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Title: Factors Associated with Adherence To a Supervised Exercise Intervention for Osteoarthritis: Data From the Swedish Osteoarthritis Registry.

Running Title: Factors Associated with Exercise Adherence in Osteoarthritis

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Abstract (250/250)

Objective: To explore how lifestyle and demographic, socioeconomic and disease-related factors are associated with supervised exercise adherence in an osteoarthritis (OA) management programme and their ability to explain exercise adherence.

Methods: A cohort register-based study on participants from the 'Swedish Osteoarthritis Registry' who attended the exercise part of a nationwide Swedish OA management programme. We ran a multinomial logistic regression to determine the association of exercise adherence with the abovementioned factors. We calculated their ability to explain exercise adherence with the McFadden R^2.

Results: Our sample comprises 19,750 (73% female sex; age: 67 (SD: 8.94)) participants. Among them, 5,862 (30%) reached a low level of adherence, 3,947 (20%) a medium level and 9,941 (50%) a high level. After a listwise deletion, the analysis was run on n=16,685 (85%), with low levels of adherence as the reference category. Some factors were positively associated with high levels of adherence, such as older age (relative risk ratio (RRR) =1.01, 95% CI 1.01-1.02 (per year)), and the 'arthritis-specific self-efficacy' (1.04, 95% CI 1.02-1.07 (per 10-point increase)). Others were negatively associated with high levels of adherence, such as 'female' sex (0.82, 95% CI [0.75-0.89]), having a 'medium' (0.89, 95% CI [0.81; 0.98] or a 'high' level of education (0.84, 95% CI [0.76-0.94]). Nevertheless, the investigating factors could explain 1% of the variability in exercise adherence (R^2= 0.012).

Conclusion: Despite the associations reported above, the low-explained variability suggests that strategies based on lifestyle and demographic, socioeconomic and disease-related factors are unlikely to improve exercise adherence significantly.

Significance & Innovations

- Though exercise is a first-line intervention in osteoarthritis (OA), levels of exercise adherence among people with OA are suboptimal. Several elements have been hypothesised to be associated with exercise adherence, including lifestyle and demographic, socioeconomic and disease-related factors in conditions other than OA.
- Analysing real-world data from a first-line intervention provided nationwide in Swedish primary care, we found that high levels of adherence were positively associated with increased age, frequent pain, walking difficulties and higher levels of self-efficacy. Conversely, high levels of adherence were negatively associated with female sex, higher BMI, and high socioeconomic positions. However, these factors could explain 1% of the exercise variability.
- In OA, strategies based on lifestyle and demographic, socioeconomic and disease-related factors are unlikely to improve exercise adherence significantly. Therefore, to improve adherence significantly, we need to consider other elements.

Introduction

In osteoarthritis (OA), exercise is considered a first-line intervention by international clinical practice guidelines (CPGs) (1,2) due to its ability to improve people's symptoms and levels of functionality (3,4). Exercise positively affects body weight, lipid metabolism, glycaemic control and systemic inflammation, preventing and treating OA-related chronic diseases (5). Despite these benefits, adherence to exercise in OA is suboptimal (6,7).

Adherence is described by the World Health Organisation (WHO) as "the extent to which a person's behaviour–taking medication, following a diet and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider" (8). Poor adherence to exercise can severely compromise its long-term effectiveness, limiting its benefits (9). Considering the rising prevalence (10) and economic burden of OA (11), identifying factors associated with exercise adherence is fundamental to creating specific interventions to improve it.

Several elements have been hypothesised to be associated with exercise adherence, including lifestyle and demographic, socioeconomic and disease-related factors (12–17). However, evidence on this topic arises mainly from other chronic conditions than OA, qualitative studies whose aims are not to generalise knowledge and studies with small samples (12–19). Moreover, the WHO stated that it is the combination of different factors rather than a single one which determines adherence (8). In contrast, the abovementioned studies focussed primarily on single factors and their measures of mean association with adherence (e.g., odds ratio). Relying just on measures of association corresponds to an abstraction that does not take into account the variability of individual-level effects (20).

Therefore, we aimed to investigate the associations between lifestyle and demographic, socioeconomic and disease-related factors with adherence to supervised exercise as a part of an OA management programme delivered nationwide in Swedish primary care. Furthermore, we aimed to investigate these factors' ability to explain exercise adherence variability.

Methods

Study Design and Setting

This study is a cohort register-based study on individual-level data retrieved from the 'Swedish Osteoarthritis Registry' (SOAR) (for data on the OA management programme) and the 'Longitudinal Integration Database for Health Insurance and Labour Market Studies' (LISA) administered by

‘Statistics Sweden’ (for data on socioeconomic positions - SEP). These datasets were merged using personal identity numbers (PINs) unique to all citizens in Sweden.

