PREVALENCE TO PATELLOFEMORAL PAIN SYNDROME IN OCCUPATIONAL CONTEXT: A SYSTEMATIC REVIEW

Pereira P.M. [1], J. Santos Baptista[2], J. Torres Costa[3]
[1] Associated Laboratory for Energy, Transports and Aeronautics, (PROA/LAETA), Faculty of Engineering, University of Porto, 4200-319 Porto, Portugal, prof.monpe@outlook.com, ORCID: 0000-0002-1586-0359
2 jsbap@fe.up.pt, ORCID: 0000-0002-8524-5503
3 Associated Laboratory for Energy, Transports and Aeronautics, (PROA/LAETA), Faculty of Medicine, University of Porto, 4200-319 Porto, Portugal, zecatoco@sapo.pt, ORCID: 0000-0003-3947-8688

Abstract
The Patellofemoral Pain Syndrome in an occupational context is an important topic to be discussed. There is a lack of information in the scientific literature, especially when dealing with populations of non-athlete workers. Its main objective is to find evidence in the literature of the prevalence of Patellofemoral Pain Syndrome in non-athlete workers from different economic sectors. This systematic review only uses studies that showed the prevalence of Patellofemoral Pain Syndrome in non-athlete workers as inclusion criteria. It is considered the population over 18 years old, without gender restriction, healthy or not, diagnosed by physicians based on clinical and/or radiological criteria. Searches were carried out in Scopus, Academic Search Complete, Science Direct, Web of Science, PMC, PubMed, Informaworld and Medline. The last search was in January 2022. The risk of bias in the selected articles was analyzed using the RoB 2.0 tool (Revised Cochrane risk-of-bias tool for randomized trials. It was verified the existence of a variation in prevalence from 1.08% to 34.9% between data collected in different studies. The main limitation of the research was the number of detected studies, only 7. However, this same fact made it possible to highlight the need for more research on populations of workers and demonstrate the general need for more studies in the area. The research is registered in PROSPERO under the number CRD42021276885.

Keywords: Prevalence, “Patellofemoral Pain Syndrome”, “musculoskeletal disorder”, “industry”, “worker”

Introduction

The Patellofemoral Pain Syndrome (PFPS) corresponds to a set of diseases that generates pain in the peripatellar region of the knees. This disease is characterised as a gradual and progressive pain, which worsens with specific movements such as crouching down, climbing or descending stairs, and squatting [1]. It is described as pain without irradiation, characteristically an acute pain [2].

Under the umbrella of PFPS, anterior knee diseases such as chondromalacia patella, anterior knee pain syndrome, runner’s knee and patellofemoral tendon disease, whether or not they are associated with other pathologies such as knee osteoarthritis [1].

The prognosis of the syndrome depends on the continuity of an aggressive process over an injured tissue [3]. As demonstrated by Kumar et al. (2018), a continuous aggression to an inflamed tissue leads to changes in cell morphology that can be reversible or irreversible if the charge last in time. The continuity of inflammation in a tissue can evolve into irreversible changes that present as persistent chronic pain, alteration of the local healthy connective tissue to a fibrous tissue with little capacity to absorb loads and more susceptible to inflammation. Finally, it can lead to local muscle atrophy due to the destruction of nerve tissues, generating a loss of function and inability to perform movements without pain [3–6].

According to Smith (2018), the prevalence of PFPS in the general population is 22.7% and can be classified as Musculoskeletal Disorder (MSD) class two or three (MSD-2 or MSD-3) when in an occupational context [7]. In the European Working Conditions Survey’s report (EWCS 2015), it is observed that the frequency of Work-Related MSD (WRMSD) on lower limbs is higher, 29% in men and 30% in women [8]. However, the data in these reports are based on self-administered questionnaires with no medical validation. Thus, there may be biases regarding these results. It also happens that the WRMSD of the lower limbs include several joints, from the feet to the hip, and there are no specific tools to analyze the risk of contracting injuries in this area of the body in the work context [9].

A Syndrome such as PFPS is characterized by a set of diseases with similar symptoms that significantly impact the person's life [10,11]. When analysing it, it is observed that there is very little information in the literature and even less when looking for specific information on worker populations [12].
To clarify the present knowledge about this problem, the objective of this study is to evidence the prevalence of PFPS in different occupational realities in non-athlete workers.

