Epidemiology of Hip and Knee Pain in a Representative Cohort of Italian Persons Aged 65 and Older

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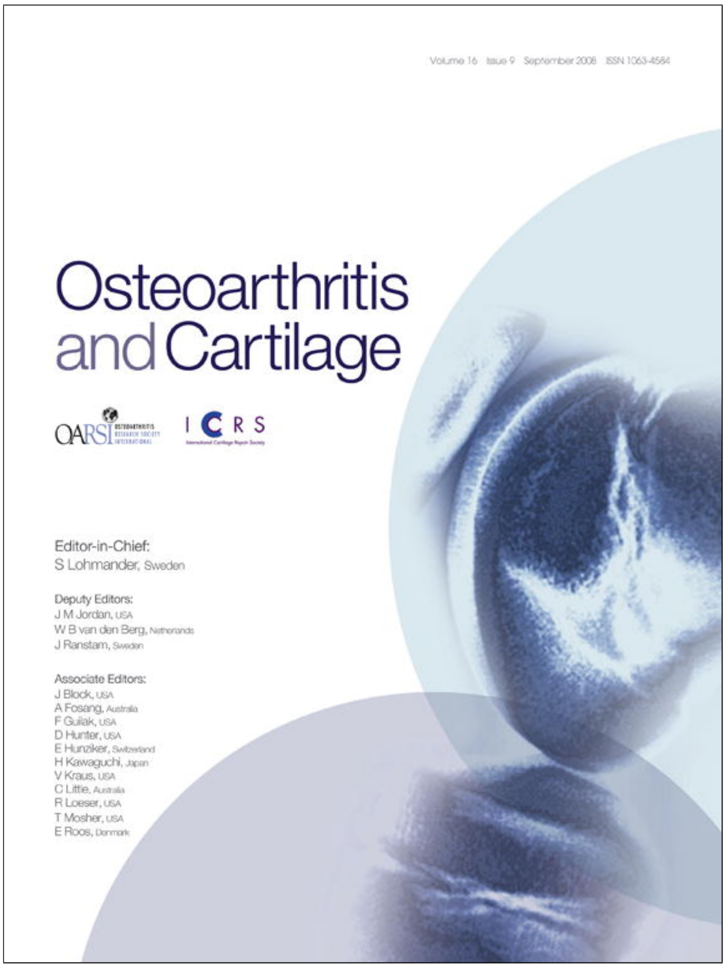
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Epidemiology of hip and knee pain in a community based sample of Italian persons aged 65 and older[1]

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Summary

Objective: To describe prevalence, characteristics and correlates of hip pain (HP) and knee pain (KP) in an Italian community based cohort aged 65 and older (65+).

Method: Baseline survey (1998–2000), population-based study in the Chianti area (Tuscany, Italy); 1299 persons aged 65+ were selected from the city registry of *Greve in Chianti* and *Bagno a Ripoli* (multistage sampling method); 1006 participants (564 women and 442 men, age 75.2 ± 7.1) provided information for this analysis. Persons reporting HP/KP in the past 4 weeks were recorded and their Western Ontario and McMaster University Osteoarthritis Index pain score (WPS-range 0–20) calculated. Potential correlates of HP/KP, including clinical, lifestyle and psycho-social features and physical measures, were tested in age- and gender-adjusted regression analyses and then entered a multivariate regression model.

Results: HP was reported by 11.9% participants, while 22.4% reported KP and 7.2% both conditions. Climbing/descending stairs and walking were the activities eliciting more severe pain in either condition. Average WPSs were 5.6 ± 3.5 for HP and 5.4 ± 10.4 for KP. Both HP and KP were related to back pain, reduced hip abduction, reduced muscle power and increased trunk flexibility. HP was also related to KP and poor self-rated health (SRH), while KP to HP, foot pain, high body mass index, reduced knee passive flexion and knee extension torque, low education.

Conclusion: In a community sample of an Italian persons aged 65+, the prevalence of KP almost doubled that of HP. While both conditions were related to pain in other joints and specific joint impairment, only HP was related to poor SRH, and only KP to mechanical overload.

Key words: Hip pain, Knee pain, Older persons, Prevalence, Correlates.

Introduction

Lower extremity joint pain is highly prevalent in older persons and is considered an important determinant of overall health status in old age[1]. Pain in weight bearing joints may be due to many different causes, including referred or radiated pain, sciatica, soft tissue disease. Joint osteoarthritis (OA) may often be involved. However, evidence is growing that quality of life and disability in OA are more related to symptoms than to radiological severity, and that the relationship between joint pain and reduced mobility is relatively independent from pain etiology[2–4].

At a population level, pain in the lower extremities has been associated with higher disability. Risk factors for musculoskeletal pain include OA and its predictors, such as age, obesity, mechanical overload and muscle weakness[5], along with a wide variety of variables, as overall health status, comorbidity, exercise practice, smoking, depression, poor personal mastery (PM) and low education[1,5–8]. The epidemiology of hip pain (HP) and knee pain (KP) has not been thoroughly investigated in many countries including Italy, and only few studies explore both HP and KP in the same sample[1,8,9]. Further, another issue that is clinically relevant, but rarely addressed in epidemiological studies

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is the relationship of joint symptoms with flexibility and muscle strength.

