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Evaluation of potentially modifiable physical factors as predictors of health status in knee osteoarthritis patients referred for physical therapy

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ABSTRACT

Objective: The purpose of this cross sectional study was to estimate the contributions of potentially modifiable physical factors to variation in joint-specific and generic physical health status in knee osteoarthritis (OA) patients referred for physical therapy.

Methods: The Knee injury and Osteoarthritis Outcome Score (KOOS), Knee Outcome Survey - Activities of Daily Living Scale (KOS-ADLS) and Medical Outcomes Study - 36 item Short Form (SF-36) questionnaires, and a battery of tests to assess physical factors (body mass index (BMI), visual analog scale (VAS) of pain intensity, isometric dynamometry, universal goniometry, step test (ST), timed "up and go" test (TUGT), 20-meter walk test (20MWT), 6-minute walk test (6MWT)) were administered to 136 subjects with symptomatic knee OA (94 females, 42 males; age: 67.2 ± 7.1 years).

Results: Multiple stepwise regression analyses revealed that knee muscle strength, VAS of pain intensity, 6MWT, degree of knee flexion and BMI were significant predictors of at least two dimensions of knee-specific or generic physical health status. In the final models, the values of adjusted R^2 indicated that the selected combinations of these potentially modifiable physical factors explained 22.3% to 37.1% of the variance in KOOS subscales scores, 40.2% of the variance in KOS-ADLS scale score, and 20.8% to 34.0% of the variance in physical health SF-36 subscales scores.

Conclusion: Physical therapists could take into consideration these moderate predictors of health status, albeit in an indirect way, to get a somewhat broader perspective on the impact of knee OA on their patients.

Key words: Knee, Osteoarthritis, Physical factors, Health status.

Running title: Potentially modifiable physical factors as predictors of health status

INTRODUCTION

Knee osteoarthritis (OA) is an important cause of severe pain and functional limitation. This clinical condition has negative effects on several aspects of health resulting in an increased need for appropriate health care interventions [1]. Physical therapy plays an active role in the conservative management of knee OA [2]. Research on the outcomes of physical therapy in knee OA patients indicates that exercise and weight reduction, in particular, are widely recognized as effective interventions to relieve pain and restore physical function [3].

Self-reported measures of health status reflect the perceived impact of a specific clinical condition on individuals and are therefore extensively used in research to assess the outcomes of health care interventions [4, 5]. Joint-specific self-reported questionnaires (e.g., Knee injury and Osteoarthritis Outcome Score (KOOS) [6, 7], Knee Outcome Survey - Activities of Daily Living Scale (KOS-ADLS) [8]), as well as generic self-reported questionnaires (e.g., Medical Outcomes Study - 36 item Short Form (SF-36) [9-11]), can be used to measure health status in knee OA patients, since they include assessments of the perceived impact of pain and functional limitation on activities of daily living. However, in general, self-reported measures of health status are still not commonly used in clinical practice [12]. In this context, body functions and structure oriented measures are most typically used. Examples of these measures, which can be used during the physical examination of knee OA patients, include: body mass index (BMI), visual analog scale (VAS) of pain intensity, isometric dynamometry, universal goniometry, step test (ST), timed “up and go” test (TUGT), 20-meter walk test (20MWT) and 6-minute walk test (6MWT). The specific and standardized tasks that patients are asked to complete using these measures, particularly performance-based measures (e.g., ST, TUGT, 20MWT, 6MWT), may not reflect the true demands of activities of daily living [13]. This is one of the reasons that explains why only a moderate correlation exists between self-reported and performance-based measures [13].

If physical therapists were able to get a broader perspective on the impact of knee OA on patients based on routinely collected physical examination findings, increasing their understanding of what and how physical examination findings contribute to the different dimensions of health status and whether physical examination findings vary in their importance, it might be helpful in designing specific and effective therapeutic interventions for individual patients. Physical factors that are potentially modifiable through exercise and weight reduction (e.g., BMI, pain intensity, knee muscle strength, knee joint motion, balance, mobility, walking speed, exercise capacity) would be of particular interest for this purpose since they can be targeted by physical therapy.