Materials and Methods

This systematic review was carried out between September 2021 and January 2022, following the PRISMA Statment [13]. The research procedures were registered in PROSPERO under the number CRD42021276885.
The search for information was carried out in two stages. The information search and screening process was carried out in two stages. First, the literature available between 2000 and 2021 was searched, considering only articles published in indexed journals and *articles in press*, written in English, and published in peer-reviewed journals or book chapters. The electronic databases searched were Scopus, Academic Search Complete, Science Direct, Web of Science, PMC, PubMed, Informaworld and Medline. In the search strategy, the keyword "prevalence" was combined with "patellofemoral pain", chondromalacia, worker, "anterior knee pain", and "Patellofemoral Pain Syndrome". The combinations used in the research were:

1. prevalence AND "patellofemoral pain"
2. prevalence AND "anterior knee pain"
3. prevalence AND chondromalacia
4. prevalence AND "Patellofemoral Pain Syndrome"
5. prevalence AND "patellofemoral pain" AND worker
6. prevalence AND "anterior knee pain" AND worker
7. prevalence AND chondromalacia AND worker
8. prevalence AND "Syndrome Patellofemoral Pain" AND worker

The records selected from the databases were saved and managed directly in reference management software (Mendeley®).
In the second step, articles and other works published before 2000 were considered in the review through a snowballing procedure [14]. All automatic screening procedures were performed by one reviewer.
After the screening process, studies that showed PFPS prevalence in a population were considered eligible if with the following characteristics: non-athlete workers, over 18 years old, healthy or not, without gender restriction, and in which PFPS had been diagnosed by medical teams based on clinical and/or radiological criteria.
Papers published as case studies, cohort studies and cross-sectional studies were accepted.
The procedures for applying the eligibility criteria were performed by two reviewers. When the opinions of these two reviewers differed, a third reviewer issued his statement. A first selection was made based on the title and abstract to verify the eligibility criteria. The records accepted in this first procedure were then analyzed in full.
The data were extracted record by record into a customised Excel file. In this file, each line corresponds to a different record and each column to one of the parameters to be extracted. Data were collected on the type of work, population, sample, control group, health status assessment (clinical or radiological examination) to identify the PFPS, prevalence and incidence values, and the research design. In the process of analysing the documents, were eliminated studies carried out on humans with prostheses and orthoses, studies on animals or dead bodies, studies with adolescents, students or athletes, studies that were not evaluated by a physician, studies that assessed the incidence of PFPS in the face of an intentional overload activity and studies with a high risk of bias according to ROB 2.0 criteria.ROB 2.0 [15].
The risk of bias was independently assessed by two reviewers. The quality of the selected articles was evaluated using the Cochrane Collaboration tool to assess the risk of bias, RoB 2.0 [15], using the Excel tool available on the platform.

The components selected for evaluation included questions distributed in 5 categories:

1 -Randomisation process (1.1 Was the allocation sequence random?/ 1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions/1.3 Did baseline differences between intervention groups at the start of the first period suggest a problem with the randomisation process?)

2 –Bias arising from period and carryover effects (2.1 Was the number of participants allocated to each of the two sequences equal or nearly equal?/ 2.2 If N/PN/NI to 2.2.1: Were period effects accounted for in the analysis?/ 2.2.2 Was there sufficient time for any carryover effects to have disappeared before outcome assessment in the second period?)

3- Missing outcome data (3.1 Were data for this outcome available for all, or nearly all, participants randomised?/ 3.2 If N/PN/NI to 3.1: Is there evidence that the result was not biased by missing outcome data?/ 3.3 If N/PN to 3.2 Could missingness in the outcome depend on its true value?/ 3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?)

4 -Measurement of the outcome (4.1 Was the method of measuring the outcome inappropriate?/ 4.2 Could measurement or ascertainment of the outcome have differed between interventions within each sequence?/ 4.3 If N/PN/NI to 4.1 and 4.2: Were outcome assessors aware of the intervention received by study participants?/ 4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received? 4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?)

