Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Nutrition during rehabilitation after anterior cruciate ligament injury and reconstruction: perspectives of healthcare professionals and patients

Danny Holtus

d.holtus@zgv.nl

Sports Valley, Gelderse Vallei Hospital

Marco Mensink

Wageningen University & Research

Ellen Oosting

Sports Valley, Gelderse Vallei Hospital

Wybren A. van der Wal

Sports Valley, Gelderse Vallei Hospital

Daan Boersma

DB Nutrition

Wouter Welling

Institute of Training Medicine and Training Physiology, TGTF, Royal Netherlands Army

Johannes Zwerver

University Medical Center Groningen

Research Article

Keywords: anterior cruciate ligament injury, anterior cruciate ligament reconstruction, anterior cruciate ligament rehabilitation, nutrition, patient perspective, dietary supplements

Posted Date: November 19th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10411402/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Return to sport after cruciate ligament (ACL) reconstruction is a complex and lengthy process. Nutrition is an underutilized target in rehabilitation and standardized nutritional recommendations are lacking in existing guidelines. The aim of this study was to map the perceptions, experiences and barriers of both healthcare professionals and patients regarding nutritional advice within ACL rehabilitation (ACLR).

Methods

Two cross-sectional online surveys were conducted. One among healthcare professionals (n = 180) and one among patients with ACL injuries (n = 186). Both groups were recruited independently via professional networks and patient platforms. Quantitative data were descriptively analysed, and qualitative open-ended response were analysed on thematic analysis.

Results

The majority of both healthcare professionals, including orthopaedic surgeons, sports medicine physicians and physiotherapists, (79%) and patients (80%) believed that nutrition plays a role in ACLR. Only 22% of patients reported having received nutritional advice. Protein intake was the most frequently reported advice in both groups. The main barrier for healthcare professionals was insufficient knowledge regarding nutrition. Adherence to received advice was high among patients.

Conclusions

Our study showed that both healthcare professionals and patients share the perception that nutrition can play a role in ACLR. Main barriers for professionals to provide nutrition advice was insufficient knowledge and the absence of standardized guidelines. This study identified a gap between the perception of the importance of nutrition in ACLR and clinical practice, i.e. receiving nutritional advice, and supports the development of nutritional recommendations and incorporating these in ACLR guidelines and protocols.

Background

Returning to sport (RTS) after anterior cruciate ligament (ACL) reconstruction is a challenging and long process for athletes. About a fifth of athletes do not RTS, about a third do not return to their preinjury level, and about half do not return to competitive sport [1–3]. Among the athletes who do RTS, re-injury rates remain high, with secondary (ipsilateral and contralateral) ACL re-injury rates described as high as

23% [4]. The low RTS and high re-injury percentages are of concern and there is a need to optimise rehabilitation strategies after ACL injury.

The trajectory to RTS is multifactorial and challenges every member of the multidisciplinary team [5]. While research in the past decade has focused on aspects such as rehabilitation content, RTS criteria, and physical and psychological readiness, a critical gap remains in incorporating a more holistic view of patient care [6]. One underutilized factor within this landscape is nutrition. Existing literature research suggests that adequate and balanced nutrition can improve the healing process and is therefore essential for ACL rehabilitation (ACLR) progress [7–8]. Most sports injuries trigger an acute inflammatory process that initiates wound healing and soft tissue and/or bone repair. In this phase, sufficient energy and protein intake, as well as adequate levels of vitamins, minerals, and macronutrients, are important to optimize the initial healing process [9].

In the rehabilitation phase that follows, rapid soft tissue and bone deconditioning in the athlete occur due to mechanical unloading. Skeletal muscle appears to be the tissue most susceptible to disuse, with atrophy evident after only a couple of days of immobilisation [10]. Adequate protein intake may be a promising option attenuating atrophy following muscle disuse [11]. Given the metabolic demand of tissue recovery processes and the impact of disuse on muscle mass, maintaining energy balance and adequate protein intake are perhaps the most crucial nutritional aspect during rehabilitation [12, 13].