SOAR includes data from approximately 195,000 people with OA who attended an OA management programme provided nationwide by the Swedish healthcare system (21,22). This programme has already been thoroughly described elsewhere (23,24). Briefly, it is composed of two parts: i) education and ii) exercise. The education part is mandatory, whilst the exercise part is optional. The education part is based on three sessions that revolve around the pathophysiology of the disease and its self-care management. The first two sessions are mandatory and held by a physiotherapist. The third one is optional and held by a person with OA, trained as an OA communicator. The exercise (optional) part starts with an individual encounter with a physiotherapist to tailor the exercise programme to the participants’ needs and characteristics. At this point, participants can decide whether to exercise at home or with a physiotherapist. Those who decide to exercise with a physiotherapist are offered to attend 12 sessions over 6-8 weeks (two sessions a week) following OA Swedish CPGs (25). LISA provides socioeconomic data such as cohabitation, institutionally-based education level, employment, income and residential area (26). The research was conducted in respect of the Declaration of Helsinki and reported following the Strengthening the Reporting of Observational studies in Epidemiology (STROBE). Ethical approval was obtained from the Swedish Ethics Committee (Dnr: 2019-02570).

Population

The study cohort comprises all the participants in the SOAR with a first registration (baseline) between 2012 and 2015. We included only those who started the exercise group sessions supervised by the physiotherapists after the initial encounter with them. We selected participants with knee or hip OA who were recorded in the SOAR only once.

Variables

Dependent Variables

The ‘Levels of Adherence’ to the supervised exercise part, reported in the SOAR, is the dependent variable of this study. This is a pre-determined categorical variable recorded by the physiotherapists and stratified on the number of sessions participants attended (Low levels of adherence (1-6 training sessions) / Medium Levels of Adherence: (7-9 training sessions) / High Levels of Adherence: 10-12 sessions). In this study, high levels of adherence represent > 80% of the adherence with the recommended interventions (12 sessions) (25), which is typically considered a satisfactory level of adherence (27).

Independent Variables

The collected independent variables are reported hereafter and divided as 'Demographic and Lifestyle Characteristics', 'Socioeconomic Characteristics' and 'Disease-Related Characteristics'.

Demographic and Lifestyle Characteristics

Participants' demographic and lifestyle characteristics were reported by the participants themselves at the baseline and recorded in the SOAR. These characteristics were 'assigned sex (at birth)' (binary variable – Male / Female), 'age' (continuous variable), body mass index ('BMI') (continuous variable computed from self-reported height and weight), 'weekly physical activity' (continuous variable – hour) that was assessed with the question "How active are you during a regular, typical week?" (21), and 'health-related quality of life' ('HRQoL') (continuous variable - EuroQol5-visual analogue scales, EQ5DVAS). In the EQ5DVAS, the respondents report their perceived HRQoL on a VAS scale that scores from 0 (the worst possible HRQoL) to 100 (the best possible HRQoL). The EQ5DVAS is part of the EQ-5D scale (28).

Socioeconomic Characteristics

Each SEP indicator from the year before the enrolment to the SOAR was considered for the analysis. In particular, the following SEP factors were retrieved and categorised as follows: 'Living alone' (binary variable - living alone / living with someone), 'Institutionally-based education level' (categorical variable - low (primary school [0–9 years]) / medium (secondary school up to postsecondary education <3 years [10–14 years]), / high (postsecondary education [>=15 years]), 'employment' (binary variable - employed / retired-unemployed), 'residential area' (categorical variable - rural / suburban / urban) and the net income.

'Residential area' is classified based on the 'Swedish Association of Local Authorities and Regions' (SALAR) classification of Swedish municipalities. Specifically, 'rural' areas are smaller towns/urban areas and rural municipalities, 'suburban' areas are medium-sized towns (≥40,000 inhabitants) and municipalities near medium-sized towns, 'urban' areas are large cities (≥200,000 inhabitants) and municipalities near large cities (29). The individual yearly net income was categorised into quartiles based on the sample income distribution: lowest income quartile (< 146,500 SEK) / second income quartile (146,501- 198,100 SEK) / third income quartile (198,111 – 278,800 SEK) / highest Income Quartile (> 278,800 SEK) (29).