5 – Selection of the reported result (5.1 Were the data that produced this result analysed in accordance with a pre-specified analysis plan that was finalised before unblinded outcome data were available for analysis? / 5.2 ... multiple eligible outcome measurements (e.g. scales, definitions, time points) within the outcome domain? / 5.3 ... multiple eligible analyses of the data? / 5.4 Is a result based on data from both periods sought, but unavailable on the basis of carryover having been identified?)

The quality of each component was classified as “high risk”, “low risk” or “some concerns”.

The synthesis of the results was carried out through quantitative and qualitative analyzes of the selected studies. The quantitative results are intended to show PFPS prevalence in each study. The qualitative analysis focused on the eligibility criteria, selecting only the articles that responded to the review’s objectives. The entire synthesis was summarized in a table to allow a better presentation and interpretation of the results of each article.

Results

The research results are summarized in the PRISMA flow diagram in figure 1. The overall quality of each article is presented in the bias analysis in table 1.

The selection of articles followed the PRISMA Statement guidelines [13]. Initially, 411 items were obtained directly from the Databases. The application of the snowballing method allowed finding 8 more articles. Using automatic search filters for date, article type, source type and language restrictions, 202 reports were excluded. At the end of this phase, 217 articles were identified for exclusion. Of these, 83 were duplicates, leaving 134 articles for a third phase based on the eligibility criteria.

The first verification of the exclusion criteria was verified from the title and abstract. Articles that did not address the prevalence or frequency of the disease were excluded. Were excluded 102 articles.

The 32 remaining articles were evaluated for the full text. This stage was characterized by the verification of eligibility criteria. The following criteria were used for exclusion: works that assessed the prevalence in university sportsmen, in which the diagnosis was not made by trained physicians, works in which there was a lack of information or dubious information that made the papers at high risk of bias.

***Table 1**: Overall risk of bias judgement by the Cochrane Collaboration's Tool, RoB 2.0 [15].*

Study ID	D1	D2	D3	D4	D5	Overall
John Winslow & Yoder, 1995	+	+	+	+	+	+
Lakstein et al., 2009	+	+	+	+	+	+
Boling et al., 2009	+	+	+	+	+	+
Coppack et al., 2010	+	+	+	+	+	+
Lovalekar et al., 2016	+	+	+	+	+	+
Sharifian et al., 2019	+	+	+	+	+	+
Pereira, Amaro, et al., 2022	!	+	+	+	+	!

+ Low risk
! Some concerns
- High risk

Label:
D1-Randomisation process
D2-Deviations from the intended interventions
D3-Missing outcome data
D4- Measurement of the outcome
D5- Selection of the reported result

Each manuscript was analyzed to determine its compliance with the eligibility criteria. Thus 25 articles were excluded. In the end, 7 studies were selected on the prevalence of PFPS in workers, which corresponded to the following economic sectors according to EU-OSHA [8]: one in Manufacturing [16], one in Transport and Stock [17], four studies in the Public Administration and Defense [18–21]and a study in the Arts, Entertainment and Recreation [22].