Standardized nutritional recommendations for ACLR are however currently lacking, in particular due to limited evidence and a scarcity of high-quality research on the relationship between nutrition and ACLR outcomes [14]. This may negatively impact the utilisation of the potential of nutrition in the treatment and rehabilitation of injuries like ACL ruptures. We therefore explored the perspective of the healthcare professional and patient on the role of nutrition in rehabilitation after ACL reconstruction in terms of knowledge, informing, advising, and barriers in clinical practice. Our objectives were to explore perspective and experience with nutritional advice in the context of ACLR and to examine how these differ between healthcare professionals and patients, to identify barriers experienced by both groups in giving and receiving nutritional advice, and to determine which nutritional strategies and recommendations are considered most effective.

Methods

Study design

The study consisted of two cross-sectional surveys on nutrition on ACLR. One questionnaire was designed for (para)medical professionals specialized in orthopaedic surgery, sports medicine, physiotherapy, or nutritional science. The other questionnaire targeted patients who underwent ACL reconstruction. The questionnaires were administered electronically using the Qualtrics survey tool (Qualtrics XM, Provo, UT USA) to ensure broad and efficient data collection. This study was reported in accordance with the STROBE guidelines.

Setting

The study was conducted at the end of 2024 by researchers from Sports Valley, the high-performance medical centre of Gelderse Vallei Hospital, Ede, The Netherlands, in collaboration with Wageningen University & Research, division of Human Nutrition and Health The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and complied with all applicable national and institutional regulations governing research involving human participants. It was designed to minimize burden on participants with a questionnaire that only took approximately 10 minutes. .

Participants

(Para)Medical professionals were recruited via professional networks and digital channels. The questionnaires were distributed via newsletters from the Dutch Association for Sports Physiotherapy (NVFS), The Dutch Arthroscopy Society (NVA), the Association for Sports Medicine (VSG) and the Team Physicians and consultants in professional football. Digital recruitment included LinkedIn professional networks. This multi-channel approach aimed to reach (Para)Medical professionals with direct clinical experience in ACLR. Patients were recruited via FC Kruisband (www.fckruisband.nl), a large Dutch and Belgian patient platform for ACL injuries.

Healthcare professionals and patients were recruited independently; we did not intend to have a direct patient-professional relationship between the two populations. Inclusion criteria in general were age 18 years and older and proficiency in Dutch language. Inclusion criteria for (para)medical professionals were; treated and/or supervised at least 3 patients per year with an ACL reconstruction. Healthcare professionals may include orthopaedic surgeons, sports physicians, physiotherapists, nutritionists/dietitians or strength and conditioning coaches. For the patients group additional inclusion criteria was having sustained an ACL injury. All participant information was treated confidentially and processed anonymously to ensure privacy and compliance with ethical standards.

Outcomes

The questionnaires aimed to assess perspectives, knowledge and practical experience with nutritional advice within the ACLR trajectory. Besides demographic and clinical background characteristics, the questionnaires explored perceived barriers to providing and receiving/following nutritional advice, and the extent to which nutritional advice was considered a relevant factor during rehabilitation.

Statistics

Descriptive statistics were analysed with Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). Quantitative data are presented as frequency of responses and/or percentage of total response with no further statistical analysis. Qualitative responses were analysed using thematic content analysis, with

respondent quotations. As not all questions were or could be answered by all participants, the number of respondents/ responses is indicated where appropriate.

Results

In total, 180 health care professionals and 186 patients completed the survey. Demographics and other characteristics can be found in Table 1. The healthcare professionals group consisted primarily of men (67%). Average age was 36 years, years of experience with ACLR was 9 years, and most professionals treated either between 4 and 20 patients per year (46%) or between 21 and 40 (16%). Within the professional's group, physiotherapists were most represented (n = 113) followed by orthopaedic surgeons (n = 43).