Maly et al. [14-16] estimate the contributions of selected combinations of variables to variation in performance-based and self-reported measures in knee OA patients: functional self-efficacy, quadriceps strength, BMI and pain self-efficacy accounted for 62.0% of the variance in the scores of the 6MWT; functional self-efficacy, quadriceps strength and BMI accounted for 63.2% of the variance in the scores of the TUGT; and functional self-efficacy and hamstrings strength accounted for 52.7% of the variance in the scores of a stair-climbing task [14]; knee flexion-extension range of motion during gait and BMI accounted for 29% of the variance in the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC [17]) pain subscale scores [15]; pain (WOMAC pain subscale) and quadriceps strength accounted for 73.1% of the variance in the WOMAC physical functioning subscale scores; and pain (WOMAC pain subscale), hamstring strength and depression accounted for 62.9% of the variance in the

SF-36 total scores [16]. However, these studies were not limited to variables commonly used in clinical practice as potentially predictor variables. Additionally, some dimensions of self-reported health status (e.g., WOMAC pain subscale) were used as potentially predictor variables of other dimensions of self-reported health status (e.g., WOMAC physical functioning subscale).

The objective of this paper was to estimate the contributions of potentially modifiable physical factors to variation in joint-specific and generic physical health status in knee OA patients referred for physical therapy. It was hypothesized that a moderate proportion of the variance in health status would be explained by potentially modifiable physical factors.

METHODS

Subjects

The sample consisted of consecutive patients with symptomatic knee OA referred for physical therapy at 11 Portuguese outpatient health care institutions during a 12-month period. Subjects were selected after obtaining informed consent and checking the inclusion and exclusion criteria. To be included in this cross sectional study, subjects had to have a diagnosis of uni- or bilateral knee OA according to the clinical and radiographic criteria of the American College of Rheumatology [18], to have a Kellgren-Lawrence grade of 2 (minimal) or 3 (moderate) [19] based on plain radiographs taken within one year before inclusion, to experience knee pain, to be aged between 50 and 80 years and to be referred to a physical therapy intervention for the knee. Subjects with severe OA (Kellgren-Lawrence grade 4) were excluded because of the increased likelihood of failing to complete the study measurements, especially the physical tests. Subjects older than 80 years were excluded because of the increased likelihood of comorbidity. Subjects were also excluded if they had received physical therapy interventions (for the knee) within the previous 30 days, had other disease of the bones and joints of the lower limb, cardiovascular or pulmonary disease, neurological disease, or any other disabling condition (e.g., back problems or widespread pain) or due to illiteracy. All outpatient health care institutions obtained approval from their respective review boards.

Measurements

Measurements were carried out in the physical therapy departments of the above mentioned outpatient health care institutions. The subjects were assessed in a single session, before initiating the physical therapy intervention. In case of bilateral involvement, the unilateral measurements were always taken only on the more painful knee. A form was used to acquire subject information on gender, age, involved knee (knee with OA), duration of knee OA and walking aids. The measures mentioned below in this section were used to collect data on potentially modifiable physical factors and on knee-specific and generic health status. The chosen physical tests are commonly used in both research and clinical practice. The same investigator (RSG), a physical therapist, conducted all measurements (using the same portable equipment and methods), except radiographic grading of OA. All radiographs were read by another investigator (JPP), a physical medicine and rehabilitation physician, using the Kellgren-Lawrence grading scale [19]. The physical tests were performed in a random order with an approximately 5 min rest period in between. The health status questionnaires were self-administered either before or after physical tests on a random basis.

Potentially modifiable physical factors measurements

BMI was used as a measure of body size (in $kg.m^{-2}$). The BMI was derived from measured weight and height. The World Health Organization defined BMI normal range is 18.50 to 24.99 $kg.m^{-2}$ [20].

A VAS was used to measure knee pain intensity. The VAS ranges from 0 (no pain) to 100 mm (extreme pain). The VAS has been demonstrated to be reliable and valid to assess musculoskeletal knee pain [21].

Maximum isometric knee muscle strength was measured with a computerized strain gauge dynamometer (Digimax, Hamburg, Germany), with the subject comfortably seated, and the hip and knee flexed to 90º. The maximum isometric knee extensor and flexor strength were recorded. For each of the two muscle groups, the highest obtained value (in N) of three consecutive trials was defined as the maximal isometric force. A comparable isometric strength testing device has been shown to demonstrate discriminant validity and high test-retest reliability in knee OA patients [22].