Disease-Related Characteristics

The physiotherapists recorded the 'index joint' (categorical variable - hip or knee) (21), namely, the joint with OA. They assessed this variable based on the participant's medical history, symptoms, and clinical assessment. In the case of multiple joints with OA, the most symptomatic joint was considered the index joint for the treatment. The participants self-recorded the 'numbers of painful joints' (continuous variable), their 'desire for surgery' (binary variable - yes / no) that was assessed by asking them: "Are your knee / hip symptoms so severe that you wish to undergo surgery?" (21); their 'pain intensity' (ordinal variable 0-10, Numeric Rating Scale (NRS) (30)) in their 'index Joint'; their 'pain frequency' (binary variable – infrequent pain [less than every week] / frequent pain [almost every day]) that was assessed with the question: "How often do you have pain in your knee/hip" (21); their 'fear of movement' (binary variable – yes / no) that was assessed with the question "Are you afraid your joints will be injured by physical training/activity?"; the 'Charnley score' (categorical variable – Charnley score; A = unilateral hip or knee OA / B = bilateral hip or knee OA / C = multiple joint OA or some other condition) that categorises people with OA into three classes based on the disease(s) that affect walking ability (31); and the 'arthritis-specific self-efficacy' (continuous variable 10-100 – pain and symptom arthritis self-efficacy scale, ASES) the Swedish version of the scale was adopted (32). The ASES scale is a reliable instrument that assesses patients' arthritis-specific self-efficacy, namely, their beliefs about their ability to perform a specific task and cope with OA (33). The full version is composed of three subscales: 1) 'self-efficacy pain scale' (5 items); 2) 'function scale' (9 items); 3) 'other symptoms scale' (6 items). Participants indicate to what extent they feel confident they can do the tasks reported in the items from 10 ('very uncertain') to 100 ('very certain). In the SOAR, only 1) and 3) were adopted and combined as suggested in the scale instruction (33).

Statistical Analysis

Descriptive statistics are reported as mean ± standard deviation (SD) and absolute and percentage frequencies. A multivariable exploratory analysis was performed to identify which independent variables were independently associated with exercise adherence in the SOAR (34). Multivariable exploratory analyses detect patterns and identify relationships between the independent variables and the outcome (34–36).

Since the proportional odds assumption was not met, an ordered logistic regression could not be performed. Hence, we ran a multinomial logistic regression with a listwise deletion (Stata function ‘mlogit’) to determine the association between the independent variables and the adherence to exercise. No missing data were reported in the outcome (adherence). Less than 1% of the data on 'socioeconomic' characteristics was missing, primarily due to an error during the data upload process in ‘LISA’. ‘Demographic and lifestyle’ and ‘disease-related’ characteristics missing data in the SOAR are most likely a result of a mistake by the physiotherapists responsible for uploading the data at the local unit. Hence missing data in both registers could be considered missing completely at random, introducing no or minimal bias in our analysis.

The selection of the variables in the model was informed by previous literature on exercise adherence in other chronic pain conditions (12–17) and the evidence for action on adherence by the WHO (8). Then, the variables were clustered in ‘demographic and lifestyle’, ‘socioeconomic and ‘disease-related’ following the dimensions proposed by the WHO (8). The multicollinearity assumption between continuous variables was tested, and none of the continuous variables was highly correlated. The relative risk ratio (RRR) of being in ‘medium level of adherence’ or ‘high level of adherence’ with respect to ‘low level of adherence’ and 95% confidence intervals (CIs) were estimated for each covariate in the model. For the variables ‘HRQoL’ and ‘arthritis-specific self-efficacy’, the RRR is presented as a 10-point change in these scales.

Finally, the ability of the models to explain the variability of exercise adherence was calculated with McFadden R^2 (Stata function ‘fitstat’). McFadden R^2 measures the ability of a model to explain the variance of dependent variables on a convenient 0 – 100% scale. In particular, this value highlights how much of the variance in the dependent variable (adherence) can be explained by the independent variables collectively. We calculated McFadden R^2 for the model with all variables included (full model). Afterwards, we excluded one set of variables from the model and calculated the difference between McFadden R^2 with the full model. A higher difference would indicate a higher contribution of the variables set into the explanatory power of the full model. The analysis was done through Stata 17.

Results

Between 1st January 2012 and 31st December 2015, 46,905 people with OA were recorded in the SOAR. However, we excluded n=7 participants as they had joints other than hip and knee as their first cause of pain, n=27,147 as they did not perform any supervised exercise session(s) and n=1 for attending the programme more than once. Hence, 19,750 (73% female sex; age: 67 (SD: 8.9)) participants with knee (69%) and hip (31%) OA were included in this study. Figure 1 reports the participants' selection process. Table 1 presents the characteristics of the entire sample and stratified by the levels of adherence. Specifically, 5,862 (30%) reached a low level of adherence, 3,947 (20%) a medium level and 9,941 (50%) a high level.

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Figure 1. Selection of the study population

After the listwise deletion, the multinomial logistic regression was run on n=16,685 (85%), using low levels of adherence as the reference category (Table 2). Overall, excluded participants (N=3,065) had similar characteristics to the ones included in the analysis (Supplementary Material 1). We found that 'female' sex (RRR=1.13, 95% CI [1.02-1.27]), 'living with someone' (1.21, [1.10-1.32]) and an increase of one 'number of joints with OA' (1.06, 95% CI [1.01-1.10]) were positively associated with achieving medium levels of adherence. Conversely, an increase in an hour of 'weekly physical activity' (0.98, 85% CI [0.96-0.99]), living in an 'urban' area (0.87, 95% CI [0.78-0.98]) and being 'employed' (=0.82, 95% CI [0.72-0.93]) were negatively associated with achieving medium levels of adherence.