The patient group consisted primarily of women (72%), with an average age of 25 years. Of the patients, 120 (66%) were in active ACL rehabilitation during the time of the survey. The majority of patients (94%) had undergone ACL reconstruction.

Table 1
Demographic and clinical characteristics of study participants

Healthcare professionals		**Patients**	
(n = 180)		*(n = 186)*	
Sex		**Sex**	
Male	120 (67)	Female	133 (72)
Female	60 (33)	Male	52 (28)
		Non-binary	1 (1)
Age (years), median [IQR]	36 [29–43]	**Age (years), median [IQR]**	25 [21–29]
Profession (n = 175)		**Currently in ACLR trajectory (n = 183)**	
Physiotherapist	113	Yes	120 (66)
Orthopaedic surgeon	43	No, ACL injury in the past	63 (34)
Sports physician	7		
Dietitian/nutritionist	5	**Surgery history (n = 183)**	
Other/combination	29	Yes	173 (94)
		No	10 (6)
Years of experience, median [IQR] (n = 161)	9 [4–15]		
ACL patients seen per year (n = 160)			
0–20	79 (49)		
21–40	26 (16)		
41–60	10 (6)		
61–80	5 (3)		
81–100	6 (4)		
>100	34 (21)		

Values are presented as n (%) unless otherwise indicated

ACL anterior cruciate ligament, ACLR anterior cruciate ligament rehabilitation, IQR interquartile range

Multiple answers were possible

Professional’s perspective and knowledge

The vast majority of professionals agreed (45%, n = 65) or strongly agreed (34% n = 50) with the statement that nutrition plays a role in ACLR (Fig. 1A). No professional strongly disagreed with the statement. When comparing the two most dominant groups in the professionals cohort, physiotherapists and physicians (orthopaedic surgeons and sports physicians), the first were more likely to (strongly) agree with the statement (87% vs 56% for physiotherapists and physician respectively, Table 2). Regarding the aspects most positively influenced by optimal nutrition, healthcare professionals indicated that recovery of muscle size and function benefits the most, followed by the ability to sustain the rehabilitation program. Recovery of the ACL graft after reconstruction was considered least influenced by nutrition.

When asked to assess their own nutritional knowledge about nutrition during ACLR; professionals rated their knowledge as good/excellent, 36% (n = 50), average, 41% (n = 57) and 22% (n = 31) as poor/very poor. More physiotherapists rated their own nutritional knowledge as good/excellent compared to physicians (orthopaedic surgeons and sports physicians) (44% vs 15%; Table 2) The most frequently mentioned source of information to obtain knowledge was networking with colleagues (69 responses), followed by conferences and seminars (43 responses) and social media channels (35 responses). Peer-reviewed journals were mentioned by 35 respondents. Less frequently mentioned sources were patient experiences and online platforms (both 8 times).

Table 2
Comparison of healthcare professionals by profession

Variable	Total	Physiotherapists	Physicians
'Nutrition plays a role'			
Agree/strongly agree	108/138 (78)	86/99 (87)	22/39 (56)
Self-rated nutrition knowledge level			
Good/excellent	50/138 (36)	44/99 (44)	6/39 (15)
Average	57/138 (41)	43/99 (43)	14/39 (36)
Poor/very poor	31/138 (22)	12/99 (12)	19/39 (49)
Frequency of nutrition discussion			
Always/often	55/132 (42)	50/94 (53)	5/38 (13)
Sometimes	39/132 (30)	27/94 (29)	12/38 (32)
Rarely/never	38/132 (29)	17/94 (18)	21/38 (55)

Values are presented as n/N (%), where N is the number of respondents per item

Physicians comprise orthopaedic surgeons and sports physicians

Excludes respondents who indicated they refer to a dietitian/nutritionist (n = 5)

Nutritional advice and barriers

Regarding the frequency of nutrition advice given to ACL patients, 42% (n = 55) of professionals stated that they always or often discuss nutrition, 30% (n = 39) sometimes, and 29% (n = 38) rarely or never (Table 2.). Only 4% (n = 5) refers to a dietitian for nutritional advice. 53% of the physiotherapists always/often discussed nutrition compared to only 13% of the physicians (Table 2).