The present study uses data from the baseline of a large clinical–epidemiological survey to investigate on prevalence and characteristics of HP and KP in an Italian population aged 65 and older, and to explore the cross-sectional association of HP and KP in this sample with a variety of clinical, lifestyle, psycho-social and physical features that have been previously identified as predictors of muscoloskeletal pain at a population level.

Materials and methods

The InCHIANTI Study was designed and conducted by the Italian National Research Council on Aging. A detailed description of the study design is reported elsewhere[10]. In 1998, a representative cohort of persons aged 65 or more (65+) was randomly selected from the registries of *Greve in Chianti* (rural area) and *Bagno a Ripoli* (urban area near Florence) using a multistage sampling method. Baseline data collection (1998–2000) included a structured home interview, instrumental tests (peripheral quantitative computed tomography, surface electroneurography, electrocardiogram, and color-Doppler), laboratory tests, a structured physical examination performed by a geriatrician, and a performance assessment by a physiotherapist. Of the initial sample (1299 persons), 17 men and 22 women were not eligible for the study (died or moved away). In the eligible, participation rate to the interview was 91.6% (1154/1260). The instrumental and clinical evaluation took place in different days, and some persons who were interviewed did not participate to further assessments. Thus 1006 participants (564 women and 442 men, age 75.2 ± 7.1) provided complete information for the variables used in this report (participation rate 80%; 1006/1260). The drop outs were fairly distributed across age and gender classes: altogether, participants to this analysis represented 27% of the whole registry population 65+, and percentage of participants for each 10-year-age and gender class ranged from 22 to 29% of the registry population for each class, with the lowest participation rate in women 85+ (22%).

SELECTED VARIABLES

HP/KP

Participants were asked "*Nelle ultime 4 settimane ha avuto dolore all'anca?*" ("In the past 4 weeks have you had hip pain?"); those who answered yes were classified as affected by HP. A similar question was used to ascertain KP.

Pain severity and stiffness in the affected joint

Participants reporting HP were administered the pain section of the Western Ontario and McMaster University OA Index (WOMAC)[11] (pain severity in walking on a plain surface, climbing/descending stairs; while in bed; sitting or lying down; standing) and their global WOMAC pain score (WPS; range 0–20) was calculated. Presence and mean duration of morning stiffness in the affected joint and pain-related use of drugs in the past 2 weeks were also recorded. The same information, but related to the knee, including the pain section of the WOMAC, was recorded in those reporting KP.

Possible correlates of HP (or KP) were derived from the interview, the geriatric evaluation and the functional assessment, to include *physical measures* of strength and flexibility in the hip, knee and back along with those *clinical, lifestyle and psycho-social features* identified in the literature as predictors of lower extremity joint pain[1,5–8].

Clinical features

Weight was measured to the nearest 0.1 kg, with the participant wearing light clothes and without shoes, using a high precision mechanical scale.

Standing height without shoes was measured to the nearest 0.1 cm. Weight and height were measured in standardized position and body mass index (BMI) was calculated as weight (kg)/height $(m)^2$.

Back pain (BP): participants were asked how often they had BP over the past year. Given the high prevalence and the low clinical impact of sporadic BP, participants were considered affected if they reported BP from very often to almost always in the past year[12].

Foot pain (FP): participants were simply asked if they had FP in the past month.

Self-rated health (SRH) was assessed with a one-item question that asked, "How would you rate your health at the present time?" Respondents answered on a five-point scale, from very poor (1) to excellent (5).

Lifestyle

Current smoking was recorded (yes/no).

Physical activity in the previous 12 months was classified as: hardly any; mostly sitting; light exercise (no sweat); moderate exercise 1–2 h/week; moderate exercise 3 h/week; intense exercise 3 h/week or more[13].

Participants provided information on current and previous jobs, including a subjective evaluation of the physical demand that each job required on a scale from 0 to 10. The average physical demand *per year* was computed for ages 20–60 years by adding up the products of all the job-specific demands multiplied by the number of months that specific job had been performed and dividing the sum by 12.

Psycho-social features

Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D)[14].

PM, the sense of personal control over health outcomes, was evaluated by a standard questionnaire (lower score meaning lower mastery)[15].

Marital status and education (years of formal education) were also recorded.

Physical measures

Measures of muscle strength were obtained bilaterally in eight lower extremity muscle groups (hip adduction/abduction, flexion/extension; knee flexion/extension; foot plantar/dorsiflexion) using a hand held dynamometer (Nicholas Manual Muscle Tester, Fred Sammons, Inc., USA) according to a standardized protocol[16]. Since all measures were highly correlated (Pearson's correlation coefficients from 0.87 to 0.92)[17], the right knee extension torque was used as a marker of lower extremity muscle strength. Upper extremity muscle strength was assessed by a standard handgrip test[18]. Lower extremity muscle power was measured in a single leg extension movement using the power rig testing equipment developed by Bassey and Short[19]; the weight-adjusted value of the best performance over eight repetitions on each side was obtained by dividing crude values of power by individual body weights and multiplying the resulting values by the sex-specific average body weight for the study population[17].