An increase of one year in 'age' (1.01, 95% CI [1.01-1.02]), having 'frequent' Pain (1.13, 95% CI [1.02-1.25]), having 'walking difficulties' (1.12, 95% CI [1.01-1.24]) and with a 10-point increase on the 'arthritis-specific self-efficacy' scale (1.04, 95% CI [1.02-1.07]) were positively associated with high levels of adherence. Instead, 'female' sex (0.82, 95% CI [0.75-0.89]), an increase of one point in 'BMI' (0.99, 95% CI [0.98-0.99]), living in a 'suburban' (0.79, 95% CI [0.73-0.86]) or an 'urban' area (0.78 95% CI [0.71-0.86]), being 'employed' (OR=0.71, 95% CI [0.64-0.78]), having a medium (0.89, 95% CI [0.81; 0.98] or a high 'level of institutionally-based education' (0.84, 95% CI [0.76-0.94]) and having 'knee' as 'worst Joint' (0.92, 95% CI [0.85-0.99]) were negatively associated with high levels of adherence.

Finally, the McFadden R^2 of the full model suggested that 'participants' demographic and lifestyle characteristics', 'socioeconomic characteristics' and 'disease-related characteristics' can explain about 1.2% of the variation in adherence. Once we removed 'participants' demographic and lifestyle characteristics', 'socioeconomic characteristics' and 'disease-related characteristics' alternatively, there was a difference in the McFadden R^2 with respect to the full model of 0.3%, 0.4% and 0.2%, respectively. ‘Disease-Related characteristics’ had the most explanatory power, albeit the total explanatory ability of the full model was very small.

Discussions

This study is the first to try to understand the relationship between demographic and lifestyle, socioeconomic and disease-related factors, with the level of adherence to a face-to-face supervised exercise programme for OA in a large sample of participants with this disease. Out of the total sample, around 30% had low adherence levels, 20% had medium adherence levels, and 50% had high adherence levels. The distribution of adherence levels in our sample is consistent with that of participants in a similar Danish intervention (37) but differs from the distribution observed in an online version of the same intervention, which had a higher proportion of people with high levels of adherence than our sample (38). While several factors were associated with adherence, the full model could explain only 1% of the variability, which suggests these factors are unlikely to have a tangible impact on adherence.

Regarding demographic and lifestyle factors, the female sex was negatively associated with a high level of adherence. Previous evidence indicated that women (with or without OA) might face societal expectations of household and caregiving responsibilities, experiencing greater difficulty finding time to exercise (39–43). However, in the digital version of this intervention, the female sex suggested a positive association with high levels of exercise adherence (38), suggesting that digital interventions may be more convenient for females. Despite these findings, it is crucial to address the root causes of these disparities in exercise adherence rather than focusing on exercise delivery mode to reduce this gender gap. However, our study only collected information on participants' assigned sex (at birth), limiting the generalisability of our results to those individuals who are not cisgender. Therefore, further research is needed to explore the relationship between gender identity, sex and exercise adherence in individuals with OA. Then, participants’ older age was positively associated with reaching a high level of adherence. Considering how exercise is delivered in this programme, our result aligns with previous evidence where older adults adhered more to self-paced rather than moderate-intensity exercise (44). Finally, BMI was negatively associated with reaching high levels of adherence, which is consistent with previous evidence where people with high BMI are less keen on engaging in physical exercise (38,45).

Among the socioeconomic factors, people who lived in an urban or suburban area, were employed, and with medium or high levels of institutionally-based education tended to exercise less than their counterparts. Similar results were found in the digital version of this intervention, where lower institutionally-based education and living outside the largest Swedish cities were associated with higher adherence (38). These results contrast the previous literature, where socioeconomic categories typically representing higher SEP tended to adhere more to exercise (46,47). However, it is essential to consider that most of the data on adherence are retrieved from secondary analyses of RCTs (48). Firstly, these studies were not designed to study adherence. RCTs per se tend to enhance adherence to treatment which might bring to an overestimation of the factors related to it (49). Secondly, in RCTs, people are volunteers that are selected following specific inclusion and exclusion criteria which may fail to mirror the socioeconomic variability of the underlying population from which the sample is drawn (50). Moreover, we might not have reached the more socioeconomically disadvantaged groups, considering the higher SEP of the SOAR sample compared to the general Swedish population (29). Finally, another explanation of this tendency is that people in lower SEP seemed exposed to a more detrimental OA-disease burden than their higher counterparts (51). Severe symptoms can act as a motivator and drive exercise adherence (46,52). Those who experience a higher disease burden might be more motivated to follow exercise regimens. This phenomenon was also highlighted in our study once looking at the disease-related factors as having frequent pain and walking difficulties were associated with high levels of adherence.