Thematic analysis of responses to open questions (n = 103) regarding specific nutritional advice showed protein intake as the dominant theme. Other mentioned topics included general healthy nutrition, vitamins, supplements, collagen, carbohydrates and stop smoking.

Professionals stated multiple barriers to providing nutritional advice (there were multiple responses possible, n = 110). Most frequently reported barrier was insufficient nutritional knowledge (n = 62), followed by lack of training in nutrition counselling (n = 51). The other significant barriers included

difficulty measuring the impact of nutrition on recovery (n = 43) and limited time during consultations (n = 42).

Patient's Perspectives and Experiences

The majority of patients (80%) indicated that they think that nutrition has played or can play a role in their ACLR (Fig. 1B). Only 5% of patients indicated that nutrition has no role in their rehabilitation. Only 38 (22%) patients reported receiving or having received nutritional advice during their ACLR. This advice was primarily given by physiotherapists and dietitians/nutritionists. Less frequently mentioned were personal trainers and orthopaedic surgeons, while some patients indicated to have received information via online sources.

Of those receiving advice, the majority of patients did indicate having received guidance during the rehabilitation phase post-surgery, with nearly one third of respondents (also) received advice pre-surgery.

Thematic analysis of open-ended responses from patients who received nutritional advice revealed protein intake as the main theme. Other themes included supplements, i.e. vitamins and collagen, and general healthy nutrition.

37 of the 38 patients who received nutritional advice responded to questions about adherence. High adherence ('Yes always' and 'mostly Yes') was reported by 35 patients, only 2 patients reported rarely or not following the recommendations.

Regarding barriers, most patients reported experiencing no barriers. Among those who did experience barriers, the most common were difficulty implementing the advice, lack of specific information, and financial costs. Less frequently reported barriers included insufficient nutritional knowledge.

Discussion

The most important finding of this study was that a large majority of healthcare professionals (79%) agree or strongly agree that nutrition plays a role in ACLR closely mirroring the patient's perspective (80%). This high percentage is remarkable since only 43% of the professionals discussed nutrition always/often, while an even a smaller number of patients (22%) reported having received nutritional advice. Physiotherapists did more often discuss nutrition with their patients compared to physicians. When advice was given or received, the main recommendation was to optimize protein intake. A lack of nutritional knowledge was the greatest barrier reported by the healthcare professionals. Patients indicated that adherence to nutritional advice was high.

The potential of nutrition in ACLR as recognised by both the professionals and the patients, aligns with the increasing quantity of scientific interest and evidence. Multiple recent reviews emphasize the role of nutrition in tissue repair, muscle mass maintenance, and return to sport after injuries including ACL reconstruction [7, 11–14]. Quadriceps muscle atrophy due to disuse is one of the most functional relevant consequences of an ACL injury, which persist despite rehabilitation [11]. A recent large-scale

systematic review concluded that knee extensor strength was still reduced by more than 10% after one year compared to the uninjured leg with minimal improvement after this point up to five years post-surgery [15]. This deficit is a significant barrier to a return to sport and contributes to the risk of re-rupture [4]. This was recognised by the healthcare professionals, as recovery of muscle mass and function was mentioned as the most important reason to give nutritional advice.

Protein intake was the key nutritional theme for professionals, and the main topic of advice as reported by the patients. Protein intake can play a major role in the aforementioned disuse muscle atrophy. George et al. conducted a systematic review of 14 randomized controlled trial and concluded that protein supplementation post-surgery, including ACL reconstruction, significantly protected against muscle atrophy as measured by cross-sectional area and isokinetic muscle strength [16, 17]. In general, a protein intake of 1.6–2.5 g/kg/day in athletic rehabilitation is recommended, with sufficient carbohydrates (energy) to prevent protein catabolism as an energy source [13, 18].

