
40  
41 18 reported that they did not know when they were diagnosed with OA, or reported that they had  
42  
43 19 not been diagnosed with OA. Although in Australia data on type of arthritis are regularly  
44  
45 20 collected as part of surveillance,<sup>45</sup> the validity of such questions is not known. It is possible that  
46  
47 21 respondents were misclassified as having hip or knee OA when they did not. To assess  
48  
49 22 participation in stretching and strengthening exercises, respondents were asked whether they  
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51 23 engaged in these PA. Information on frequency and duration of their participation were not asked  
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1 and thus it was not possible to determine whether respondents were meeting recommendations  
2 for participation in these exercises. Also of note is that the 31% response rate was low compared  
3 to the 63%–82% response rates obtained in previous studies that mailed questionnaires to people  
4 with arthritis.<sup>21, 46</sup> However, comparisons with state and national data indicate that our sample  
5 was fairly representative of people with OA in this area. The proportion of men in our sample  
6 (40%) is comparable to the proportion of men in Queensland (39%) and in Australian (39%)  
7 with self-reported medically-diagnosed osteoarthritis,<sup>1</sup> although our sample was older (30% aged  
8  $\geq 75$  y) than representative samples of people with OA (Queensland 20%; Australia 21%).<sup>1</sup> It is  
9 also likely that respondents were experiencing more symptoms of OA than was the general  
10 population of people with OA, given that nationally, 36% of people with arthritis report that they  
11 are taking actions for their condition,<sup>45</sup> whereas 99% of our sample reported using therapies to  
12 manage OA symptoms. These findings are not surprising given respondents were members of  
13 Arthritis Queensland, which people tend to join once they need support for their condition.  
14 Caution is warranted in generalizing the findings to other populations, particularly younger  
15 population of people with OA and to people experiencing few, if any, OA symptoms.

### 16 **Conclusions**

17 Acknowledging the limitations of the cross-sectional design, the findings indicate particular  
18 management strategies may ease OA symptoms sufficiently to make PA tolerable for people  
19 with hip or knee OA. Promoting these strategies may encourage people with OA to be physically  
20 active. The findings also suggest sources of support for engaging in PA and therefore indicate  
21 avenues for recruiting people with OA into PA programs. Last, the study adds to the growing  
22 body of literature on the correlates of PA for people with arthritis by indicating psychological  
23 factors associated with PA behavior in people with hip or knee OA, information that is important

## Correlates of Physical Activity

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2  
3 1 for developing PA programs tailored to this population. Additional research is required to  
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6 2 duplicate these findings in other communities.

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8 3 *Acknowledgements*

9  
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17  
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1 **Table 1 Demographic and Health-Related Characteristics of the Sample (N = 485)**

Characteristic	<i>n</i>	%
Age (y) <sup>a</sup>		
<65	178	36.7
65-74	162	33.4
75+	145	29.9
Country of birth		
Australia	360	74.2
Other country	125	25.8
Area of residence		
Suburban	285	58.8
Urban	200	41.2
Marital status		
Married/common-law relationship	314	64.7
Never married/separated/divorced	90	18.6
Widowed	81	16.7
Education		
No high school degree	192	39.6
Completed high school	79	16.3
Trade certificate	127	26.2
University degree	87	17.9
Employment status		
Not employed/retired	380	78.4
Employed	105	21.6
Body mass index		
Normal-range weight (BMI < 25)	145	29.9
Overweight (BMI 25 to ≤30)	202	41.6
Obese (BMI > 30)	138	28.5
Number of chronic conditions		
0	74	15.3
1	98	20.2
2	107	22.1
3 or more	206	42.5
Years since osteoarthritis diagnosis		
≥ 5 y	325	67.0
4 to 5 y	65	13.4
≤ 3 y	95	19.6
Number of non-pharmacological therapies using		
0-1	94	19.4
2	90	18.6
3	77	15.9
4 or more	224	46.2
Number of pharmacological therapies using		
0	105	21.6
1	163	33.6
2	127	26.2

## Correlates of Physical Activity

$\geq 3$	90	18.61
Meeting physical activity recommendations		
No	174	35.92
Yes	311	64.1
Currently using stretching exercises		3
No	208	42.9
Yes	277	57.14
Currently using strengthening exercises		
No	239	49.35
Yes	246	50.7
		6