Trunk flexibility was measured by locating the C7 spinal process and a point on the lower spine along an imaginary line connecting the posterior superior iliac spines: the distance between these two points was measured, first while the participant was standing, and then following maximal spinal forward flexion and backward flexion (with knees extended); finally the difference in centimeters between the two latter measures was calculated[20].

Hip flexion, extension, extrarotation, adduction, abduction range of motion (ROM) and knee flexion and extension ROM were measured with a goniometer using a standard protocol[21].

STATISTICAL ANALYSIS

Data are reported as means (Ms) ± standard deviations (SDs) or percentages. Statistical analysis was performed using the STATA 7.1 software[22] and carried out separately for HP and KP. Continuous variables showing marked skewness were log-transformed before being entered into calculations. The associations of potential correlates with reported HP (or KP) in the past month were tested in age- and gender-adjusted analyses. Then, in order to verify which factors were independently related to HP (or KP), all variables significantly associated ($P < 0.05$) with HP (or KP) in the preliminary analysis, were entered into a multiple logistic regression-based model with HP (or KP) as the outcome (dependent variable). The initial fully adjusted model, inclusive of age and gender, was reduced to a "most parsimonious" model by using backward selection that only retained variables independently associated with HP (or KP), with a P-value < 0.05.

Results

PREVALENCE OF HP, KP, AND BOTH HP AND KP

The age and gender specific prevalence rates for HP are shown in Fig. 1. Altogether, prevalence of HP was 11.9% (120/1006) and was significantly higher in women than in men ($P = 0.01$). The prevalence of those reporting KP in our study population was 22.3% (225/1006); KP prevalence stratified by age and gender is also shown in Fig. 1. Similarly to HP, the prevalence of KP was significantly higher in women than in men ($P = 0.02$). Altogether, age

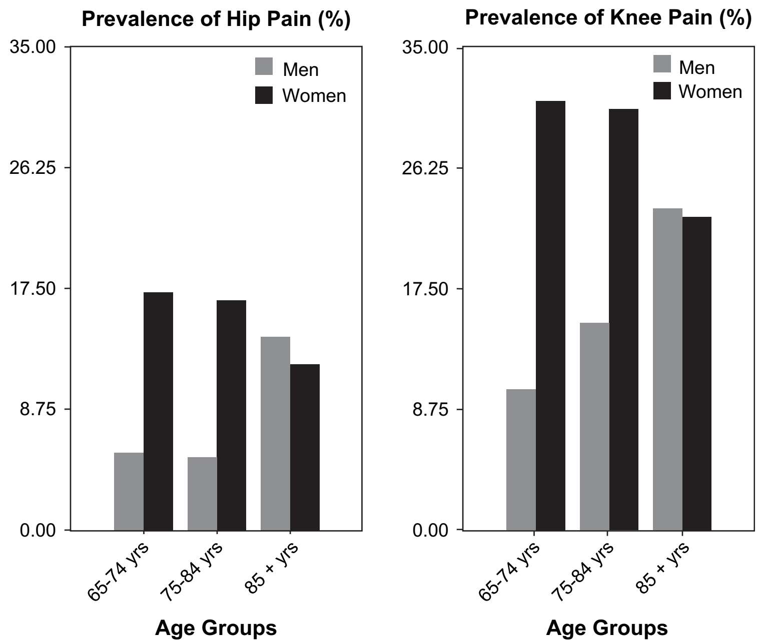

Fig. 1. Distribution of HP and KP according to age groups and gender.

was neither significantly different in those with or without HP (M ± SD: HP 75.2 ± 7.2; no HP 75.2 ± 7.1) nor in those with or without KP (M ± SD: KP 75.4 ± 7.2; no KP 75.2 ± 7.2), however, considering the relationship separately for women and men, age was significantly related to increased prevalence in men and with reduced prevalence in women, both for HP and KP (Fig. 1).

The overall prevalence of the HP/KP association was 7.2%; these persons, 12 men and 60 women, mean age 74.2 ± 6.26, were not significantly older than those reporting pain in one joint only. Among those with HP, 60% also had KP, and 32% of those with KP also had HP, while 733 participants (72.9% of our population) did not report pain in either joint.

HP CHARACTERISTICS AND CORRELATES

Table I shows HP characteristics across age and gender strata. Climbing/descending stairs and walking were the activities that elicited more severe pain, with average pain scores ranging from 1.2 ± 1.3 to 2.2 ± 0.8 across age and gender strata. The average WPS was 5.6 ± 3.5; WPS was generally higher in women ($P = 0.007$) while it was not significantly related to age. Morning stiffness affected 30% of those with HP (lasting 5 min or less in 72.2% of cases) with no significant age or gender difference. Pain-related use of medications in the past 2 weeks was 19.2%, with no significant age or gender difference.