A number of patients and health professionals mentioned, next to protein, supplements and vitamins in general as nutritional strategies. Indeed, existing literature suggests important roles for Omega 3 fatty acids and Vitamin D in orthopaedic rehabilitation [7, 11, 13]. Omega-3 fatty acids also play an important role during ACLR by regulating the postoperative inflammatory response by inhibiting pro-inflammatory cytokines (TNF-α, IL-1β) and promote the organization of collagen fibers in extracellular connective tissue [19]. Vitamin D deserves specific attention as potentially underutilized nutritional factor. Vitamin D deficiency is prevalent not only in the general population, but specifically also in (indoor) athletes. Backx et al. (2017) found in a longitudinal study of Dutch elite athletes that vitamin D status showed strong seasonal variation. Lowest values were found in winter, a finding that is particularly relevant to Dutch practice [20]. Vitamin D deficiency is associated with reduced muscle strength and delayed recovery after orthopaedic surgery [21]. An ongoing double-blind randomized placebo-controlled trial by Ong et al. is currently investigating whether vitamin D supplementation improves quadriceps strength maintenance after ACL reconstruction, with results pending [21].

Although the quantity of evidence is increasing, nutritional advice seems not to be a standard procedure during ACLR, at least in the perception of the patients included in this study. Only 22% indicated to have received advice, and adherence was (self-)reported to be strong, indicating that patients are open to nutritional advice in ACLR. Indeed, Germano et al. [22] showed that patients are open to it but do not know how to achieve optimal nutrition. The healthcare professionals indicated that they discuss nutrition always/often in 43% of the cases. Physiotherapists reported discussing nutrition more often, which aligned with the perception of the patients – as the physiotherapist was most often cited as the source of nutritional advice. We sampled patients and professionals separately, and therefore no direct patient-professional relationship between the two populations existed in our study. A lack of clear protocols or recommendations for nutrition advice in ACLR could be an explanation for the relatively low frequency of nutritional advice.

We found that professionals indicated that insufficient knowledge was the greatest barrier, followed by a lack of formal training. This is a broadly found pattern, not only in ACLR, but identified generally in the medical profession. Khiri and Howells [23] identified in a recent scoping review four structural reasons for the nutritional knowledge gap in medicine: insufficient time for nutritional education, lack of clinical confidence, stigma around nutritional advice and practical barriers to implement nutritional advice. A perspective article from 2024 stated that most medical schools globally did not meet the minimum 25 hours of nutritional education per residency [24]. This shows a systematic lag on nutrition in clinical practice. Eisenberg et al. (2024) published a consensus statement on specific nutritional competencies for physicians in training, a possible starting point to ensure nutritional knowledge in the medical curricula [25].

Current national [26, 27] and international protocols [28] and guidelines do not contain standardized nutritional advice specifically for ACLR. In the Netherlands, the last multidisciplinary NOV/FMS guideline [26] from 2018 consists of the complete pathway from surgical indications to return to sports. This guideline refers to nutrition indirectly in the form of BMI optimization without a specific nutritional protocol. The evidence-based clinical practice guideline on ACLR by Van Melick et al. [27] addressed nine clinical topics, including amongst others preoperative predictors, strength and neuromuscular training and return to sport. Nutritional advice is again not mentioned. Internationally Best Practice Guidelines for the Management of ACL injuries [28] supported by the British Orthopaedic Association described the importance of prehabilitation, but did not provide nutritional recommendations. Translating existing evidence into clinical practice is essential to improve nutritional knowledge among healthcare professionals. Since persistent muscle weakness and insufficient physical recovery are considered important contributors to unsuccessful return to sport and secondary ACL injuries [15], nutritional strategies that support muscle maintenance, tissue healing and recovery may indirectly contribute to improved rehabilitation outcomes and reduced re-injury risk.

