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Human Kinetics
METHODOLOGY REVIEWS

Methodological and Statistical Quality in Research Evaluating Nutritional Attitudes in Sports

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The assessment of dietary attitudes and behaviors provides information of interest to sports nutritionists. Although there has been little analysis of the quality of research undertaken in this field, there is evidence of a number of flaws and methodological concerns in some of the studies in the available literature. This review undertook a systematic assessment of the attributes of research assessing the nutritional knowledge and attitudes of athletes and coaches. Sixty questionnaire-based studies were identified by a search of official databases using specific key terms with subsequent analysis by certain inclusion–exclusion criteria. These studies were then analyzed using 33 research quality criteria related to the methods, questionnaires, and statistics used. We found that many studies did not provide information on critical issues such as research hypotheses (92%), the gaining of ethics approval (50%) or informed consent (35%), or acknowledgment of limitations in the implementation of studies or interpretation of data (72%). Many of the samples were nonprobabilistic (85%) and rather small (42%). Many questionnaires were of unknown origin (30%), validity (72%), and reliability (70%) and resulted in low (≤ 60%) response rates (38%). Pilot testing was not undertaken in 67% of the studies. Few studies dealt with sample size (2%), power (3%), assumptions (7%), confidence intervals (3%), or effect sizes (3%). Improving some of these problems and deficits may enhance future research in this field.

Keywords: athletes, nutrition, behavior, methods, questionnaires, statistics

Research evaluating attitudes toward nutrition in the sports environment focuses mainly on specific cognitive and behavioral traits of athletes (Rosenbloom et al., 2002) and coaches (Bedgood & Tuck, 1983). Athletes and coaches exhibit poor nutritional knowledge, and this necessitates proper nutrition planning and education (Jessri et al., 2010; Torres-McGehee et al., 2012), but primarily the design and conduction of high-quality research (Heaney et al., 2011). Assessing the quality of research is a common practice in sports medicine (Brophy et al., 2005), physical education (Chatoupis & Vagenas, 2011), sports management (Smucker & Grappendorf, 2008), athletic coaching (Gilbert & Trudel, 2004), and adapted physical activity (Zhang et al., 2006). In sports nutrition, however, the only relevant review examined solely nutritional knowledge traits, and it briefly assessed only some of the potential methodological threats (Heaney et al., 2011).

The present study aimed to evaluate the methodology of research assessing the cognitive and behavioral traits of athletes and coaches toward sports nutrition, with a specific focus on studies of knowledge, opinions, beliefs, attitudes, habits and practices. Our objective was to evaluate the methodological and statistical aspects of this research by collecting all relevant studies and then identifying, tabulating, coding, and systematically analyzing their characteristics. By undertaking this study, we hoped to identify potential deficits and problems with quality, the improvement of which may enhance future research in this field.

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Methods

Searching, Selection, and Final Sample

We searched Google Scholar, PubMed (Medline), and ISI Web of Science with the last month of analysis being April 2013. Search key terms included nutrition, knowledge, opinions, beliefs, attitudes, habits, practices, behaviors, sports, athletes, coaches. The bibliography of the selected papers was checked to find additional relevant studies. We excluded a variety of papers from further processing (Appendix I): reviews, conference proceedings, papers that were published in other languages, and studies that assessed nutritional attitudes in relation to various health issues (e.g., cardiovascular: Armstrong et al., 1990). Three studies were excluded because of their use of dietary records (Aerenhouts et al., 2008; Berning et al., 1991; van Erp Baart et al., 1989) or a 3-day inventory of food (Cole et al., 2005) rather than questionnaires. Studies that met the criteria for inclusion—namely, being written in English; employing questionnaires; and examining at least one cognitive–behavioral characteristic of nutrition in healthy athletes, coaches, or physical education students—are summarized in Appendix II. The final sample consisted of 60 studies.

Variables (Criteria), Processing, Analysis

Thirty-three variables were chosen to assess the quality of research according to a number of methodological (Table 1), questionnaire (Table 2), and statistical (Table 2) criteria. The raw data were extracted, classified, and tabulated in their original format and then converted to analyzable numerical values according to specific ordered or nominal categories. Each quantitative criterion was analyzed by descriptive statistics, and each categorical was converted to frequencies (f, %f). All analyses were carried out in SPSS 22.

Results

Methodological Criteria: General

A summary of the general methodological characteristics of the studies included in the review is displayed in Table 1. From the total of 202 authors, the vast majority (188) participated in only one study (93%), with only 14 authors participating in two to four studies (the maximum repeated authorship). The number of coauthors ranged from one (three studies, 5%) to six (eight studies, 13%).