Table II shows the age- and gender-adjusted associations of HP with potential correlates. As to *clinical, lifestyle and psycho-social* features, a lower physical activity in the past year ($P < 0.029$), a higher probability of reporting a history of physically demanding jobs in the age range 20–60 ($P = 0.003$) were significantly associated with HP, as well as slightly higher weight ($P = 0.011$) and BMI ($P = 0.002$). HP was also significantly associated with BP ($P < 0.001$), KP ($P < 0.001$), and FP ($P = 0.007$). Compared to those without HP, persons with HP reported a poorer SRH ($P < 0.001$), more depressive symptoms ($P = 0.001$) and lower PM ($P = 0.03$).

As far as *muscle strength and flexibility* were concerned, muscle strength measures, such as handgrip and knee extension torque were not associated with HP. Participants with HP had higher trunk flexibility ($P = 0.002$ and $P < 0.001$) and lower muscle power ($P = 0.002$ and $P = 0.004$) than those not reporting HP. HP was associated with reduced hip abduction and adduction ROM ($P < 0.001$ and $P = 0.001$), Table III shows the final model obtained by using backward selection from the initial fully adjusted models that included all variables significantly associated with HP, after age and sex adjustment. Independent correlates of HP were KP, BP, lower SRH, lower hip abduction ROM, reduced lower extremity power and higher trunk flexibility.

KP CHARACTERISTICS AND CORRELATES

Table IV shows KP characteristics across age and gender strata. Similar to HP, climbing/descending stairs and walking were the activities associated with more severe pain, with average pain scores ranging from 1.2 ± 1.0 to 2.3 ± 07 (M ± SD) across age and gender strata. The average WPS was 5.4 ± 3.0; WPS was generally higher in women ($P < 0.012$; β: 1.2 ± 0.47) and in older age ($P < 0.001$; β: 0.006 ± 02). Morning stiffness affected 28.9% of those with KP (lasting 5 min or less in 63.0% of cases), with no age or gender significant difference. Pain-related use of medications in the past 2 weeks was 14.2% in those with KP, and the prevalence did not differ across genders or age-group.

The age- and gender-adjusted associations of KP with potential correlates are shown in Table V. As to *clinical, lifestyle and psycho-social features*, KP was significantly associated with high weight ($P = 0.001$) and BMI ($P = 0.001$) and with HP, BP and FP ($P < 0.001$, for all three). KP was associated with poor SRH ($P = 0.008$), but not with number of medical visits, depressive symptoms or

Table I
WPS, morning stiffness and use of drugs among InCHIANTI Study participants aged 65 and over reporting HP, according to gender and age-class

	Women			Men		
	65–74	75–84	85 over	65–74	75–84	85 over
WOMAC						
Pain while walking (0–4) (M ± SD)	1.2 ± 0.9	1.6 ± 1.1	2.2 ± 0.8	1.1 ± 1.3	1.0 ± 1.0	1.7 ± 0.8
Pain climbing/descending stairs (0–4) (M ± SD)	1.6 ± 1.0	1.9 ± 1.0	2.1 ± 1.2	1.4 ± 1.3	1.2 ± 1.0	1.6 ± 0.8
Pain in bed (0–4) (M ± SD)	1.0 ± 1.3	0.5 ± 0.9	0.6 ± 1.1	0.2 ± 0.6	0.5 ± 1.2	0.0 ± 0.0
Pain sitting/laying down (0–4) (M ± SD)	1.1 ± 1.1	1.1 ± 1.1	1.5 ± 1.1	0.7 ± 1.1	0.6 ± 1.0	1.4 ± 0.7
Pain standing up (0–4) (M ± SD)	1.2 ± 1.1	1.0 ± 1.2	1.3 ± 1.2	0.6 ± 0.9	0.3 ± 0.8	0.6 ± 0.8
WPS (0–20) (M ± SD)	6.1 ± 3.5	5.9 ± 3.7	7.7 ± 4.2	4.2 ± 3.7	3.5 ± 2.0	5.3 ± 2.1
Morning stiffness (% HP+ or KP+)	26.9	29.0	66.7	20.0	0.0	66.7
Use of NSAID (% HP+ or KP+)	23.1	19.4	22.2	13.3	0.0	16.7

PM. KP was also associated with lower education ($P = 0.004$), lower physical activity in the past year ($P = 0.04$), and with higher probability of reporting a history of physically demanding jobs in the age range 20–60 ($P < 0.001$).

Regarding *muscle strength and flexibility* (Table V), handgrip was not associated with KP, while those with KP had higher trunk flexibility ($P = 0.002$ and $P < 0.001$) and lower muscle power ($P = 0.002$ and $P = 0.004$) than those not reporting KP. The knee extension torque was significantly lower in those with KP compared to those without KP ($P = 0.03$). KP was also associated with reduced hip abduction ($P < 0.001$) and extrarotation ($P = 0.032$), as well as with reduced knee flexion and extension ROM ($P < 0.001$ and $P = 0.002$).

Table VI shows the final model obtained including all variables significantly associated with KP after age and sex adjustment. Independent correlates of KP were HP, BP, reduced hip abduction ROM, reduced lower extremity power and increased trunk flexibility, as well as FP, higher BMI, lower education, reduced knee flexion ROM and reduced knee extension torque.