Moreover, self-efficacy was associated with exercise adherence, as per previous evidence (53), but with a modest RRR. Self-efficacy is characterised by a curvilinear (u-shaped) relationship between this construct and task accomplishment (54). People with low self-efficacy are likely to doubt their chance to accomplish a task, and those with a high-self efficacy might be characterised by complacency, inadequate preparation and focus on achieving task-related targets (54). Therefore, low and high levels of self-efficacy can lead to a similar outcome, namely, low adherence to a task (e.g., exercise). Considering the large cohort of our study, the effect of self-efficacy might be diluted due to the high variety of our population.

However, our model could explain just 1% of the variability, as indicated by the McFadden R^2. Thus, if we wanted to design an exercise intervention and understand which strategies to adopt to increase adherence, we should accept that demographic and lifestyle, socioeconomic and disease-related factors are unlikely to improve adherence significantly, considering how little they explain adherence variability. This conclusion is further supported by the limited ability of similar factors to explain exercise adherence in the digital version of the intervention (38). Therefore, other factors should be taken into account.

The SOAR gathers real-world data from more than 500 different units throughout Sweden, with considerable variability among them. These contexts are characterised by specific contextual factors (e.g., structures' facilities, clinicians' communication style and ability to motivate patients etc.) that affect people's outcomes via a placebo (or nocebo) response if positively (placebo) or negatively (nocebo) encoded by one's brain via the so-called 'Mindsets' (55). Mindsets are "core assumptions about a domain or category that orient individuals to a particular set of attributions, expectations, and goals" (56,57). Preliminary evidence indicated that improving mindsets about exercise increased its adherence (57). Moreover, booster sessions, reminders and behavioural change techniques can improve exercise adherence by increasing people's motivation to partake in exercise (58,59). These strategies seem to ground their efficacy on contextual factors too (e.g., communication with the clinicians, feeling to be taken care of by them etc.). Therefore, it is possible to argue that contextual factors and the mindsets responsible for interpreting them are worth exploring in future studies to understand their relationship with exercise adherence.

Some limitations of this study need to be discussed. Firstly, the observational nature of the study does not allow us to establish causality and draw any definitive conclusion on the relationship between exercise adherence and the investigated factors. Secondly, a few variables were not reported. However, as explained in the methods section, the missingness of our data could be considered to be completely at random, primarily due to an error during the data upload process in the registers, introducing no or minimal bias in our results. However, we recommend interpreting our results cautiously as it was impossible to verify the reason for the data missingness. Thirdly, our results might not be reliably applied to other forms of exercise (e.g., unsupervised home exercise) due to the specific research question of our study. Finally, 'physical activity hours', 'number of painful joints', and 'living alone', were found to be associated with medium but not high levels of adherence. However, this result may be influenced by chance and could also be attributed to the *ad hoc* adherence categorisation adopted in the SOAR. Bearing in mind the limits of this study, it is worth highlighting that we reported the results of roughly 20,000 people with OA, followed by physiotherapists in the Swedish national healthcare system that tailored their intervention to patients' needs and characteristics. The size and data quality of our study strengthens its clinical importance and relevance for research.

To conclude, strategies based on demographic and lifestyle, socioeconomic and disease-related factors are unlikely to improve exercise adherence significantly. Other elements, such as mindsets and contextual factors, need to be investigated. Moreover, as booster sessions, reminders, and behavioural-change techniques seem to improve exercise adherence (58,59), we should also understand how they motivate people to partake in exercise. Considering the complexity of adherence and the types of treatments that have succeeded in improving it so far, there is a call for solutions that go beyond a 'one-size-fits-all' approach, accept humans' variability and uncertainty, and foster tailored interventions for individuals.