Thirty-four of the studies (57%) were published in nutrition journals and 26 (43%) in sport science journals ($p > .05$). The impact factor of each journal was assessed according to factor categories and ranged from 0 to 0.9 (lowest category: 18 studies, 30%) to ≥3 (highest category: 16 studies, 27%). Of the 60 studies, 21 (35%) were published between 2000 and 2009, 13 (22%) between 1974 and 1989, and 11 (18%) between 2010 and 2013. Only half of the studies (50%) identified that approval from an ethics committee had been obtained, and informed consent was gained from the participants in 36 (60%).

Methodological Criteria: Specific

Only 8% of the studies stated a hypothesis to guide their inquiry. Participants were recruited via convenience sampling in 85% of studies, and only 7% included control groups. Response rate was found or calculated in 57% of the studies and ranged from 21% to 98%. High response rates (≥81% of invited participants) were found in 17% of the studies while 7% of investigations reported response rates that were lower or equal to 40%. Participant populations included athletes (77% of the studies), coaches (13%), a combination of athletes and coaches (7%), and physical education students (3%). Respondents included a combination of males and females in 50% of the studies while females only and males only were studied in 30% and 18% of studies, respectively. The number of sports represented in studies ranged from one to 18, with the mode being one sport (48%).

Within investigations, the number of dependent variables ranged from one (48% of the studies) to three (17% of studies). Independent variables were inferred in 92% of the studies and ranged from one (37% of studies) to 10 (2% of studies). Limitations of the studies were recognized in 28% of the papers while 30% of the studies stated recommendations for future work.

Questionnaire Criteria

The results of the analysis of questionnaire criteria are displayed in Table 2. Seventy-two percent of the studies included questions related to general and sports nutrition whereas 27% covered only general nutrition issues and 2% targeted sports nutrition only. A preexisting questionnaire was adopted in 25% of the studies and adapted in another 18% while 27% of the studies used a new tool and 30% used a questionnaire of unspecified origin. A pilot study was undertaken in 33% of the studies. Questionnaire validity was considered only in 28% of the studies while there was uncertainty in 70% of investigations regarding the measurement of questionnaire reliability.

Statistical Criteria

The results of the statistical criteria are displayed in Table 2. Sample size and power calculations were reported only in 2% and 3% of the studies, respectively. Sample sizes (e.g., the number of respondents) varied from 13 to 4,746, with the mean and mode being 385 (±772) and 31, respectively. Sample sizes were considered to be very small (< 50) in 23% of the studies and very large (501–5,000) in 18%.

Statistical assumptions were stated in only 7% of the studies. Parametric analyses were undertaken in 53% of the studies whereas data were treated with nonparametric analyses in 8%, and mixed analyses in 23%. Fifteen percent of the studies used only descriptive statistics. The number of distinct statistical analyses ranged from one in 38% of the studies to three or more in 27%. Confidence intervals and effect sizes were reported only in 3% of the studies.

Discussion

General Methodological Criteria

Coauthorship is a critical prerequisite of scientific research, with studies showing a relationship to the quality of the research (Lawani, 1986). Indeed, Melin (2000) interviewed 195 university professors and found that 30% of them ascribed higher scientific quality to collaboration. Collaborations take advantage of the expertise and qualifications of each researcher (Daprano et al., 2005) and achieve better research outcomes in shorter time periods (Lee & Bozeman, 2005). In our current review, 95%

Table 1 Methodological Criteria (General, Specific): Categories and Frequencies (f, %f)