Table II
Correlates of HP among InCHIANTI Study participants aged 65 and over

	Yes ($n = 120$)	No ($n = 886$)	$\beta \pm$ SE (β)	Odd ratio (95% CI)	P*
Clinical features					
Weight (kg) (M ± SD)	69.6 ± 12.7	69.0 ± 12.3	2.72 ± 1.08	–	**0.011**
Height (cm) (M ± SD)	155.9 ± 8.9	158.8 ± 9.4	–	–	0.739
BMI (kg/cm^2) (M ± SD)	28.7 ± 4.4	27.3 ± 4.0	1.26 ± 0.40	–	**0.002**
BP (%)	60.8	27.5	–	3.50 (2.36–5.20)	<**0.001**
KP (%)	60.0	17.3	–	6.35 (4.22–9.56)	<**0.001**
FP (%)	30.8	16.4	–	1.80 (1.17–2.79)	**0.007**
SRH (1–5 score, 5 best) (M ± SD)	3.2 ± 0.8	3.7 ± 0.8	−0.39 ± 0.08	–	<**0.001**
Lifestyle					
Current smokers (%)	9.0	11.9	–	–	0.332
Physical activity last year (1–5 score, 5 best) (M ± SD)	1.0 ± 0.9	1.3 ± 0.9	−0.16 ± 0.08	–	**0.029**
Work activity age 20–60 (0–10 score, 10 highest overload) (M ± SD)	5.8 ± 3.4	5.3 ± 3.5	1.00 ± 0.33	–	**0.003**
Psycho-social features					
Depression (CES-D) (M ± SD)	19.2 ± 6.4	17.1 ± 5.9	1.45 ± 0.57	–	**0.012**
PM (6–30 score, 30 best) (M ± SD)	18.6 ± 4.5	19.7 ± 4.1	−0.88 ± 0.39	–	**0.031**
Marital status [% single/widow(er)]	44.2	37.4	–	–	0.934
Education (years) (M ± SD)	4.7 ± 2.7	5.5 ± 3.3	–	–	0.136
Physical measures					
Knee extension torque (N/dm) (M ± SD)	333 ± 143	387 ± 157	–	–	0.310
Handgrip (kg) (M ± SD)†	22.9 ± 9.6	26.9 ± 11.9	–	–	0.420
Lower extremity power (W) (M ± SD)‡	74.4 ± 52.6	105 ± 59	−14.3 ± 4.3	–	**0.002**
Trunk flexibility (cm) (M ± SD)	9.6 ± 4.0	8.6 ± 3.5	1.06 ± 0.34	–	**0.002**
Hip abduction ROM (°) (M ± SD)	21.8 ± 7.1	25.2 ± 7.2	−3.10 ± 0.65	–	<**0.001**
Hip adduction ROM (°) (M ± SD)	10.9 ± 3.2	11.8 ± 3.8	−0.82 ± 0.36	–	**0.001**
Hip flexion ROM (°) (M ± SD)	128 ± 58	124 ± 28	–	–	0.950
Hip extension ROM (°) (M ± SD)	10.9 ± 4.9	11.8 ± 15.6	–	–	0.160
Hip extrarotation ROM (°) (M ± SD)	32.1 ± 9.0	33.5 ± 8.1	–	–	0.340
Knee flexion ROM (°) (M ± SD)	137 ± 41	136 ± 21	–	–	0.580
Knee extension ROM (°) (M ± SD)	−0.1 ± 4.9	−0.4 ± 2.2	–	–	0.730

*From age- and sex-adjusted linear or logistic regression models, as appropriate.
†Data missing in 161 participants, 10 with and 151 without HP.
‡Weight-adjusted.

Table III
Odds of HP given associated correlates: multivariable backward analysis

HP	Odd ratio (95% CI)	*P*
BP (Y/N)	2.26 (1.36–3.76)	0.002
KP (Y/N)	5.73 (3.50–9.37)	<0.001
SRH (score)	0.57 (0.40–0.80)	0.001
Lower extremity power (W)	0.99 (0.98–1.00)	0.006
Trunk flexibility (cm)	1.17 (1.09–1.25)	<0.001
Hip abduction ROM (°)	0.94 (0.90–0.98)	0.005

Final model: Logistic Regression $\chi^2 = 159.40$; Prob $> \chi^2 < 0.001$; Pseudo $R^2 = 0.2616$. The initial fully adjusted model for HP also included: age, sex, weight, BMI, FP, depression, PM, physical activity last year, work activity age 20–60 and hip adduction ROM.

Discussion

The present study uses data from the baseline of a large clinical–epidemiological survey with a follow-up assessment every 3 years. Thus, rather than focusing on a specific clinical hypothesis, this paper has the primary purpose to establish the prevalence of HP and KP in an italian cohort of persons aged 65 and older and to identify specific correlates of each condition among those suggested by the literature as risk factors for musculoskeletal pain[1,5–8]. Further analysis on the follow-up data will necessary to clarify the actual cause–effect relationship of the associations.