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Tables

Table 1. Descriptive Statistics

Variables	Total Sample (n=19,750)	Low Levels of Adherence (n=5,862)	Medium Levels of Adherence (n=3,947)	High Levels of Adherence (n=9,941)
		Demographic and Lifestyle Characteristics		
Assigned Sex (at Birth)	n=19,750	n=5,862	n=3,947	n=9,941
Male (n(%))	5,421 (27.45)	1,519 (25.91)	925 (23.44)	2,977 (29.95)
Female (n(%))	14,329 (72.55)	4,343 (74.09)	3,022 (76.65)	6,964 (70.05)
Age	n=19,750	n=5,862	n=3,947	n=9,941
Mean(SD)	66.86 (8.94)	65.87 (9.39)	66.47 (9.01)	67.60 (8.57)
BMI	n=19,381	n=5,735	n=3,867	n=9,779
(Mean(SD))	27.56 (4.76)	27.73 (4.90)	27.75 (4.89)	27.43 (4.63)
HRQoL (EQ5DVAS, 0-100)	(n=17,933)	n=5,317	n=3,592	n=9,024
(Mean(SD))	65.82 (19.22)	65.84 (19.37)	65.74 (19.35)	65.85 (19.07)
Weekly Physical Activity (hour)	n=18,050	n=5,364	n=3,606	n=9,080
(Mean(SD))	4.11 (2.53)	4.14 (2.53)	4.03 (2.49)	4.13 (2.54)
		Socioeconomic Characteristics		
Institutionally-Based Education Level (n)	n=19,699	n=5,862	n=3,938	n=9,918
Low (n(%))	4,331 (21.99)	1,170 (20.02)	795 (20.19)	2,366 (23.86)
Medium (n(%))	9,843 (49.97)	2,962 (50.69)	2,007 (50.96)	4,874 (49.14)
High (n(%))	5,525 (28.05)	1,711 (29.28)	1,136 (28.85)	2,678 (27.00)
Income – Quartile (n)	n=19,738	n=5,858	n=3,945	n=9,935
Lowest Income Quartile (n(%))	4,942 (25.04)	1,345 (22.96)	1,022 (25.91)	2,575 (25.92)
Second Income Quartile (n(%))	4,936 (25.01)	1,393 (23.78)	982 (24.89)	2,561 (25.78)
Third Income Quartile (n(%))	4,929 (24.97)	1,517 (25.90)	976 (24.74)	2,436 (24.52)
Highest Income Quartile (n(%))	4,931 (24.98)	1,603 (27.36)	965 (24.46)	2,363 (23.78)
Area of Living (n)	n=19,738	n=5,858	n=3,945	n=9,935
Rural (n(%))	6,047 (30.64)	1,667 (28.46)	1,180 (29.91)	3,200 (32.21)
Suburban (n(%))	8,252 (41.81)	2,435 (41.57)	1,708 (43.30)	4,109 (41.36)
Urban (n(%))	5,439 (27.56)	1,756 (29.98)	1,057 (26.79)	2,626 (26.43)
Employment (n)	n=19,738	n=5,858	n=3,945	n=9,935
Unemployed (n(%))	12,244 (62.03)	3,275 (55.91)	2,394 (60.68)	6,575 (66.18)
Employed (n(%))	7,494 (37.97)	2,583 (44.09)	1,551 (39.32)	3,360 (33.82)
Living Alone (n)	n=19,738	n=5,858	n=3,945	n=9,935
Living Alone (n(%))	7,754 (39.28)	2,411 (41.16)	1,457 (36.93)	3,886 (39.11)
Living with Someone (n(%))	11,984 (60.72)	3,447 (58.84)	2,488 (63.07)	6,049 (60.89)
		Disease-Related Characteristics		
Worst Joint (n)	n=19,750	n=5,862	n=3,947	n=9,941
Hip (n(%))	6,049 (30.63)	1,708 (29.14)	1,188 (30.10)	3,153 (31.72)
Knee (n(%))	13,701 (69.37)	4,154 (70.86)	2,759 (69.90)	6,788 (68.28)
Pain Intensity (NRS 0-10)	n=19,686	n=5,843	n=3,935	n=9,908
(Mean(SD))	5.25 (1.83)	5.23 (1.85)	5.24 (1.87)	5.26 (1.80)
Pain Frequency (n)	n=19,700	n=5,842	3,940	n=9,918
Infrequent (n(%))	3,436 (17.44)	1,100 (18.83)	723 (18.35)	1,613 (16.26)
Frequent (n(%))	16,264 (82.56)	4,742 (81.17)	3,217 (81.65)	8,305 (87.34)
Number of Painful Joints	n=19,750	n=5,862	n=3,947	n=9,941
(Mean(SD))	1.94 (1.29)	1.95 (1.28)	2.00 (1.32)	1.91 (1.27)
Charnley Score (n)	n=19,735	n=5,855	n=3,946	n=9,934
A (n(%))	6,814 (34.53)	2,000 (34.16)	1,340 (33.96)	3,474 (34.97)
B (n(%))	3,437 (17.42)	1,009 (17.23)	686 (17.38)	1,742 (17.54)
C (n(%))	9,484 (48.06)	2,946 (48.61)	1,920 (48.66)	4,718 (47.49)
Walking Difficulties (n)	n=19,651	n=5,835	n=3,932	n=9,884
No (n(%))	3,472 (17.67)	1,105 (18.94)	731 (18.59)	1,636 (16.55)
Yes (n(%))	16,179 (82.33)	4,730 (81.06)	3,201 (81.41)	8,248 (83.45)
Fear of Movement (n)	n=19,651	n=5,821	n=3,928	n=9,902
No (n(%))	16,562 (84.28)	4,871 (83.68)	3,303 (84.09)	8,388 (84.71)
Yes (n(%))	3,089 (15.72)	950 (16.32)	625 (15.91)	1,514 (15.29)

Desire for Surgery (n)	n= 19,558	n=5,798	n=3,906	n=9,854
No (n(%))	14,936 (76.37)	4,441 (76.60)	3,017 (77.24)	7,478 (75.89)
Yes (n(%))	4,622 (23.63)	1,357 (23.40)	889 (22.76)	2,376 (24.11)
Arthritis-Specific Self-Efficacy (ASES Pain and Symptoms, 0-100)	n=19,149	n=5,660	n=3,834	n=9,655
(Mean(SD))	65.54 (16.43)	65.44 (16.54)	65.51 (16.62)	65.61 (16.28)

* To calculate the missing values, subtract the number of participants listed in the second column (labelled 'Total Sample') from the total sample size of 19,750. Legend: n, number; SD, standard deviation; HRQoL, health-related quality of life; EQ5DVAS, EuroQol-5D Health Visual Analogue Scale; OA, osteoarthritis; NRS, numeric rating scale; ASES, Arthritis Self-Efficacy Scale.