Strengths and limitations

This study is the first reporting perceptions of both healthcare professionals and patients on the role of nutrition in ACL rehabilitation. This dual approach enabled us to collect valuable data on the perspective and barriers of both the professional and patient on the topic of nutrition and ACLR. The inclusion of different professional groups, orthopaedic surgeons, sports physicians, physiotherapists and dietitians, offered a broad perspective. To minimize selection bias, participants were recruited through multiple professional associations, patient platforms and digital networks instead of a single clinical centre. However, selection bias cannot be ruled out, as individuals with a more positive attitude toward nutrition may have been more likely to complete the survey. Healthcare professionals and patients were recruited independently, without intended pairing between both groups. Recall bias was reduced by using a concise questionnaire focused on current and recent experiences regarding nutritional advice during ACL rehabilitation. In addition, most patients were still actively involved in rehabilitation at the time of participation. However, the study had several other limitations. The outcome measures were based on self-report where recall bias and/or wishful answers cannot be ruled out. A further limitation is the

limited participation of dietitians among the healthcare professional respondents, and may be indicative of the lack of cross-disciplinary collaboration. Finally, the Dutch sample probably limits generalizability to foreign healthcare systems with different financing structures and educational backgrounds.

Clinical practice

This survey highlighted the strong perception of both patients and healthcare professionals that nutrition can play a role in ACLR. However, the survey also indicated that giving or receiving nutrition advice is not a standard part of the rehabilitation trajectory. The motivation is there, the challenge is to create a standardized protocol to incorporate evidence based nutritional advice into the pre- and postoperative consultation. Patient education but most important education of healthcare professionals is a key component. Our study reported a strong adherence of patients and Germano et al. [22] showed that patients are open to it but do not know how to achieve optimal nutrition. For example, a standardized patient brochure could enhance patient motivation and adherence without an investment from the healthcare professional.

This study indicates the potential of a validated standardized nutritional protocol for ACLR as part of the perioperative and rehabilitation trajectory. But to develop such protocols, future studies are needed to provide solid scientific evidence for specific nutritional interventions. Current literature is fragmented and shows methodological heterogeneity. [17] Well-designed trials on protein dosing and supplementation of vitamin D and omega-3 fatty acids in an ACL reconstruction population should fill this gap.

Conclusion

Our study showed that both healthcare professionals and patients share the perception that nutrition can play a role in ACLR. Main barriers for professionals to provide nutrition advice was insufficient knowledge and the absence of standardized guidelines. This study identified a gap between the perception of the importance of nutrition in ACLR and clinical practice, i.e. receiving nutritional advice, and supports the development of nutritional recommendations and incorporating these in ACLR guidelines and protocols.

Abbreviations

ACL
Anterior Cruciate Ligament
RTS
Return to sports
ACLR
Anterior Cruciate Ligament Rehabilitation

Declarations

Ethics approval and consent to participate: The study was conducted in accordance with relevant ethical guidelines and regulations for research involving human participants. It was designed to minimize burden on participants with a questionnaire that only took approximately 10 minutes. Prior to participation in this study, informed consent was obtained from all participants. Participants were informed about the purpose of the study and the confidentiality of their data.

Consent for publication: Not applicable

Availability of data and materials: : The datasets used and/or analysed during the current study are available from the corresponding author on request.

Competing interests: Not applicable

Funding: No funding was received for this work

Authors' contributions:

DH was responsible for interpretation of the data and writing the manuscript.

MM conceived and designed the study, performed data analysis, and drafted the manuscript.

EO was involved in data collection and manuscript editing

WVDW was involved in the study design, data collection, and manuscript editing.

DB was involved in data collection and manuscript editing.

WW was involved in the study design, data collection, and manuscript editing.

JZ conceived and designed the study, performed data analysis, and drafted the manuscript.

All authors contributed to manuscript revision and approved the final version.

Acknowledgements: Not applicable

References

1. Ardern CL, Taylor NF, Feller JA, Webster KE. Fifty-five per cent return to competitive sport following anterior cruciate ligament reconstruction surgery: an updated systematic review and meta-analysis including aspects of physical functioning and contextual factors. Br J Sports Med. 2014;48(21):1543–52. 10.1136/bjsports-2013-093398.
2. Ardern CL, Webster KE, Taylor NF, Feller JA. Return to sport following anterior cruciate ligament reconstruction surgery: a systematic review and meta-analysis of the state of play. Br J Sports Med. 2011;45(7):596. 10.1136/bjsm.2010.076364.