In our study population we found that HP in the past month was reported by 11.9%, while KP was reported by 22.4% of participants. The two conditions overlapped in 7.2% of participants, while 72.9% of them did not report pain in either joint. Investigating on independent correlates of either HP or KP, we found that HP and KP were independently related to each other, and both were significantly associated to BP, reduced hip abduction, reduced muscle power and increased trunk flexibility. While poor SRH was associated with HP but not KP, FP, high BMI, low education, low knee flexion, and low knee extension torque were significantly related to KP but not to HP.

Although differences in sample characteristics and case definition do not allow direct comparison of data[23], our prevalence rates seem in agreement with the international literature. In the US, according to the data from the third National Health and Nutrition Examination Survey, a total of 14% of participants aged 60 years and older reported significant HP on most days over the past 6 weeks[24], while 22% reported KP[25]. Using the question: '*During the past 12 months, have you had pain in or around either of your hip/knee joints on most days for 1 month or longer?'* in a UK sample of 5500 persons over 65, Dawson *et al.* reported that 19.2% prevalence of HP and 32.6% of KP, and the percentage reporting HP and KP was 11.3%, where the somewhat higher prevalence rates may be influenced by the wider time frame considered for pain reports[1].

This is to our knowledge the first study presenting data on musculoskeletal pain in a community based sample of Italian elderly persons. The only previous Italian large community based study reporting the prevalence of joint problems in the elderly was published in 2003 and focused on symptomatic OA in a representative sample of a rural population aged 65 and older: the prevalence of Knee OA was 29.8, while that of Hip OA was 7.7[26].

In agreement with most of the literature, the prevalence of KP in our cohort was almost two-fold that of HP, and both conditions were significantly more frequent in women than in men[23–27]. Confirming the optimistic finding by Dawson *et al.*, about 70% of our population did not report either HP or KP and prevalence rates altogether did not increase significantly with age[1]. However, in our sample but not in theirs, prevalence of either condition significantly increased with age in men, but significantly decreased in women. This finding is in contrast with other reports: Wijnhoven *et al.*, in a survey of the Dutch general population on chronic musculoskeletal pain showed that pain in the lower limbs increased by age only in women[28], and a recent Swedish study also reported increasing pain prevalence in arms and legs by age in women but not in men, possibly explained by increasing prevalence of OA in women by age[29]. The decreased pain prevalence by age in our female sample may be possibly due to progressively impaired mobility with increasing age and comorbidity[30], as well as to reduced survival in those reporting joint pain according to pain-associated deterioration of health status[27]; the slightly reduced participation of the eldest female sample could also partially explain this finding. However, gender differences in pain reports include biological, acquired and psycho-social factors as well as differences in health reporting behavior, that should be comprehensively analyzed to verify these hypotheses[31].

One third of those with KP also reported HP, and 60% of those with HP also reported KP. Further, in the regression analysis we found that HP and KP were independently related to each other, and both were significantly associated to BP. This may be explained by a generalized disease affecting multiple joints, but also by impairment of general mobility in HP/KP, with consequent BP and possibly back

Table IV
WPS, morning stiffness and use of drugs among InCHIANTI Study participants aged 65 and over reporting KP, according to gender and age-class

	Women			Men		
	65–74	75–84	85 over	65–74	75–84	85 over
WOMAC						
Pain while walking (0–4) (M ± SD)	1.2 ± 1.0	1.6 ± 1.1	1.6 ± 1.0	0.9 ± 0.9	1.7 ± 1.1	1.6 ± 1.0
Pain climbing/descending stairs (0–4) (M ± SD)	1.9 ± 0.8	2.0 ± 1.0	2.0 ± 1.0	1.6 ± 0.9	2.2 ± 0.9	2.3 ± 0.7
Pain in bed (0–4) (M ± SD)	0.7 ± 1.1	0.5 ± 0.9	0.8 ± 1.2	0.2 ± 0.7	0.4 ± 1.0	0.4 ± 0.8
Pain sitting/laying down (0–4) (M ± SD)	0.8 ± 1.1	1.0 ± 1.0	1.4 ± 1.1	0.3 ± 0.7	0.9 ± 1.3	1.1 ± 0.9
Pain standing up (0–4) (M ± SD)	1.1 ± 1.1	1.0 ± 1.2	1.4 ± 1.1	0.7 ± 1.1	0.8 ± 1.3	0.6 ± 0.8
WPS (0–20) (M ± SD)	5.7 ± 3.0	6.1 ± 3.6	7.1 ± 3.6	3.7 ± 2.6	6.0 ± 4.5	5.9 ± 2.5
Morning stiffness (% HP+ or KP+)	40.4	47.4	35.3	18.5	30.0	60.0
Use of NSAID (% HP+ or KP+)	13.8	21.1	5.9	0.0	20.0	20.0