The measurements of the active assisted knee joint motion (in º) were taken with a standard plastic 360º universal goniometer (Gymna, Bilzen, Belgium) with 50 cm movable arms, according to the procedures outlined by Norkin and White [23]. The degrees of maximal extension and flexion were recorded. A negative degree of extension means that the subject was unable to reach the zero position. Goniometric measurements of knee join motion have been shown to be reliable and valid [24].

The ST, a measure with known reliability and validity, was used to evaluate dynamic standing balance [25]. A previous study has shown that this test can detect balance deficits in knee OA patients [26]. Subjects were instructed to keep the balance on the involved lower limb, without hand support, while stepping the contralateral foot on and off a 15 cm high step, as fast as possible. The number of times (n) the subject could place the foot fully on the step and return it fully back to the floor during a 15 s period was recorded.

The TUGT was used to assess basic functional mobility [27]. Subjects were instructed to rise from a chair (with armrest), walk 3 m, turn around, walk back and sit down in a self-selected speed. The time required to complete the task was recorded (in s). The TUGT have been proven to be a reliable and valid performance-based test of mobility in older adults [27].

The 20MWT was used to assess walking speed [28]. Subjects were instructed to walk a 20 m distance at a self-paced speed. The walking speed (in $m.s^{-1}$) was calculated from the measured time required to walk a 20 m long indoor track. Self-paced walking time measures have been shown to be reliable and valid in reflecting functional performance in knee OA patients [29].

The 6MWT, a measure with well established reliability and validity, was used to assess functional exercise capacity [30]. Patients were instructed to walk at their own pace for 6 min. The 6MWT was recorded in a 20 m long indoor track. The distance covered during 6 min was recorded (in m). The 6MWT has been used to measure physical function in OA patients [31].

During the performance of the TUGT, 20MWT and 6MWT walking aids were permitted if needed.

Knee-specific and generic health status measurements

The KOOS [6, 7], a joint-specific measure of perceived health status, contains 42 items which cover five subscales: pain, other symptoms, function in daily living, function in sport and recreation, and knee-related quality of life. A score, from 0 (extreme problems) to 100 (no problems), is separately produced for each subscale [32]. The KOOS was cross-culturally adapted and validated for use in Portugal [33].

The KOS-ADLS [8], another joint-specific measure of perceived health status, contains 17 items which assess symptoms (pain, crepitus, stiffness, swelling, instability and weakness) and the functional disability that could be felt during the performance of daily living activities (walking, stairs ascending/descending, standing, kneeling, squatting, chair sitting/rising). A score, from 0 (lower level of function) to 100 (higher level of function), is produced for the scale [8]. The KOS-ADLS was cross-culturally adapted and validated for use in Portugal [34].

The SF-36 [9-11], a generic measure of perceived health status, contains 36 items that covers eight subscales. The physical functioning, role-physical and bodily pain subscales correlate most highly with physical health, the social functioning, role-emotional and mental health subscales correlate most highly with mental health, and the general health and vitality subscales correlate moderately with both physical and mental health [10]. A score, from 0 (worst possible health status) to 100 (best possible health status), is independently produced for each subscale [35]. The SF-36 was cross-culturally adapted and validated for use in Portugal [36, 37].

Statistical analyses

Continuous variables were described using mean and standard deviation values whereas categorical variables were described using frequency and percentage values.

Multiple regression analyses were used to estimate the contributions of different independent variables to variation in a dependent variable. The five KOOS subscales, the KOS-ADLS scale and the three purely physical health SF-36 subscales (physical functioning, role-physical and bodily pain) were used as dependent variables. Separate models were run for each dependent variable. The BMI, VAS of pain intensity, knee extensor and flexor strength, degrees of knee extension and flexion, ST, TUGT, 20MWT and 6MWT were used as independent variables.

The multiple regression analyses were carried out in two phases. In the first phase, Pearson's correlations were used to assess the univariate association between all independent variables and each dependent variable. A P value of 0.20 [38] was accepted as the level of significance to assure that potentially relevant independent variables were not excluded at this phase. In the second phase, all independent variables that were significantly univariately associated with each dependent variable were entered into multiple stepwise regression models (with stepping method criteria of probability of F to enter $\leq$ 0.05 and F to remove $\geq$ 0.10). However, if two potentially relevant independent variables were highly correlated ($|r| \geq 0.80$) [39], then the independent variable with lower correlation with the dependent variable was dropped from the model. All models met the assumptions of multiple regression in terms of linearity, homoscedasticity, normality, independence and non-multicollinearity.