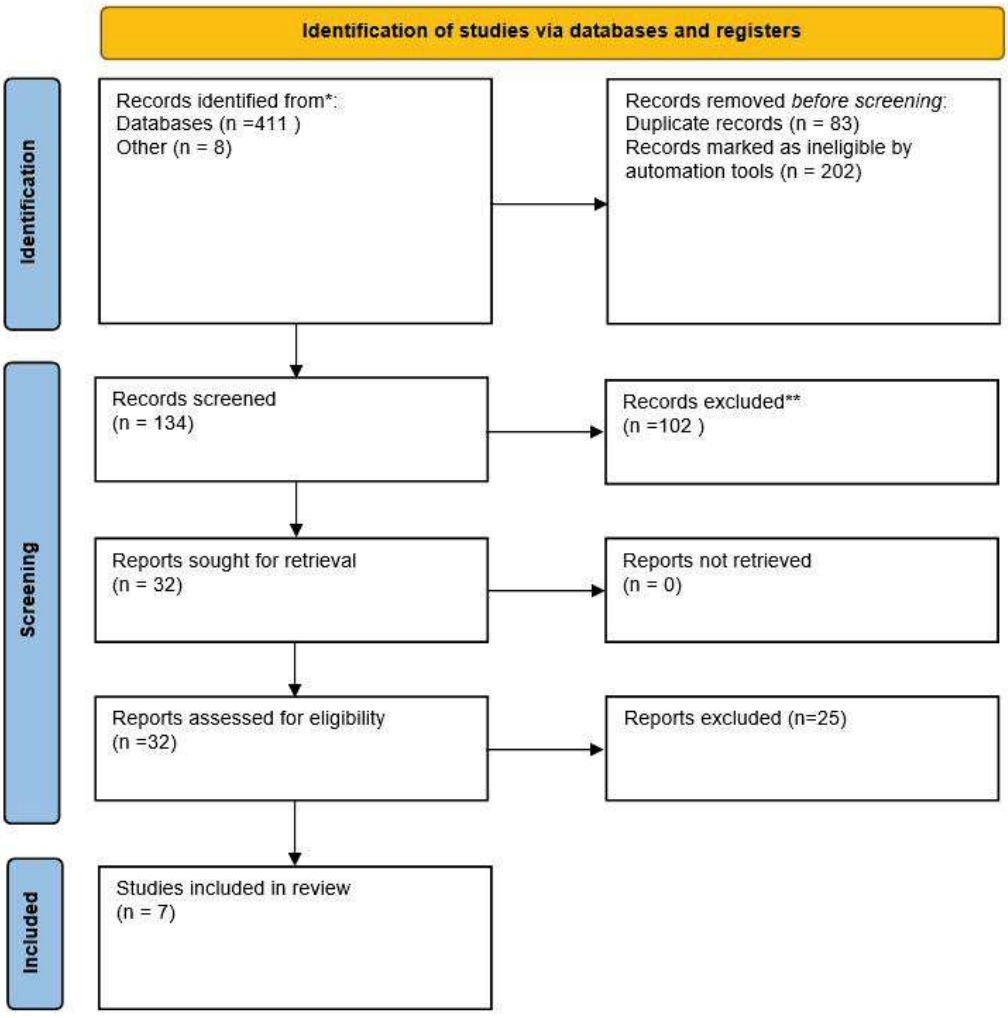

***Figure 1**: Flow-diagram of the research, based on Page et al. (2021)*

***Table 1**: Study characteristics*

Authors	Year	Job Specification		Population						Evaluation Methodology		Result				Study Design
		category	Specificity	Nationality	Kind of work	Size	gender distribution		mean age (years)	Clinical Medical Evaluation	Complementary diagnostic	Prevalence (overall)		Incidence (overall)		
							Intervention Group (IG)	Control (C)		Anamnesis and physical examination		Total	(%)	Total	(%)	
(John Winslow & Yoder, 1995)	1995	Arts, entertainment, and recreation	Ballet dancers from a university department of dance	USA	Dancers	24	12	12	NA	Yes	NA	7	29,16%	NA	Na	Cross-sectional
(Lakstein et al., 2010)	2010	Public Administration and Defense	Israel Defense Force Recruit	Israel	Military	97.279 recruits	-18.338 females -78.941 males	NA	17.2 (range, 16.5–19.3 years)	Yes	NA	Anterior knee pain was found in 4,042 recruits	4.15%	NA	NA	Cross-sectional
(Boling et al., 2010	2010	Public Administration and Defense	United States Naval Academy (USNA)	USA	Military	1.525	-606 females -919 males	NA	NA	Yes	NA	206	13,5%	40	2,2%/year	Cohort
(Coppack et al., 2011)	2011	Public Administration and Defense	British Army recruits	United Kingdom	Military	1502	759	743	19.7 years.	Yes	NA	46	3,1%	IG: 10/759 C: 36 / 743	1,2% per recruit-months of training.	Randomised controlled trial
(Lovalekar et al., 2017)	2017	Public Administration and Defense	Naval Special Warfare Operators and students	USA	Military	920	920	NA	Na	Yes	NA	3 chondromalacia patellar in 277 reported injuries	1,08%	NA	NA	Descriptive cross-sectional
(Sharifian et al., 2020)	2020	Manufacturing	Large Iranian automobile manufacturing company	Iran	Worker	1570	1570	Na	38.8 years ± 5.4	Yes	NA	547,93	34.9%	NA	NA	Cross-sectional study
(Pereira, Amaro, et al., 2022)	2022	Transport and Stock	Selective Garbage Truck Drivers	Portugal	Worker	20	18 men 2 women	NA	NA	Yes	NA	6	30%	NA	NA	Cross-sectional study

Discussion

The results showed a lack of information on PFPS prevalence in the work context, even though limits to the publication period were not considered during the search for information. A total of 7 works were identified, of which 4 are the result of studies in military populations [18–21], one with professional ballet dancers [22], one in the Automobile Industry [16] and 1 with Selective Garbage Truck Drivers [17].