7 **Table 2 Physical Activities of Respondents ( $N = 485$ )**

Physical Activities	Sample		Men		Women	
	$N = 485$		$n = 192$		$n = 293$	
	$N$	%	$n$	%	$n$	%
Walk for exercise	305	62.9	115	59.9	190	64.8
Aqua-aerobics classes/warm water exercises <sup>a</sup>	94	19.4	17	8.9	77	26.3
Swim	78	16.1	31	16.1	47	16.0
Aerobic/fitness classes <sup>a</sup>	71	14.6	20	10.4	51	17.4
Cycle	63	13.0	27	14.1	36	12.3
Golf <sup>a</sup>	50	10.3	28	14.6	22	7.5
Dance <sup>a</sup>	49	10.1	10	5.2	39	13.3
Yoga <sup>a</sup>	48	9.9	9	4.7	39	13.3
Racquet sports (tennis, squash)	41	8.5	15	7.8	26	8.9
Lawn bowls	39	8.0	17	8.9	22	7.5
Run/jog	30	6.2	12	6.2	18	6.1
Football (soccer, Australian rules, rugby)	24	4.9	8	4.2	16	5.5
Cricket	23	4.7	8	4.2	15	5.1
Basketball/netball	21	4.3	6	3.1	15	5.1
Other physical activities and sports*	11	2.3	3	1.6	8	2.7

8 \*Participants listed bowling, kayaking, table tennis, field hockey, and softball as other activities  
 9 that they did. <sup>a</sup>  $P < 0.05$  for differences between men and women.

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2  
3 **Table 3 Multivariable Logistic Regression Results for the Correlates of Meeting**  
4 **Arthritis-Specific Physical Activity Recommendation (N = 485)**  
5

6	7	8	9	10	11
Characteristics	% Meeting Recommendation	Odds ratio	(95% CI)	p-value	
8	Gender				
9	Male	64.1%	1.00	(ref.)	
10	Female	64.2%	0.93	(0.60-1.46)	0.766
11	Age (y)				
12	<65	70.8%	1.00	(ref.)	
13	65-74	66.0%	0.95	(0.57-1.55)	0.804
14	75+	53.8%	0.75	(0.43-1.31)	0.311
15	Country of birth				
16	Australia	63.1%	1.00	(ref.)	
17	Other country	67.2%	1.14	(0.70-1.85)	0.594
18	Education				
19	No high school	58.9%	1.00	(ref.)	
20	Completed high school	63.3%	0.89	(0.49-1.63)	0.714
21	Trade certificate	68.5%	1.25	(0.73-2.15)	0.413
22	University degree	70.1%	0.93	(0.50-1.73)	0.815
23	PHYSICAL FACTOR				
24	Body mass index				
25	Normal-range (BMI<25)	71.7%	1.00	(ref.)	
26	Overweight (BMI 25 to ≤30)	63.9%	0.67	(0.40-1.13)	0.134
27	Obese (BMI>30)	56.5%	0.50	(0.27-0.92)	0.025
28	Cardiovascular disease				
29	No	74.6%	1.00	(ref.)	
30	Yes	56.2%	0.52	(0.34-0.81)	0.004
31	PSYCHOLOGICAL FACTOR				
32	Self-efficacy		1.15	(0.85-1.55)	0.369
33	Barriers to physical activity		0.78	(0.56-1.09)	0.147
34	OA MANAGEMENT				
35	Efforts to lose weight				
36	No	59.0%	1.00	(ref.)	
37	Yes	67.7%	1.84	(1.17-2.90)	0.008
38	Walking aids				
39	No	70.6%	1.00	(ref.)	
40	Yes	43.0%	0.41	(0.25-0.68)	0.001
41	Hydrotherapy				
42	No	61.4%	1.00	(ref.)	
43	Yes	77.8%	2.04	(1.10-3.77)	0.024
44	Magnet therapy				
45	No	62.1%	1.00	(ref.)	
46	Yes	72.3%	1.96	(1.13-3.42)	0.017

3

## Correlates of Physical Activity

1 **Table 4 Multivariable Logistic Regression Results for the Correlates of Stretching**  
 2 **Exercises (N = 485)**