All statistical analyses were conducted using SPSS 15.0 for Windows.

RESULTS

A total of 136 patients participated in this study. The descriptive statistics are presented in Tables I and II. A total score could be obtained for all KOOS and SF-36 subscales, and for KOS-ADLS scale for all patients.

<Please insert Table I here>

<Please insert Table II here>

Table III displays the correlation coefficients between health status and potentially modifiable physical factors, and highlights the potentially relevant physical factors that were statistically significantly correlated with each KOOS subscale, KOS-ADLS scale and SF-36 physical health subscales and, consequently, were entered into multiple stepwise regression models. Two potentially relevant independent variables, 20MWT and 6MWT, were highly correlated with each other ($r = 0.86$) (Table IV). Because 20MWT demonstrated lower correlations with all dependent variables (Table III), this variable was dropped from all models.

<Please insert Table III here>

<Please insert Table IV here>

Tables V and VI show the multiple stepwise regression models of knee-specific and generic physical health status, respectively. In the final models, the values of adjusted

R^2 indicated that potentially modifiable physical factors explained 22.3% to 37.1% of the variance in KOOS subscales scores and 40.2% of the variance in KOS-ADLS scale score. In the final models, the values of adjusted R^2 indicated that potentially modifiable physical factors explained 20.8% to 34.0% of the variance in purely physical health SF-36 subscales scores. While degree of knee extension, ST and TUGT were significantly correlated with all dependent variables ($P \leq 0.05$) (Table III), they were not significant predictors of scores for any of these variables (Tables V and VI).

Finally, from Table IV, note that extensor and flexor knee strength demonstrated a relatively large significant positive correlation (r = 0.64), while degrees of knee extension and flexion demonstrated a relatively small significant positive correlation (r = 0.27). Note also that the performance-based tests demonstrated relatively large significant positive correlations between them (6MWT vs. ST, r = 0.68; 6MWT vs. TUGT, r = 0.77).

<Please insert Table V here>

<Please insert Table VI here>

DISCUSSION

In this paper we assessed the contributions of potentially modifiable physical factors to variation in joint-specific and generic physical health status in knee OA patients referred for physical therapy. As hypothesized, a moderate proportion of the variance in health status was explained by potentially modifiable physical factors. More specifically, muscle strength, pain intensity, exercise capacity, joint flexion motion and BMI were shown to be moderate predictors of health status. Thus, in clinical practice, physical therapists could take into consideration these physical factors, albeit in an indirect way, to get a somewhat broader perspective on the impact of knee OA on their patients.

Muscle strength, pain intensity, exercise capacity, joint flexion motion and BMI were significant predictors of knee-specific health status, whereas muscle strength, pain intensity, exercise capacity and joint flexion motion were significant predictors of generic physical health status. In fact, with the exception of BMI, the same physical factors were predictors of both knee-specific and generic measurements of health status. Moreover, muscle strength and pain intensity were significant predictors of a greater number of health status dimensions, when compared with exercise capacity, joint flexion motion and BMI. Not surprisingly, muscle strength and pain intensity were both predictors of almost all studied dimensions of health status, confirming their relevance to knee OA. Interestingly, the two purely pain health status dimensions (KOOS pain subscale and SF-36 bodily pain subscale) were predicted by the same combination of physical factors (pain intensity and knee flexor strength). On the contrary, degree of knee extension, ST and TUGT did not contribute any significant additional variance to the studied dimensions of health status. The direction of the relationships between health status and potentially modifiable physical factors is plausible and consistent with prior research in knee OA [14-16, 40-44].

Knee muscle weakness, in particular quadriceps weakness, has been associated with pain and disability in knee OA [40, 41]. Like in our study, Maly et al. [16] also verified that either knee extensor strength or knee flexor strength, isokinetically measured, were determinants of important dimensions of osteoarthritis-specific and generic health status. Our findings corroborate that the strength of the different muscles around the knee was related with health status in knee OA patients. Nevertheless, quadriceps weakness is generally considered much more important than hamstrings weakness in knee OA patients [40]. However, our results indicate that the knee extensors were twice as strong as the flexors. It should be emphasized that these results were probably influenced by active insufficiency of the hamstrings due to the testing position (with the knee flexed at 90º).