3. Gokeler A, Dingenen B, Hewett TE. Rehabilitation and Return to Sport Testing After Anterior Cruciate Ligament Reconstruction: Where Are We in 2022? Arthrosc. Sports Med Rehabilitation. 2022;4(1):e77–82. 10.1016/j.asmr.2021.10.025.
4. Wiggins AJ, Grandhi RK, Schneider DK, Stanfield D, Webster KE, Myer GD. Risk of secondary injury in younger athletes after anterior cruciate ligament reconstruction: a systematic review and meta-analysis. Am J Sports Med. 2016;44(7):1861–76. 10.1177/0363546515621554.
5. Zaffagnini S, Grassi A, Marcheggiani Muccioli GM, Tsapralis K, Ricci M, Bragonzoni L, et al. Return to sport after anterior cruciate ligament reconstruction in professional soccer players. Knee. 2014;21(3):731–5. 10.1016/j.knee.2014.02.005.
6. Welling W, Gokeler A, Benjaminse A, Verhagen E, Lemmink K. Have we forgotten our patient? An exploration of patient experiences after anterior cruciate ligament reconstruction. J Sport Rehabil. 2022;31(8):993–9. 10.1123/jsr.2021-0270.
7. Papadopoulou SK, Mantzorou M, Kondyli-Sarika F, Alexandropoulou I, Papathanasiou J, Voulgaridou G, et al. The key role of nutritional elements on sport rehabilitation and the effects of nutrients intake. Sports (Basel). 2022;10(6):84. 10.3390/sports10060084.
8. Shaw G, Serpell B, Baar K. Rehabilitation and nutrition protocols for optimising return to play from traditional ACL reconstruction in elite rugby union players: a case study. J Sports Sci. 2019;37(15):1794–803. 10.1080/02640414.2019.1594571.
9. Demling RH. Nutrition, anabolism, and the wound healing process: an overview. Eplasty. 2009;9:e9.
10. Wall BT, Snijders T, Senden JMG, Ottenbros CLP, Gijsen AP, Verdijk LB, et al. Disuse impairs the muscle protein synthetic response to protein ingestion in healthy men. J Clin Endocrinol Metab. 2013;98(12):4872–81. 10.1210/jc.2013-2098.
11. Smith MJ, Hoffman NJ, Jose AJS, et al. Nutritional Interventions to Attenuate Quadriceps Muscle Deficits following Anterior Cruciate Ligament Injury and Reconstruction. Sports Med. 2025;55:569–96. https://doi.org/10.1007/s40279-025-02174-w.
12. Collins J, Maughan RJ, Gleeson M, Bilsborough J, Jeukendrup A, Morton JP, et al. UEFA expert group statement on nutrition in elite football. Current evidence to inform practical recommendations and guide future research. Br J Sports Med. 2021;55(8):416–28. 10.1136/bjsports-2019-101961.
13. Close GL, Sale C, Baar K, Bermon S. Nutrition for the Prevention and Treatment of Injuries in Track and Field Athletes. Int J Sport Nutr Exerc Metab. 2019;29(2):189–97. 10.1123/ijsnem.2018-0290.
14. Raghoebar S, Roozenboom-van Vliet C, van der Wal W, Welling W, Boersma D, Oosting E, Zwerver J, Mensink M. Nutrition and rehabilitation after anterior cruciate ligament reconstruction: a systematic review. Knee Surg Sports Traumatol Arthrosc. 2026;1–17. 10.1002/ksa.70441.
15. Girdwood M, Culvenor AG, Rio EK, Patterson BE, Haberfield M, Couch J, et al. Tale of quadriceps and hamstring muscle strength after ACL reconstruction: a systematic review with longitudinal and multivariate meta-analysis. Br J Sports Med. 2025;59(6):423–34. 10.1136/bjsports-2023-107977.
16. Greif DN, Emerson CP, Allegra P, Arizpe A, Mansour KL, Cade WH 2nd, Baraga MG. Supplement use in patients undergoing anterior cruciate ligament reconstruction: a systematic review. Arthroscopy.