PFPS is a multifactorial syndrome and can develop in different situations [23,24]. The main factors related to PFPS are the inflammations that occur in the joints, tendons and muscles due to overuse, with the continuity of activity without adequate recovery time [3,7,25], performing strength movements with the knee flexed [26–28], such as going stairs up and down and squatting. The knee flexion in which the knees advance the ipsilateral toe line is also a significant cause of this syndrome [23,24,26–29]

Although the risk factors for the aggravation of the syndrome are clear, the selected works do not describe the genesis of the syndrome. Thus, it was impossible to determine whether the lesions presented in the selected studies were caused by overuse or by acute processes that were not completely healed.

In the "Arts, entertainment and recreation" sector, the only work found was with professional ballet dancers, 29.16% had PFPS [22]. This profession requires a large number of knee flexion, high jumps and hard training loads, predisposing factors to wear from "overuse" and due to knee flexion with the anterior translation of the tibia [22].

According to the results of the study carried out in a Large Iranian automobile manufacturing company with 1570 workers [16], a 34.9% prevalence of PFPS was found. It was evidenced in this study the existence of numerous postures with knees flexed at more than 60°, in sustained positions and with force movements constantly exerted in hyperflexion. These positions and movements are predisposing factors for the worsening of PFPS [9,16,23,24,26–29].

In the economic sector of Transport and Stock, it was verified by Pereira et al. (2022) that 30% of workers of the Selective Garbage Collection had PFPS. This syndrome is mainly related to the risk factor of going up and down the truck's vertical stairs, as well as knee flexion above 60 degrees[9].

In the Public Administration and Defense sector, 4 studies were found in military populations. Prevalence results ranged from 1.08% [21]to 13.5% [19]. A PFPS prevalence of 4.15% was found in Israeli military personnel [18], 13.5% in US military personnel in 2010 [19] and 3.1% in British military personnel[20]. After finding a prevalence of 13.5% in the United States Naval Academy (USNA), a cohort study on this population was developed in 2017, 6 years after the first one. In this second study, a prevalence value of 1.08% was found [21]. This second value is in line with those obtained in other studies. The decrease in the percentage value probably demonstrates that greater care was taken concerning the training of recruits [21].

According to Thijs et al. (2007), in their prospective study at the Belgian Royal Military Academy, it was shown that high training loads can generate PFPS incidence degrees of up to 43% due to activity overload and overuse injuries [3,7,25,30]. This study was not accepted in this review because overuse activity was induced in the recruits. However, it allows verifying the existence of interdependence between the PFPS and the excessive use of the knee joints.

Conclusion

The present systematic review aimed to find evidence in the literature of the prevalence of PFPS in the work context in different economic sectors.

Given the results, it was possible to highlight the few existing studies on this subject. The 4 studies in the military context had the lower percentages, ranging from 1.08% to 13.5%. However, in the "Arts, entertainment and recreation" sector, the value found in the study was 29.16%. In the manufacturing sector and transport sector, the values were 34.9% and 30%, respectively. These findings show that the prevalence of PFPS in the workplace may be higher than ILO estimates.

PFPS is a reality in the work context. It deserves greater attention from occupational medicine, as very little is known about the prevalence of this syndrome.

Future studies must fill this gap in scientific information, allowing adequate information to occupational safety and health professionals and the correct prevention and management of PFPS in the work context.
The most significant limitation of this review was the small number of specific studies on the prevalence of PFPS in the work context with non-athlete and non-military workers.