Characteristics	% Doing Stretching Exercises	Odds ratio	(95% CI)	p-value
Gender				
Male	52.1%	1.00	(ref.)	
Female	60.4%	1.00	(0.63-1.59)	0.986
Age (y)				
<65	59.0%	1.00	(ref.)	
65-74	56.2%	1.23	(0.75-2.02)	0.412
75+	55.9%	1.78	(1.03-3.08)	0.039
Country of birth				
Australia	55.6%	1.00	(ref.)	
Other country	61.6%	1.49	(0.92-2.41)	0.104
Education				
No high school	50.0%	1.00	(ref.)	
Completed high school	58.2%	1.14	(0.62-2.11)	0.676
Trade certificate	56.7%	1.13	(0.66-1.92)	0.664
University degree	72.4%	2.23	(1.16-4.29)	0.017
Hypertension				
No				
Yes		0.50	(0.33-0.77)	0.002
PHYSICAL FACTOR				
WOMAC pain		0.99	(0.94-1.05)	0.838
PSYCHOLOGICAL				
Self-efficacy for physical activity		1.33	(0.97-1.83)	0.075
Benefits to physical activity		1.62	(1.09-2.40)	0.016
OA MANAGEMENT				
Information/education course				
No	49.9%			
Yes	75.0%	1.88	(1.14-3.12)	0.014
Efforts to lose weight				
No	44.0%	1.00	(ref.)	
Yes	66.3%	2.28	(1.47-3.53)	<0.001
Shoes with shock-absorbing properties or orthotics				
No	48.9%	1.00	(ref.)	
Yes	68.1%	1.71	(1.0-2.65)	0.016
Occupational therapy				
No	55.3%	1.00	(ref.)	
Yes	80.0%	1.57	(0.59-4.17)	0.366
Hydrotherapy				

## Correlates of Physical Activity

No	53.2%	1.00	(ref.)	
Yes	76.5%	1.75	(0.91-3.34)	0.093
Transcutaneous electrical nerve stimulation (TENS)				
No	55.5%	1.00	(ref.)	
Yes	75.0%	1.08	(0.43-2.68)	0.873
Heat/cold treatment				
No	50.0%	1.00	(ref.)	
Yes	69.9%	2.04	(1.26-3.30)	0.004
Massage therapy				
No	53.3%	1.00	(ref.)	
Yes	78.4%	2.05	(1.03-4.08)	0.041
Paracetamol				
<4 d/wk	54.8%	1.00	(ref.)	
≥4 d/wk	66.0%	2.09	(1.20-3.65)	0.009

1

**Table 5. Multivariable Logistic Regression Results for the Correlates of Strengthening Exercises (N = 485)**

3

Characteristics	% Doing Strengthening Exercises	Odds ratio	(95% CI)	p-value
Gender				
Male	46.4%	1.00	(ref.)	
Female	53.6%	1.07	(0.67-1.72)	0.775
Age (y)				
<65	52.2%	1.00	(ref.)	
65-74	53.1%	1.16	(0.71-1.88)	0.553
75+	46.2%	1.01	(0.58-1.74)	0.982
Country of birth				
Australia	48.1%	1.00	(ref.)	
Other country	58.4%	1.77	(1.09-2.85)	0.020
Education				
No high school	44.8%	1.00	(ref.)	
Completed high school	46.8%	0.84	(0.45-1.54)	0.568
Trade certificate	54.3%	1.20	(0.70-2.04)	0.509
University degree	62.1%	1.53	(0.83-2.82)	0.177
Cancer				
No	54.5%			
Yes	46.1%	1.69	(0.82-3.50)	0.158
Osteoporosis				
No	47.6%	1.00	(ref.)	
Yes	60.9%	1.83	(1.11-3.04)	0.019
PSYCHOLOGICAL				
Self-efficacy for physical activity		1.26	(0.90-1.76)	0.185
Perceived benefits		1.29	(0.88-1.89)	0.192

## Correlates of Physical Activity

1					
2					
3					
4	Perceived barriers		0.69	(0.49-0.97)	0.035
5	0A MANAGEMENT				
6	Information/education course				
7	No	43.5%			
8	Yes	68.6%	1.84	(1.14-2.97)	0.013
9	Phone counseling				
10	No	49.7%			
11	Yes	77.8%	1.98	(0.56-6.94)	0.287
12	Efforts to lose weight				
13	No	35.5%	1.00	(ref.)	
14	Yes	61.4%	2.42	(1.58-3.70)	<0.001
15	Shoes with shock-absorbing				
16	properties or orthotics				
17	No	45.3%			
18	Yes	58.0%	1.21	(0.79-1.86)	0.377
19	Occupational therapy				
20	No	48.4%	1.00	(ref.)	
21	Yes	80.0%	2.75	(1.06-7.15)	0.038
22	Objects to help with daily				
23	living				
24	No	47.3%			
25	Yes	58.4%	1.07	(0.67-1.72)	0.777
26	Massage therapy				
27	No	47.2%			
28	Yes	70.3%	1.68	(0.88-3.22)	0.116
29	Heat/cold treatment				
30	No	44.6%	1.00	(ref.)	
31	Yes	61.8%	1.65	(1.05-2.61)	0.031
32	Hydrotherapy				
33	No	47.3%			
34	Yes	67.9%	1.33	(0.74-2.42)	0.343
35	Paracetamol				
36	<4 d/wk	48.8%	1.00	(ref.)	
37	≥4 d/wk	58.0%	1.84	(1.08-3.15)	0.026

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