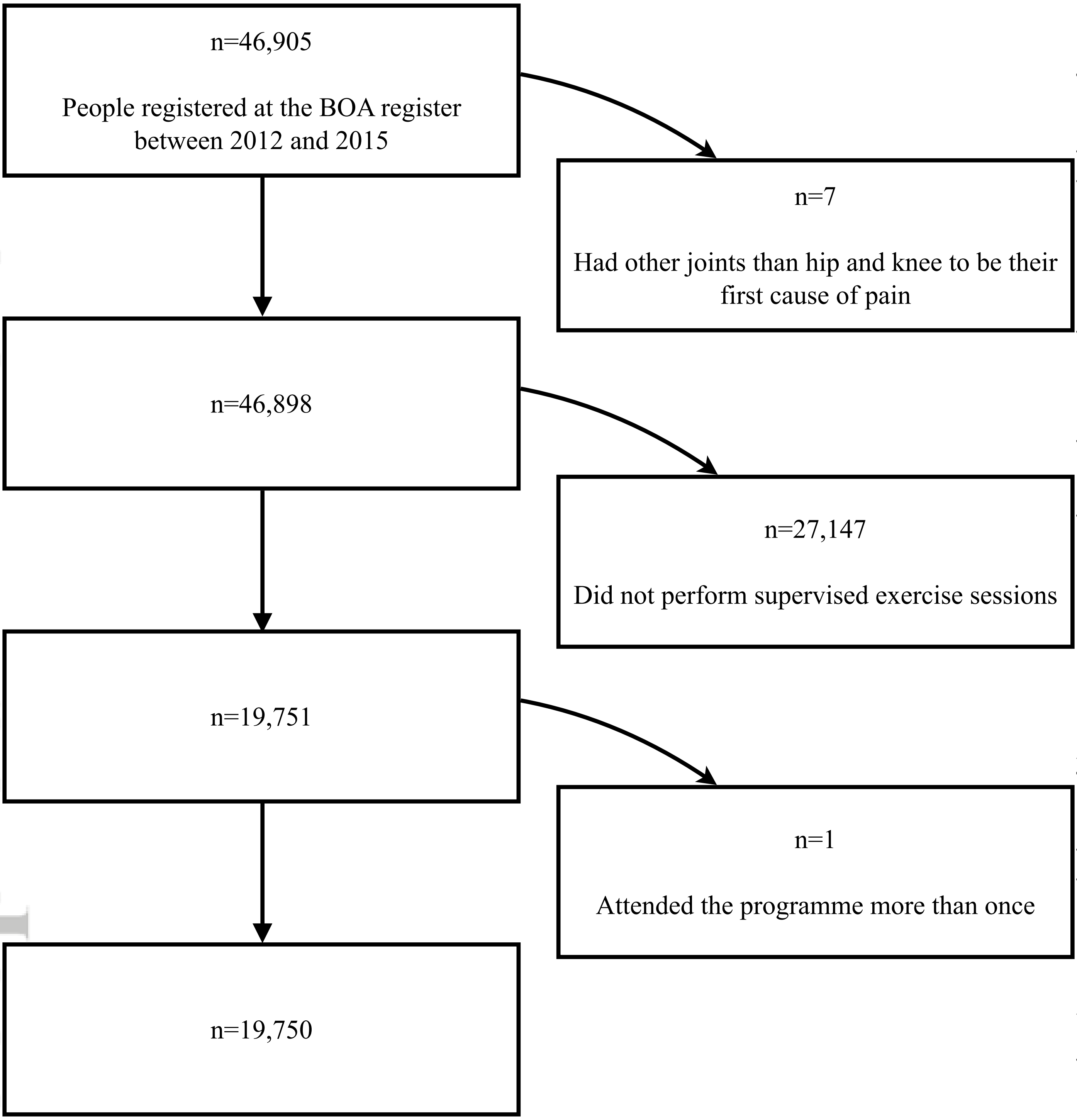
Table 2 Association between Exercise Adherence and Investigated Factors