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Reference:

[1] Crossley KM, Stefanik JJ, Selfe J, Collins NJ, Davis IS, Powers CM, et al. 2016 Patellofemoral pain consensus statement from the 4th International Patellofemoral Pain Research Retreat, Manchester. Part 1: Terminology, definitions, clinical examination, natural history, patellofemoral osteoarthritis and patient-reported outcome m. British Journal of Sports Medicine 2016;50:839–43. https://doi.org/10.1136/bjsports-2016-096384.
[2] Liporaci RF, Saad MC, Felício LR, Baffa A do P, Grossi DB. Contribuição da avaliação dos sinais clínicos em pacientes com síndrome da dor patelofemural. vol. 21. 2013. https://doi.org/10.1590/s1413-78522013000400003.
[3] Kumar V, Abbas AK, Aster JC. Robbins Basic Pathology. Elsevier, vol. 1. 10th ed., Elsevier; 2018, p. 775–6.
[4] Narici MV, Monti E, Franchi M, Reggiani C, Toniolo L, Giacomello E, et al. Early Biomarkers of Muscle Atrophy and of Neuromuscular Alterations During 10-Day Bed Rest. The FASEB Journal 2020;34:1–1. https://doi.org/10.1096/fasebj.2020.34.s1.09027.
[5] Steultjens MPM, Dekker J, Bijlsma JWJ. Avoidance of activity and disability in patients with osteoarthritis of the knee: The mediating role of muscle strength. Arthritis and Rheumatism 2002;46:1784–8. https://doi.org/10.1002/art.10383.
[6] Buford TW, Cooke MB, Manini TM, Leeuwenburgh C, Willoughby DS. Effects of age and sedentary lifestyle on skeletal muscle nf-κb signaling in men. Journals of Gerontology - Series A Biological Sciences and Medical Sciences 2010;65 A:532–7. https://doi.org/10.1093/gerona/glp196.
[7] Pereira PM, Amaro J, Ribeiro BT, Gomes A, De Oliveira P, Duarte J, et al. Musculoskeletal Disorders' Classification Proposal for Application in Occupational Medicine. International Journal of Environmental Research and Public Health 2021;18. https://doi.org/10.3390/ijerph18158223.
[8] Jan de Kok, Vroonhof P, Snijders J, Roullis G, Clarke M, Peereboom K, et al. Work-related musculoskeletal disorders: prevalence, costs and demographics in the EU. Luxembourg: 2019. https://doi.org/10.2802/66947.
[9] Pereira PM, Duarte J, Santos Baptista J, Torres Costa J. Patellofemoral Pain Syndrome Risk Factors Analysis in Selective Garbage Truck Drivers. Occupational and Environmental Safety and Health III, Portugal: Springer, Cham; 2022, p. 357–68. https://doi.org/10.1007/978-3-030-89617-1_32.
[10] Fredericson M, Yoon K. Physical examination and patellofemoral pain syndrome. American Journal of Physical Medicine and Rehabilitation 2006;85:234–43. https://doi.org/10.1097/01.phm.0000200390.67408.f0.
[11] Piazza L, Lisboa ACA, Costa V da, Brinhosa GC da S, Vidmar MF, Oliveira LFB de, et al. Sintomas e limitações funcionais de pacientes com síndrome da dor patelofemoral. vol. 13. 2012. https://doi.org/10.1590/s1806-00132012000100009.
[12] Smith BE, Selfe J, Thacker D, Hendrick P, Bateman M, Moffatt F, et al. Incidence and prevalence of patellofemoral pain: A systematic review and meta-analysis. PLoS ONE 2018;13:e0190892. https://doi.org/10.1371/journal.pone.0190892.
[13] Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. The BMJ 2021;372. https://doi.org/10.1136/bmj.n71.
[14] Wohlin C. Guidelines for snowballing in systematic literature studies and a replication in software engineering. ACM International Conference Proceeding Series, New York, New York, USA: ACM Press; 2014, p. 1–10. https://doi.org/10.1145/2601248.2601268.
[15] Higgins JPT, Li T, Sterne JAC. Revised Cochrane risk of bias tool for randomized trials Cross-over (RoB 2.0). Cochrane Methods Cochrane Database of Systematic Reviews 2016 2016;10:52.
[16] Sharifian SA, Chinichian M, HalimiMilani A, Mehrdad R. Prevalence and risk factors of patellofemoral pain in an automobile manufacturing factory. vol. 16. 2020.
[17] Pereira PM, Amaro J, Duarte J, Santos Baptista J, Torres Costa J. Prevalence of Patellofemoral Pain Syndrome in Selective Garbage Collection Workers—Cross Sectional Study. Occupational and Environmental Safety and Health