2020;36(9):2537–49. 10.1016/j.arthro.2020.04.047.

17. George A, Holderread BM, Lambert BS, Harris JD, McCulloch PC. Post-operative protein supplementation following orthopaedic surgery: a systematic review. Sports Med Health Sci. 2024;6(1):16–24. 10.1016/j.smhs.2023.08.002.
18. Papadopoulou SK. Rehabilitation nutrition for injury recovery of athletes: the role of macronutrient intake. Nutrients. 2020;12(8):2449. 10.3390/nu12082449.
19. Calder PC. Omega-3 fatty acids and inflammatory processes. Nutrients. 2010;2(3):355–74. 10.3390/nu2030355.
20. Backx E, van der Avoort C, Tieland M, Maase K, Kies A, van Loon L, et al. Seasonal variation in vitamin D status in elite athletes: a longitudinal study. Int J Sport Nutr Exerc Metab. 2017;27(1):6–10. 10.1123/ijsnem.2016-0177.
21. Ong MTY, Lu X, Choi BCY, Wan SW, Wang Q, Man GCW, et al. Vitamin D as an intervention for improving quadriceps muscle strength in patients after anterior cruciate ligament reconstruction: study protocol for a randomized double-blinded, placebo-controlled clinical trial. Trials. 2024;25(1):251. 10.1186/s13063-024-08094-w.
22. Germano J, Baichoo N, Germano A, Scuderi G. Patient perception of preoperative nutrition and recovery after orthopaedic surgery. J Arthroplasty. 2024;39(9):2221–4. 10.1016/j.arth.2024.04.035.
23. Khiri N, Howells K. Nutritional education in medical curricula and clinical practice: a scoping review on the knowledge deficit amongst medical students and doctors. J Hum Nutr Diet. 2025;38(2):e70031. 10.1111/jhn.70031.
24. Albin JL, Thomas OW, Marvasti FF, Reilly JM. There and back again: a forty-year perspective on physician nutrition education. Adv Nutr. 2024;15(6):100230. 10.1016/j.advnut.2024.100230.
25. Eisenberg DM, Cole A, Maile EJ, Salt M, Armstrong E, Broad Leib E, et al. Proposed nutrition competencies for medical students and physician trainees: a consensus statement. JAMA Netw Open. 2024;7(9):e2435425. 10.1001/jamanetworkopen.2024.35425.
26. Nederlandse Orthopaedische Vereniging. Nazorg bij VKB-letsel (postoperatieve traject). Richtlijn Voorste kruisbandletsel [internet]. Utrecht: Richtlijnendatabase; 2018. [geraadpleegd 12 maart 2026]. Beschikbaar via. https://richtlijnendatabase.nl/richtlijn/voorste_kruisbandletsel/nazorg_bij_vkb-letsel_postoperatieve_traject.html.
27. van Melick N, van Cingel REH, Brooijmans F, Neeter C, van Tienen T, Hullegie W, et al. Evidence-based clinical practice update: practice guidelines for anterior cruciate ligament rehabilitation based on a systematic review and multidisciplinary consensus. Br J Sports Med. 2016;50(24):1506–15. 10.1136/bjsports-2015-095898.
28. British Association for Surgery of the Knee (BASK); British Orthopaedic Sports Trauma and Arthroscopy Association (BOSTAA). Best practice book for management of anterior cruciate ligament (ACL) injuries [internet]. London: British Orthopaedic Association. 2020 [cited 2025].

Available from: https://www.boa.ac.uk/resource/best-practice-book-for-management-of-anterior-cruciate-ligament-injuries.html

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- QuestionnairepatientsEN.pdf