Pain intensity has been also identified as an important predictor of physical functioning in knee OA [42]. This is in line with our study which found that higher pain intensity predicted worst scores in all but one studied dimensions of health status. This finding suggests that the higher the pain intensity, the higher the pain interference with knee-specific and generic physical health status. At first sight, it might be expected that a higher correlation would be found between VAS of pain intensity and KOOS pain subscale, and SF-36 bodily pain subscale. Two reasons must be considered to explain the magnitude of the correlations that were obtained: the VAS assesses the intensity of knee pain, while the KOOS pain subscale and SF-36 bodily pain subscale assess the impact of pain (knee-specific and generic, respectively) on activities of daily living; the VAS, KOOS and SF-36 subscales consider different observation periods (today, past week and past 4 weeks, respectively).

In a consistent manner, the exercise capacity (measured with 6MWT) was a predictor of health status dimensions that contain items related to walking ability or related to role-physical limitations (including reduction of time spent on work or other activities). The other performance-based tests were not significant predictors of health status. However, due to their relatively large significant positive correlations with 6MWT it seems that they can give approximately equivalent information. It has been shown that performance-based tests, more specifically the 6MWT, the TUGT and a stair-climbing task, are influenced in general by the same psychosocial and mechanical variables in knee OA patients [14]. Interestingly, Briem et al. [43] suggest that a functional index, calculated by dividing 6MWT scores by KOS-ADLS scores at baseline, may be a simple measure to predict treatment response in knee OA patients.

The knee flexion motion was a predictor of health status dimensions related with knee symptoms (other than pain), knee-related quality of life and generic role-physical. These findings suggest that reduced knee flexion interferes not only with the ability to bend the knee but also with the sense of well-being, and with the ability to work or perform usual physical activities. The joint extension motion did not appear to have the same importance to knee OA. Steultjens et al. [44] evaluated the relationship between range of motion and disability in patients with knee or hip OA and concluded that flexion of the knee, and extension and external rotation of the hip appear to be important determinants of disability. Briem et al. [43] also found an association between knee flexion range of motion and self-reported and tested function, and an association between improvements in range of motion and improvements in other functional measures.

The BMI was a predictor of knee-specific health status dimensions that contain items related with demanding physical activities, like e.g. squatting and kneeling. This finding suggests that knee function in demanding physical activities may be more striking to patients with a higher BMI. Other studies identified BMI as predictive of pain [15] and function [14] in knee OA.

The selected combinations of significant predictors of health status cumulatively explained 22.3% to 37.1% of the variance in KOOS subscales scores, 40.2% of the variance in KOS-ADLS scale score, and 20.8% to 34.0% of the variance in physical health SF-36 subscales scores. Overall, the percentage of explained variance was higher for the knee-specific than for the generic health status measurements. This seems to be intuitively obvious since, comparing with generic measures, site-specific measures contain items that are more relevant for patients with a health problem in a specific body region [5]. Additionally, the percentage of explained variance was higher for the KOS-ADLS scale than for the five KOOS subscales. This also seems to be intuitively correct since KOS-ADLS aggregates symptoms and functional disability into a composite score whereas KOOS addresses pain, other symptoms, function in daily living, function in sport and recreation, and knee-related quality of life in separate scores. Nevertheless, these findings suggest that, even for KOS-ADLS scale, some amount of the variance in health status must be explained by other predictors (e.g., frontal plane knee alignment, muscle co-contraction), not collected in this study.

Some limitations of this study should be acknowledged. The sample used may not be representative for the entire population of Portuguese patients with knee OA referred for physical therapy. In fact, this study used a convenience sampling method. Moreover, only a small number of potentially predictor variables were evaluated. Due to the high correlation between two performance-based tests, one potentially relevant independent variable (20MWT) had to be dropped from all multiple stepwise regression models to avoid multicollinearity. Furthermore, there are other physical factors (modifiable or non-modifiable) that might help to explain the variance in knee-specific and generic physical health status. Finally, neither correlation nor prediction necessarily indicates causation. Additionally, the cross-sectional nature of this study precludes any conclusions regarding causation.

In conclusion, muscle strength, pain intensity, exercise capacity, joint flexion motion and BMI were moderate predictors of joint-specific health status, whereas muscle strength, pain intensity, exercise capacity and joint flexion motion were moderate predictors of generic physical health status in knee OA patients referred for physical therapy. Our results suggest that a somewhat broader understanding of the impact of pain and functional limitation (due to knee OA) on activities of daily living can be obtained based on these routinely collected physical examination findings. However, the inclusion of short and meaningful self-reported health status measures into clinical practice may improve individual patient assessment, even assuming that these measures may be limited by recall bias. More research is required in order to evaluate whether therapeutic interventions targeting these potentially modifiable physical factors would improve health status in knee OA patients.