	Categories					
Criteria	**1**	**2**	**3**	**4**	**5**	**6**
No. of authors	1 author: 3 (5%)	2 authors: 15 (25%)	3 authors: 20 (33%)	4 authors: 9 (15%)	5 authors: 5 (8%)	6 authors: 8 (13%)
Same authorship	1 study: 188	2 studies: 10	3 studies: 2	4 studies: 2		
Journal subject	Nutrition/diet: 34 (57%)	Other: 26 (43%)				
Impact factor[a]	0–0.9: 18 (30%)	1–1.9: 14 (23%)	2–2.9: 12 (20%)	≥3: 16 (27%)		
Publication year	1974–1989: 13 (22%)	1990–1999: 15 (25%)	2000–2009: 21 (35%)	2010–2013: 11 (18%)		
Ethical approval	Yes: 30 (50%)	No: 30 (50%)				
Consent (participants)	Yes: 36 (60%)	No: 21 (35%)	Not sure: 3 (5%)			
Research hypothesis	Yes: 5 (8%)	No: 55 (92%)				
Sampling type	Convenience: 51 (85%)	Other: 9 (15%)				
Control group	Yes: 4 (7%)	No: 56 (93%)				
Response rate	21–40%: 4 (7%)	41–60%: 9 (15%)	61–80%: 11 (18%)	81–100%: 10 (17%)	Not stated: 26 (43%)	
Participants type	Athletes: 46 (77%)	Athletes/ coaches: 4 (7%)	Coaches: 8 (13%)	PE students: 2 (3%)		
Participants' sex	Males: 11 (18%)	Females: 18 (30%)	Males/Females: 30 (50%)	Not defined: 1 (2%)		
No. of sports	1–3: 36 (60%)	4–6: 4 (7%)	7–9: 6 (10%)	10–12: 1 (2%)	13–15: 5 (8%)	16–18: 1 (2%)
Dependent variables	1: 29 (48%)	2: 21 (35%)	3: 10 (17%)			
Independent variables	1: 22 (37%)	2: 16 (27%)	3: 2 (3%)	4: 5 (8%)	5: 3 (5%)	6–10: 7 (12%)
Limitations	Yes: 17 (28%)	No: 43 (72%)				
Recommendations	Yes: 18 (30%)	No: 42 (70%)				

[a]Impact factor sources: Hopkins (2011, 2012), journal's website, http://www.medical-journals-links.com/nutrition-journals.php, or journals relevant to nutrition-diet (Medical Journal Links, 2012). Journals with unknown or too small (< 0.1) impact factor were assigned a 0.

Table 2 Questionnaire and Statistical Criteria: Categories and Frequencies (f, %f)

	Categories				
Criteria	**1**	**2**	**3**	**4**	**5**
Subject-topic	General nutrition: 16 (27%)	Sport nutrition: 1 (2%)	General/sport nutrition: 43 (72%)		
Origin-application	Adopted: 15 (25%)	Adapted: 11 (18%)	New: 16 (27%)	Not defined: 18 (30%)	
Pilot study	Yes: 20 (33%)	No: 40 (67%)			
Validity	Yes: 17 (28%)	No: 43 (72%)			
Reliability	Yes: 18 (30%)	No: 42 (70%)			
Sample size estimation	No: 59 (98%)	Yes: 1 (2%)			
Power calculation	No: 58 (97%)	Yes: 2 (3%)			
Sample size M = 385, *SD* = 772	1–50: 14 (23%)	51–100: 11 (18%)	101–200: 11 (18%)	201–500: 13 (22%)	501–5,000: 11 (18%)
Statistical assumptions	Homogeneity/ normality: 1(2%)	Normality: 2 (3%)	Multicollinearity: 1 (2%)	Not defined: 56 (93%)	
Type of statistical analysis	Descriptive: 9 (15%)	Nonparametric: 5 (8%)	Parametric: 32 (53%)	Nonparametric & parametric: 14 (23%)	
Number of statistical analyses	1: 23 (38%)	2: 21 (35%)	3+: 16 (27%)		
Confidence intervals	No: 58 (97%)	Yes: 2 (3%)			
Effect size	No: 58 (97%)	Yes: 2 (3%)			
Alpha level (α)	.001: 1 (2%)	.01: 1 (2%)	.05: 39 (65%)	NA: 9 (15%)	Not defined: 10 (17%)
Exact *p* value	No: 36 (60%)	NA: 9 (15%)	Yes: 15 (25%)		

Note. NA = not applicable.

of the studies included three or more coauthors, which is more than satisfactory compared with other fields of sport science. For example, studies with two or more coauthors account for 82% of publications in physical education (Chatoupis & Vagenas, 2011), 62% in sports management (Smucker & Grappendorf, 2004), 70% in adapted physical education (Zhang et al., 2006), and 40% in sports economics (Mondello & Pedersen, 2003).