Table V
Correlates of KP among InCHIANTI Study participants aged 65 and over

	Yes ($n = 225$)	No ($n = 781$)	$\beta \pm$ SE (β)	Odd ratio (95% CI)	P*
Clinical features					
Weight (kg) (M ± SD)	70.0 ± 12.3	68.9 ± 12.4	3.49 ± 0.85	–	<**0.001**
Height (cm) (M ± SD)	156.3 ± 9.1	159.2 ± 9.3	–	–	0.897
BMI (kg/m^2) (M ± SD)	28.7 ± 4.3	27.1 ± 3.9	1.54 ± 0.31	–	<**0.001**
BP (%)	48.9	26.5	–	2.34 (1.71–3.19)	<**0.001**
HP (%)	32	6.1	–	6.34 (4.24–9.55)	<**0.001**
FP (%)	30.7	14.5	–	2.12 (1.49–3.03)	<**0.001**
SRH (1–5 score, 5 best) (M ± SD)	3.5 ± 0.8	3.7 ± 0.8	−0.16 ± 0.06	–	**0.008**
Lifestyle					
Current smokers (%)	7.1	12.8	–	–	0.247
Physical activity last year (1–5 score, 5 best) (M ± SD)	1.1 ± 0.9	1.3 ± 0.9	−0.13 ± 0.06	–	**0.048**
Work activity age 20–60 (0–10 score, 10 highest overload) (M ± SD)	5.8 ± 3.6	5.3 ± 3.5	0.96 ± 0.26	–	<**0.001**
Psycho-social features					
Depression (CES-D) (M ± SD)	18.1 ± 5.6	17.1 ± 6.1	–	–	0.431
PM (6–30 score, 30 best) (M ± SD)	18.9 ± 4.5	19.8 ± 4.0	–	–	0.056
Marital status [% single/widow(er)]	39.1	37.9	–	–	0.072
Education (years) (M ± SD)	4.6 ± 2.6	5.6 ± 3.4	−0.73 ± 0.24	–	**0.004**
Physical measures					
Knee extension torque (N/dm) (M ± SD)	360 ± 163	386 ± 154	−19.9 ± 9.9	–	**0.045**
Handgrip (kg) (M ± SD)†	24.6 ± 10.2	27.0 ± 12.1	–	–	0.250
Lower extremity power (W) (M ± SD)‡	80.7 ± 51.8	107.2 ± 60.1	−9.82 ± 3.45	–	**0.004**
Trunk flexibility (cm) (M ± SD)	9.4 ± 4.0	8.6 ± 3.5	1.08 ± 0.27	–	<**0.001**
Hip abduction ROM (°) (M ± SD)	22.5 ± 6.3	25.4 ± 7.3	−2.65 ± 0.51	–	<**0.001**
Hip adduction ROM (°) (M ± SD)	11.2 ± 2.8	11.8 ± 3.9	–	–	0.060
Hip flexion ROM (°) (M ± SD)	127 ± 52	124 ± 25	–	–	0.090
Hip extension ROM (°) (M ± SD)	11.4 ± 5.3	11.8 ± 5.6	–	–	0.460
Hip extrarotation ROM (°) (M ± SD)	32.0 ± 8.2	33.7 ± 8.2	−1.41 ± 0.64	–	**0.032**
Knee flexion ROM (°) (M ± SD)	129 ± 17	137 ± 15	−6.44 ± 1.83	–	<**0.001**
Knee extension ROM (°) (M ± SD)	−0.7 ± 2.0	−0.4 ± 1.5	−0.44 ± 0.21	–	**0.032**

*From age- and sex-adjusted linear or logistic regression models, as appropriate.
†Data missing in 161 participants, 23 with and 138 without KP.
‡Weight-adjusted.

stiffness. On the contrary, we found a significantly increased trunk mobility in persons reporting either HP or KP: since the literature reports a poor relationship between lumbar flexion ROM and BP[32], our hypothesis is that increased spinal mobility in this sample is compensatory for impaired hip or knee flexibility. Pain involving one or more lower extremity joint and/or the back may depend on generalized joint disease, such as OA, or may be due to pain-related impairment of general mobility and/or to pain radiation and pain-induced alterations of posture and gait, as suggested by the significant association we found between reduced hip abduction and not only HP but also KP. The association of FP with KP but not HP may at least partially depend on the higher incidence of generalized OA in those with Knee OA[33]; however, joint physical proximity, which increases both biomechanical interactions and the likelihood of radiated pain, may also explain this association[34]. Altogether our findings support the hypothesis that in old age joint pain presents as a widespread musculoskeletal syndrome[35], and, although cross-sectional, suggest that prompt and efficient intervention on a single painful joint may help preventing the development of pain in other joints.