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CONFLICT OF INTEREST

The authors have no conflict of interest to report.

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Table I – Patients' characteristics (N = 136)

Characteristics	Data
Gender	
Female	94 (69.1)
Age (years)	67.2 ± 7.1 (51.0 - 80.0)
Involved knee (knee with OA)	
Bilateral	109 (80.1)
Kellgren-Lawrence grade	
2	87 (64.0)
Duration of knee OA (years)	10.5 ± 8.9 (0.3 - 44.0)
Walking aids	
No aids necessary	123 (90.4)

Continuous variables: mean ± standard deviation (range); Categorical variables: frequency (percentage).

Table II – Potentially modifiable physical factors and knee-specific and generic health status (N = 136)

Variables	Mean ± SD	Range
Potentially modifiable physical factors		
BMI (kg.m^{-2})	30.1 ± 4.9	19.1 - 47.6
Pain intensity VAS (mm)	38.1 ± 24.1	3.0 - 93.0
Knee extensor strength (N)	196.4 ± 75.1	39.2 - 431.5
Knee flexor strength (N)	99.4 ± 41.6	29.4 - 215.7
Degree of knee extension (º)	-2.3 ± 4.0	-19.0 - 5.0
Degree of knee flexion (º)	124.7 ± 11.9	90.0 - 141.0
ST (n)	9.2 ± 3.3	2.0 - 18.0
TUGT (s)	14.5 ± 6.0	7.3 - 38.3
20MWT (m.s^{-1})	1.0 ± 0.3	0.4 - 1.8
6MWT (m)	349.4 ± 96.1	112.0 - 583.0
Knee-specific health status		
KOOS (points)		
Pain	47.5 ± 19.0	5.6 - 97.2
Other symptoms	51.4 ± 22.3	0.0 - 100.0
Function in daily living	46.8 ± 21.5	5.9 - 100.0
Function in sport and recreation	28.0 ± 27.6	0.0 - 100.0
Knee-related quality of life	37.5 ± 24.6	0.0 - 100.0
KOS-ADLS (points)	55.5 ± 20.9	3.8 - 98.8
Generic health status		
SF-36 (points)		
Physical functioning	43.2 ± 22.5	0.0 - 100.0
Role-physical	47.5 ± 27.1	0.0 - 100.0
Bodily pain	39.2 ± 20.5	0.0 - 84.0
General health	40.3 ± 16.6	0.0 - 80.0
Vitality	44.7 ± 19.7	0.0 - 100.0
Social functioning	61.9 ± 23.4	12.5 - 100.0
Role-emotional	54.3 ± 29.4	0.0 - 100.0
Mental health	51.2 ± 24.7	0.0 - 100.0

KOOS, KOS-ADLS and SF- 36 are 0-100 points, worst to best.

Table III – Correlation coefficients between health status and potentially modifiable physical factors (N = 136)