The publication outlet for studies included in the present review was related to nutrition or diet in 57% of investigations (e.g., *International Journal of Sport Nutrition and Exercise Metabolism* or *Journal of American Dietetic Association*), with the remainder of journals being focused on sports science (e.g., *Journal of Athletic Training*). This finding reflects both the higher interest in the chosen topic within the field of nutrition as well as the desire of authors to target journals with established quality. We noted that 53% of the studies were published in journals with low impact factors (<2) while 27% of the studies were found in journals with higher impact factor (≥3). The impact factor, although established as an index to rate the quality of published research, is subject to an ongoing debate (Postma, 2007; Seglen, 1997). In addition, it varies with the subject area and the type and the size of the journal, as well as with the number of authors (Glänzel & Moed, 2002). For example, primary scientific outlets have higher impact factors than specific and applied subjects (Amin & Mabe, 2000). Indeed, the impact factors of sports science journals are lower than those of primary science journals such as those covering medicine and biology (Tsigilis et al., 2010). Thus, the 30% of the studies published in journals with very low (<1) impact factors are not necessarily of low quality. Simply, some of the relevant journals have a shorter publishing history or a preference for certain types of research. The slight increase in the number of publications from 1974 to 2013 indicates an increase in the scientific interest in this field, as well as a general increase in the number of journals dedicated to nutrition/diet and sports science.

It is concerning that 50% of the studies included in the present review did not report obtaining approval from a human ethics committee, and 35% of them failed to describe obtaining informed consent from their participants. The former is considered part of the *procedural ethics* while the latter is part of the *ethics in practice* in scientific research (Guillemin & Gillam, 2004). Since both criteria are mandatory conditions in the ethical conduct of research, they should have been conducted and clearly described in their respective papers. Indeed, this information is a prerequisite for publication in several journals (e.g., *IJSNEM*).

Specific Methodological Criteria

Historically, research hypotheses have been considered as essential elements of scientific logic (Mayo & Spanos, 2006), required to formulate testable relationships between variables (Kerlinger, 1992) as null or alternative reflections of the research questions under study (Banerjee et al., 2009). However, for the past decades, it has become rarer for published scientific works to include a declaration of the hypotheses underpinning their investigations; this is evident in the field we have investigated since 92% of the analyzed studies lacked an identified hypothesis.

Typically, the sampling schemes used in research are considered to be either probabilistic/random or nonprobabilistic (Collins et al., 2006; Pedhazur, 1982). The vast majority (85%) of the studies reviewed in our analysis gained their respondents using convenience sampling; that is, by recruiting from a readily accessible population of athletes or coaches. The practical difficulties associated with obtaining true random samples of the wider community of interest are acknowledged and explain the almost universal practice of using convenience sampling in many fields (Kerlinger, 1992). However, the disadvantage is that it is considered unsafe to generalize the results of a study of a specific subpopulation to a larger population unless the participants adequately represent the strata of the target group (Keppel & Wickens, 2004). While the results of the presently reviewed studies may well reflect the characteristics of their samples, there is much opportunity for future research to gain insights from larger and more representative athlete populations by using random sampling techniques. The problem of nonresponse of research participants in completing/returning questionnaires adds to sampling errors. Nonresponse is essentially equivalent to participant attrition and is a serious threat to the validity and the reliability of the statistical findings (Fincham, 2008; Pedhazur, 1982). Although there is no agreed standard for acceptable response rates in survey research, experts suggest a goal of 70–80% (Sivo et al., 2006). Only 57% of the studies investigated in our survey reported response rates, with only 17% of them reporting rates above 80%. Therefore, the validity and impact of 43% of the studies is limited by the unknown patterns of nonresponse. Response rates may be improved by using proper modes and strategies of questionnaire administration (Bowling, 2005).

The noninterventional design of most of the studies in our survey contributed to the almost total exclusion of control groups, which are essential in clarifying the effects of a treatment or an identifiable characteristic of a group (Dehue, 2005). Of the four studies we reviewed that used a control group, one included an intervention (nutritional education; Chapman et al., 1997) while the other three did not (Cho et al., 1974; Enns et al., 1987; Worme et al., 1990). Controls may be useful for comparative purposes (Heaney et al., 2011), even for the nonexperimental or quasi-experimental designs followed in this field, and should be considered for future survey research on athletes to better isolate the characteristics that can be specifically attributed to involvement in sport.

High-quality research utilizes appropriate theoretical models that reflect the phenomena under study via the identification of a number of independent and dependent variables (Keppel & Wickens, 2004). Among the currently reviewed studies, 69% focused on one to two independent variables while the remainder involved three to 10 variables. In addition, 48% of the studies identified one dependent variable while two to three dependent variables were included in the remaining 52%. This suggests that there is satisfactory complexity and sophistication in the research of this field.