n=16,685	Variables	p-value	Relative Risk Ratio (RRR)	95% C.I. for EXP(B) Lower	Upper
Low Levels of Adherence		(Reference)			
Medium Levels of Adherence					
	Assigned Sex (at Birth)				
	Male		(Base Category)		
	Female	0.03	1.13	1.02	1.27
	Age	0.14	1.00	0.99	1.01
	BMI	0.37	0.99	0.99	1.01
	HRQoL (EQ5DVAS, 0-100)*	0.57	0.99	0.97	1.02
	Weekly Physical Activity (hour)	0.02	0.98	0.96	0.99
	Institutionally-Based Education Level				
	Low		(Base Category)		
	Medium	0.88	0.99	0.88	1.12
	High	0.63	0.97	0.84	1.11
	Income – Quartile				
	Lowest Income Quartile		(Base Category)		
	Second Income Quartile	0.71	0.98	0.86	1.11
	Third Income Quartile	0.63	0.97	0.84	1.11
	Highest Income Quartile	0.41	0.94	0.81	1.09
	Area of Living				
	Rural		(Base Category)		
	Suburban	0.27	0.94	0.85	1.05
	Urban	0.02	0.87	0.78	0.98
	Employment				
	Unemployed		(Base Category)		
	Employed	<0.01	0.82	0.72	0.93
	Living Alone				
	Living Alone		(Base Category)		
	Living with Someone	<0.01	1.21	1.10	1.32
	Worst Joint				
	Hip		(Base Category)		
	Knee	0.35	0.95	0.86	1.05
	Pain Intensity (NRS 0-10)	0.49	1.01	0.98	1.04
	Pain Frequency				
	Infrequent		(Base Category)		
	Frequent	0.80	0.98	0.87	1.11
	Number of Painful Joints	0.01	1.06	1.01	1.10
	Charnley Score				
	A		(Base Category)		
	B	0.99	0.99	0.97	1.15
	C	0.13	0.91	0.81	1.03
	Walking Difficulties				
	No		(Base Category)		
	Yes	0.93	0.99	0.88	1.13
	Fear of Movement				
	No		(Base Category)		

	Yes	0.49	1.04	0.92	1.18
	Desire for Surgery				
	No		(Base Category)		
	Yes	0.26	0.94	0.83	1.05
	Arthritis-Specific Self-Efficacy (ASES Pain and Symptoms, 0-100)*	0.29	1.02	0.99	1.05
High Levels of Adherence					
	Assigned Sex (at Birth)				
	Male		(Base Category)		
	Female	<0.01	0.82	0.75	0.89
	Age	<0.01	1.01	1.01	1.02
	BMI	0.01	0.99	0.98	0.99
	HRQoL (EQ5DVAS, 0-100)*	0.18	0.98	0.96	1.01
	Weekly Physical Activity (hour)	0.79	0.99	0.98	1.01
	Institutionally-Based Education Level				
	Low		(Base Category)		
	Medium	0.02	0.89	0.81	0.98
	High	<0.01	0.84	0.76	0.94
	Income – Quartile				
	Lowest Income Quartile		(Base Category)		
	Second Income Quartile	0.79	1.01	0.91	1.13
	Third Income Quartile	0.61	1.03	0.92	1.15
	Highest Income Quartile	0.95	1.00	0.89	1.14
	Area of Living				
	Rural		(Base Category)		
	Suburban	<0.01	0.79	0.73	0.86
	Urban	<0.01	0.78	0.71	0.86
	Employment				
	Unemployed		(Base Category)		
	Employed	<0.01	0.71	0.64	0.78
	Living Alone				
	Living Alone		(Base Category)		
	Living with Someone	0.29	1.04	0.97	1.12
	Worst Joint				
	Hip		(Base Category)		
	Knee	0.03	0.92	0.85	0.99
	Pain Intensity (NRS 0-10)	0.12	1.02	0.99	1.04
	Pain Frequency				
	Infrequent		(Base Category)		
	Frequent	0.02	1.13	1.02	1.25
	Number of Painful Joints	0.50	1.01	0.98	1.05
	Charnley Score				
	A		(Base Category)		
	B	0.74	1.02	0.91	1.14
	C	0.11	0.93	0.84	1.02
	Walking Difficulties				
	No		(Base Category)		
	Yes	0.03	1.12	1.01	1.24
	Fear of Movement				

No		(Base Category)		
Yes	0.93	1.00	0.91	1.11
Desire for Surgery				
No		(Base Category)		
Yes	0.44	0.96	0.88	1.06
Arthritis-Specific Self-Efficacy (ASES Pain and Symptoms, 0-100)*	<0.01	1.04	1.02	1.07

Legend: n, number; EQ5DVAS, EuroQol-5D Health Visual Analogue Scale; *, RRR is reported as an increase of 10 points in the scale; OA, osteoarthritis; NRS, numeric rating scale; ASES, Arthritis Self-Efficacy Scale.


n=46,905
People registered at the BOA register between 2012 and 2015
n=7
Had other joints than hip and knee to be their first cause of pain
n=46,898
n=27,147
Did not perform supervised exercise sessions
n=19,751
n=1
Attended the programme more than once
n=19,750