Potentially modifiable physical factors	Health status								
	KOOS subscales (points)					KOS-ADLS scale (points)	SF-36 physical health subscales (points)		
	PA	OS	DL	SR	QL		PF	RP	BP
BMI (kg.m^{-2})	***-0.23***	<u>**-0.32**</u>	***-0.26***	<u>**-0.30**</u>	<u>**-0.34**</u>	<u>**-0.38**</u>	***-0.19***	***-0.20***	***-0.23***
Pain intensity VAS (mm)	<u>**-0.46**</u>	<u>**-0.47**</u>	<u>**-0.49**</u>	<u>**-0.35**</u>	<u>**-0.45**</u>	<u>**-0.46**</u>	<u>**-0.43**</u>	<u>**-0.30**</u>	<u>**-0.41**</u>
Knee extensor strength (N)	<u>**0.34**</u>	<u>**0.32**</u>	<u>**0.35**</u>	***0.23***	<u>**0.31**</u>	<u>**0.32**</u>	<u>**0.29**</u>	<u>**0.32**</u>	<u>**0.29**</u>
Knee flexor strength (N)	<u>**0.39**</u>	<u>**0.37**</u>	<u>**0.49**</u>	<u>**0.38**</u>	<u>**0.44**</u>	<u>**0.41**</u>	<u>**0.47**</u>	<u>**0.34**</u>	<u>**0.36**</u>
Degree of knee extension (º)	***0.19***	***0.24***	***0.20***	***0.24***	<u>**0.27**</u>	<u>**0.30**</u>	<u>**0.28**</u>	***0.26***	***0.18***
Degree of knee flexion (º)	<u>**0.36**</u>	<u>**0.46**</u>	<u>**0.37**</u>	<u>**0.35**</u>	<u>**0.49**</u>	<u>**0.46**</u>	<u>**0.41**</u>	<u>**0.35**</u>	<u>**0.33**</u>
ST (n)	<u>**0.27**</u>	***0.19***	<u>**0.35**</u>	***0.21***	<u>**0.29**</u>	<u>**0.35**</u>	<u>**0.36**</u>	<u>**0.28**</u>	***0.21***
TUGT (s)	***-0.19***	***-0.17***	<u>**-0.34**</u>	<u>**-0.30**</u>	<u>**-0.29**</u>	<u>**-0.36**</u>	<u>**-0.35**</u>	<u>**-0.33**</u>	<u>**-0.28**</u>
20MWT (m.s^{-1})	***0.20***	**0.13**	<u>**0.35**</u>	***0.24***	<u>**0.32**</u>	<u>**0.34**</u>	<u>**0.38**</u>	<u>**0.35**</u>	***0.24***
6MWT (m)	<u>**0.31**</u>	***0.25***	<u>**0.46**</u>	<u>**0.38**</u>	<u>**0.43**</u>	<u>**0.49**</u>	<u>**0.49**</u>	<u>**0.40**</u>	<u>**0.32**</u>

Pearson's correlation coefficients.
PA = Pain; OS = Other symptoms; DL = Function in daily living; SR = Function in sport and recreation; QL = Knee-related quality of life; PF = Physical functioning; RP = Role-physical; BP = Bodily pain.
KOOS, KOS-ADLS and SF-36 are 0-100 points, worst to best.
Significant correlations: $P \leq 0.001$ in bold/underline; $P \leq 0.05$ in bold/italic; $P \leq 0.20$ in bold.

Table IV – Correlation coefficients between potentially modifiable physical factors (N = 136)

Potentially modifiable physical factors	BMI (kg.m^{-2})	Pain intensity VAS (mm)	Knee extensor strength (N)	Knee flexor strength (N)	Degree of knee extension (º)	Degree of knee flexion (º)	ST (n)	TUGT (s)	20MWT (m.s^{-1})	6MWT (m)
BMI (kg.m^{-2})	-	-	-	-	-	-	-	-	-	-
Pain intensity VAS (mm)	**0.28**	-	-	-	-	-	-	-	-	-
Knee extensor strength (N)	0.08	***-0.24***	-	-	-	-	-	-	-	-
Knee flexor strength (N)	-0.08	**-0.35**	**0.64**	-	-	-	-	-	-	-
Degree of knee extension (º)	***-0.18***	**-0.30**	0.10	0.12	-	-	-	-	-	-
Degree of knee flexion (º)	**-0.48**	**-0.41**	***0.17***	**0.35**	**0.27**	-	-	-	-	-
ST (n)	-0.04	***-0.26***	**0.35**	**0.47**	***0.19***	**0.28**	-	-	-	-
TUGT (s)	**0.27**	***0.24***	***-0.21***	**-0.40**	***-0.19***	**-0.27**	**-0.64**	-	-	-
20MWT (m.s^{-1})	***-0.23***	***-0.20***	**0.28**	**0.51**	***0.23***	**0.28**	**0.61**	**-0.76**	-	-
6MWT (m)	***-0.20***	**-0.31**	**0.39**	**0.56**	***0.26***	**0.40**	**0.68**	**-0.77**	**0.86**	-

Pearson's correlation coefficients.
Significant correlations: $P \leq 0.001$ in bold/underline; $P \leq 0.05$ in bold/italic.