One pitfall of our study is that the question investigating HP and KP did record neither the affected side, nor whether the joint involvement was bilateral, and it is possible that the identified associations of joint pain with measures of physical impairment may have been attenuated. Indeed, flexibility is likely to be specifically impaired in the painful joint; although, at least for OA, the literature has shown a strong association between identical joint action ROMs in unilateral and bilateral OA[36]. In our cohort, a lower hip abduction ROM was an independent correlate of both HP and KP in the final analysis, suggesting that KP may be partially explained by radiated pain form the hip. However,

Table VI
Odds of KP given associated correlates: multivariable backward analysis

KP	Odd ratio (95% CI)	P
BMI (kg/cm^2)	1.07 (1.02–1.13)	0.009
BP (Y/N)	1.99 (1.29–3.07)	0.002
HP (Y/N)	6.02 (3.61–10.71)	<0.001
FP (Y/N)	2.03 (1.25–3.31)	0.004
Education (years)	0.92 (0.85–0.99)	0.028
Knee extension torque (N/dm)	0.96 (0.94–0.98)	0.017
Lower extremity power (W)	0.99 (0.98–1.00)	0.001
Trunk flexibility (cm)	1.16 (1.09–1.23)	<0.001
Hip abduction ROM (°)	0.97 (0.93–1.00)	0.046
Knee flexion ROM (°)	0.97 (0.96–0.99)	0.001

Final model: LR $\chi^2 = 1965.63$; Prob $> \chi^2 < 0.001$; Pseudo $R^2 = 0.2424$. The initial fully adjusted model for KP also included: age, sex, weight, SRH, physical activity last year, work activity age 20–60, hip extrarotation ROM and knee extension ROM.

participants reporting HP had an impaired flexibility of hip but not knee joints, and low knee flexibility was an independent correlate of KP but not of HP in the multiple regression model. The lack of data on hip intrarotation ROM is another pitfall of our analysis that may further attenuate our results. Nevertheless these findings altogether point out to a specific joint-related ROM impairment associated with joint pain.

As to strength measures, the problem of missing information on involved side may be partially minimized by the very high correlation found for all measures of lower extremity muscle strength in both lower limbs in our sample (Pearson's correlation coefficients from 0.87 to 0.92)[17]. Knee extension torque was associated with KP and lower limb muscle power impairment was correlated to both HP and KP, while handgrip test was not significantly impaired in either HP or KP. These data again suggest specific muscle impairment rather than generalized sarcopenia. Given the potentially reversible nature of muscle weakness, the cause–effect relationship between strength and joint pain deserves to be addressed by further longitudinal analysis[37].

Average pain severity according to WOMAC score was similar and rather mild in participants with HP and KP, and morning stiffness, lasting less than 5 min in most cases, was reported by one third of both those with HP and those with KP. Somewhat in contrast with these findings, pain-related drug use was significantly more common in participants reporting HP than in those reporting KP. This may depend on better response to non steroidal anti-inflammatory drugs (NSAIDs) treatment in those with KP than HP, as demonstrated by Svensson *et al.*[38]. On the other hand, it may be also that HP is at least perceived as more crippling than KP. Indeed, in the regression model, we found that HP was associated with poor SRH while KP was not. The reasons for this different association are probably complex; in some recent literature, HP has been associated with poorer quality of life and more depressed mood than KP[39–41], but we could not find any other study comparing SRH in those with HP and KP. SRH is widely recognized as a strong predictor of morbidity, mortality, and functional status[42]. Longitudinal research has shown that persons with poor SRH have higher risk of subsequent disability, that contributes in a mutual relationship to a cycle of health decline, independently from incident morbidity[43]. A previous Italian study on joint OA reported that hip but not knee OA was associated with disability in daily living activities[26]. To investigate if HP had greater impact on SRH than KP in our sample, in a separate analysis we also compared these effects directly in an "*ad hoc*" model with SRH as the outcome, finding that HP was strongly related to poor SRH ($P < 0.001$; β −0.360) while KP was not ($P = 0.238$). The greater impact of HP than KP on SRH may be one of the reasons why hip replacement in HP patients seems to be much more common than knee replacement in KP patients[44].

In the regression analysis BMI and lower education were significantly associated with KP but not with HP. The association of KP with knee overload is well established in the literature, while whether the same applies to HP is not clear. Creamer *et al.*[3] reported an association between high BMI and impaired knee but not hip flexibility in OA. A previous analysis on this same cohort showed that BP was not associated to BMI either[12], suggesting that obesity may be a risk factor for KP and/or for knee OA, while for the hip, as for the spine, the associations reported in other studies may result from confounding factors[45,46]. Indeed, reduction of BMI is more likely to reduce KP than pain in the hip or spine[47]. Peters *et al.*[48] showed that lower social–economical status and higher BMI were associated with greater deterioration of function over 1 year in patients reporting KP but not in patients reporting HP. Probably in our cohort low education is a proxy of poor socio-economic status which, at least in this population, is generally associated to performing heavy chores with mechanical joint overload rather independently of job-specific demands[49,50].

In conclusion, we found that HP and KP in old age often present as a widespread muscoloskeletal syndrome. At the same time, our findings confirm the great relevance of specific physical correlates to reports of joint pain in our cohort. According with previous studies, we could show that KP was independently related to direct or indirect measures of mechanical overload, while this was not true for HP. On the other hand, poor SRH was an independent correlate of HP but not of KP, implying a stronger relationship of HP with overall health status which needs to be better investigated by further longitudinal approach.

Conflict of interest

The authors declare that there is no conflict of interest whatsoever involved in this manuscript.

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