III, Portugal: Springer, Cham; 2022, p. 337–43. https://doi.org/10.1007/978-3-030-89617-1_30.
[18] Lakstein D, Fridman T, Ziv YB, Kosashvili Y. Prevalence of anterior knee pain and pes planus in Israel defense force recruits. Military Medicine 2010;175:855–7. https://doi.org/10.7205/milmed-d-09-00145.
[19] Boling M, Padua D, Marshall S, Guskiewicz K, Pyne S, Beutler A. Gender differences in the incidence and prevalence of patellofemoral pain syndrome. Scandinavian Journal of Medicine and Science in Sports 2010;20:725–30. https://doi.org/10.1111/j.1600-0838.2009.00996.x.
[20] Coppack RJ, Etherington J, Wills AK. The effects of exercise for the prevention of overuse anterior knee pain: A randomized controlled trial. American Journal of Sports Medicine 2011;39:940–8. https://doi.org/10.1177/0363546510393269.
[21] Lovalekar M, Perlsweig KA, Keenan KA, Baldwin TM, Caviston M, McCarthy AE, et al. Epidemiology of musculoskeletal injuries sustained by Naval Special Forces Operators and students. Journal of Science and Medicine in Sport 2017;20:S51–6. https://doi.org/10.1016/j.jsams.2017.09.003.
[22] Winslow J, Yoder E. Patellofemoral pain in female ballet dancers: Correlation with iliotibial band tightness and tibial external rotation. Journal of Orthopaedic and Sports Physical Therapy 1995;22:18–21. https://doi.org/10.2519/jospt.1995.22.1.18.
[23] Powers CM, Witvrouw E, Davis IS, Crossley KM. Evidence-based framework for a pathomechanical model of patellofemoral pain: 2017 patellofemoral pain consensus statement from the 4th International Patellofemoral Pain Research Retreat, Manchester, UK: part 3. British Journal of Sports Medicine 2017;51:1713–23. https://doi.org/10.1136/bjsports-2017-098717.
[24] Willy RW, Hoglund LT, Barton CJ, Bolgla LA, Scalzitti DA, Logerstedt DS, et al. Patellofemoral Pain. Journal of Orthopaedic & Sports Physical Therapy 2019;49:CPG1–95. https://doi.org/10.2519/jospt.2019.0302.
[25] Bustos AO, Belluscio V, Camomilla V, Lucangeli L, Rizzo F, Sciarra T, et al. Overuse-related injuries of the musculoskeletal system: Systematic review and quantitative synthesis of injuries, locations, risk factors and assessment techniques. Sensors 2021;21. https://doi.org/10.3390/s21072438.
[26] Fry AC, Smith JC, Schilling BK. Effect of Knee Position on Hip and Knee Torques during the Barbell Squat. vol. 17. 2003. https://doi.org/10.1519/1533-4287(2003)017<0629:EOKPOH>2.0.CO;2.
[27] Bolgla LA, Fithian DC, Mace KL, Boling MC, DiStefano MJ, Mace KL, et al. National Athletic Trainers' Association Position Statement: Management of Individuals With Patellofemoral Pain. Journal of Athletic Training 2018;53:820–36. https://doi.org/10.4085/1062-6050-231-15.
[28] Pereira PM, Reis J, Duarte J, Santos Baptista J, Torres Costa J, Conceição F. Application of bodybuilding for correction of musculoskeletal disease in Patellofemoral Pain Syndrome-A case report. International Journal of Occupational and Environmental Safety 2020;4:82–8. https://doi.org/10.24840/2184-0954_004.001.0007.
[29] Neal BS, Lack SD, Lankhorst NE, Raye A, Morrissey D, Van Middelkoop M. Risk factors for patellofemoral pain: A systematic review and meta-analysis. British Journal of Sports Medicine 2019;53:270–81. https://doi.org/10.1136/bjsports-2017-098890.
[30] Thijs Y, Tiggelen D Van, Roosen P, Clercq D De, Witvrouw E. A prospective study on gait-related intrinsic risk factors for patellofemoral pain. Clinical Journal of Sport Medicine 2007;17:437–45. https://doi.org/10.1097/JSM.0B013E31815AC44F.