Table V – Multiple stepwise regression models of knee-specific health status (N = 136)

Dependent variables	Step	Predictors	Adjusted R^2	F	df	P^*	*Beta*†	$P^‡$
KOOS subscales								
PA	1	Pain intensity VAS (mm)	*0.208*	*36.4*	*1,134*	*< 0.001*	**-0.372**	**< 0.001**
	2	Knee flexor strength (N)	**0.262**	**24.9**	**2,133**	**< 0.001**	**0.259**	**0.001**
OS	1	Pain intensity VAS (mm)	*0.213*	*37.5*	*1,134*	*< 0.001*	**-0.294**	**< 0.001**
	2	Degree of knee flexion (º)	*0.299*	*29.8*	*2,133*	*< 0.001*	**0.311**	**< 0.001**
	3	Knee extensor strength (N)	**0.332**	**23.4**	**3,132**	**< 0.001**	**0.200**	**0.007**
DL	1	Knee flexor strength (N)	*0.235*	*42.6*	*1,134*	*< 0.001*	**0.255**	**0.003**
	2	Pain intensity VAS (mm)	*0.345*	*36.6*	*2,133*	*< 0.001*	**-0.333**	**< 0.001**
	3	6MWT (m)	**0.371**	**27.6**	**3,132**	**< 0.001**	**0.213**	**0.012**
SR	1	Knee flexor strength (N)	*0.135*	*22.1*	*1,134*	*< 0.001*	**0.294**	**< 0.001**
	2	BMI (kg.m^{-2})	*0.202*	*18.1*	*2,133*	*< 0.001*	**-0.224**	**0.005**
	3	Pain intensity VAS (mm)	**0.223**	**13.9**	**3,132**	**< 0.001**	**-0.181**	**0.033**
QL	1	Degree of knee flexion (º)	*0.236*	*42.7*	*1,134*	*< 0.001*	**0.309**	**< 0.001**
	2	Knee flexor strength (N)	*0.312*	*31.6*	*2,133*	*< 0.001*	**0.247**	**0.001**
	3	Pain intensity VAS (mm)	**0.352**	**25.4**	**3,132**	**< 0.001**	**-0.237**	**0.003**
KOS-ADLS scale	1	6MWT (m)	*0.237*	*43.0*	*1,134*	*< 0.001*	**0.297**	**< 0.001**
	2	Pain intensity VAS (mm)	*0.340*	*35.8*	*2,133*	*< 0.001*	**-0.258**	**0.001**
	3	BMI (kg.m^{-2})	*0.384*	*29.0*	*3,132*	*< 0.001*	**-0.262**	**< 0.001**
	4	Knee extensor strength (N)	**0.402**	**23.7**	**4,132**	**< 0.001**	**0.168**	**0.025**

* Statistical significance of the models (all steps).
† Standardized coefficients of the predictors included in the final model.
‡ Statistical significance of the predictors include in the final model.
Data from the final steps in bold. Data from the previous steps in italic.
PA = Pain; OS = Other symptoms; DL = Function in daily living; SR = Function in sport and recreation; QL = Knee-related quality of life.
KOOS and KOS-ADLS are 0-100 points, worst to best.

Table VI – Multiple stepwise regression models of generic physical health status (N = 136)

Dependent variables	Step	Predictors	Adjusted R^2	F	df	P^*	*Beta*[†]	$P^‡$
SF-36 physical health subscales								
PF	1	6MWT (m)	*0.230*	*41.2*	*1,134*	*< 0.001*	**0.278**	**0.002**
	2	Pain intensity VAS (mm)	*0.312*	*31.7*	*2,133*	*< 0.001*	**-0.268**	**0.001**
	3	Knee flexor strength (N)	**0.340**	**24.2**	**3,132**	**< 0.001**	**0.222**	**0.012**
RP	1	6MWT (m)	*0.157*	*26.2*	*1,134*	*< 0.001*	**0.247**	**0.006**
	2	Degree of knee flexion (º)	*0.194*	*17.2*	*2,133*	*< 0.001*	**0.219**	**0.009**
	3	Knee extensor strength (N)	**0.217**	**13.5**	**3,132**	**< 0.001**	**0.184**	**0.028**
BP	1	Pain intensity VAS (mm)	*0.158*	*26.3*	*1,134*	*< 0.001*	**-0.318**	**< 0.001**
	2	Knee flexor strength (N)	**0.208**	**18.7**	**2,133**	**< 0.001**	**0.251**	**0.003**

[*] Statistical significance of the models (all steps).
[†] Standardized coefficients of the predictors included in the final model.
[‡] Statistical significance of the predictors include in the final model.
Data from the final steps in bold. Data from the previous steps in italic.
PF = Physical functioning; RP = Role-physical; BP = Bodily pain.
SF-36 is 0-100 points, worst to best.