Researchers are expected to be aware of limitations in the design and implementation of their studies. However, among the currently reviewed studies, only 28% identified or commented on such issues. A similarly infrequent recognition of study limitations has been reported among medicine and biology publications, perhaps because of the small number of scientific journals that specifically request such information to be included in manuscripts (Ioannidis, 2007). Insights into the limitations of a study facilitate a judgment of the reliability and validity of the results, and issues in generalizing them to a wider context (Gay, 1976). They should ideally be accompanied by recommendations for conducting future research, a feature provided by only 30% of the analyzed studies. Future studies should include both aspects as a means of advancing the field.

Questionnaire Criteria

The majority (72%) of the studies we reviewed used questionnaires that included a combination of general and sports nutrition topics, as opposed to general nutrition topics (27%). Although nearly a third of the studies failed to identify the source of their research tools, 16 studies involved the construction of new questionnaires while 26 either adopted or adapted existing surveys. Future research on nutritional attitudes and knowledge in sport may be enhanced by implementing guidelines for the construction of questionnaires (Francis et al., 2004), and, if applicable, by incorporating the theory of planned behavior (Ajzen, 1991). Better guidelines for the design and implementation of questionnaires may assist with response/return rates as well as improved reliability and validity of the results (Bowling, 2005).

Pilot testing of the questionnaire on a subsample of the intended population may play a critical role in this process (Francis et al., 2004). This may allow specific and standardized cognitive interviewing techniques and communication processes to be developed (Schwarz & Sudman, 1996). This practice may apply not only to new but also to adapted and adopted questionnaires, especially for the evaluation of nutritional knowledge (Parmenter & Wardle, 2000). In our analysis, 67% of the studies do not specify undertaking a pilot test.

Validity is the most important methodological criterion (Verducci, 1980) and should be checked in questionnaire-based research (Williams, 2003), even in the ideal case where an established questionnaire is adopted (Parmenter & Wardle, 2000). In the current survey, 72% of studies failed to include a test of their questionnaire's validity, thus making it uncertain to what extent they measured solely cognitive–behavioral traits. A similar figure (70%) failed to check the reliability of their questionnaires, the other very critical methodological feature of a measurement tool (Everitt, 1996). As a result, the certainty of the respective results is limited. Future studies should clarify the origin and application of the questionnaires and adequately test their validity and reliability to ensure that they can secure trustworthy results in this field of interest.

Statistical Criteria

Quality research usually involves "a priori" estimation of the minimum acceptable sample size (Dixon & Massey, 1983; Keppel, 1973). This estimation requires a definition of the desired level of power and the size of expected effect(s) for a given study design (Everitt, 1996; Field & Hole, 2003; Tabachnick & Fidell, 2007). Our analysis on these criteria found almost uniform failure to consider these issues. Only one study estimated sample size (Pessi & Fayh, 2011), and only two (Rockwell et al., 2001; Torres-McGehee et al., 2012) undertook a power estimate that could evaluate the statistical conclusions of the produced effects in light of the sample size (Tabachnick & Fidell, 2007). Similar trends of not estimating power and sample size are found even in medicine, according to two other reviews (Megwalu & Piccirillo, 2008; Schechtman et al., 1995), but are not ideal.

Sample sizes in survey research must be large enough to capture the high variability present in the data due to the subjectivity of self-reporting. Large samples result in smaller sampling errors and in increased possibility of generalizing the results (Kerlinger, 1992). Our analysis showed a very asymmetrical distribution of initial sample sizes. In 41% of the studies the samples were relatively small (13–100) whereas 40% and 18% of studies involved moderate (101–400) and large (1,001–4,746) sample sizes, respectively.

Statistical analyses should also include some information to identify the type and distribution of the data (e.g., normality, homogeneity of variance, and linearity of relationships in parametric designs; Keppel & Wickens, 2004; Pedhazur, 1982) and thus justify the chosen treatment. Only 7% of the studies included in our analysis provided such relevant information (e.g., Jessri et al., 2010; Shifflett et al., 2002), a figure that is similar to the low rates of reporting (10%) in studies in the field of physical education (Chatoupis & Vagenas, 2011). The lack of such consideration is serious since it provides a potential lack of confidence about appropriateness of the statistics used and the trustworthiness of the interpretations (Stevens, 2009; Tabachnick & Fidell, 2007). However, in 77% of the analyzed studies, authors identified that parametric statistics were used and included two or more major analyses (62%). Thus, assumptions must have been more frequently tested for each major statistical analysis than was conveyed in the accompanying report.

A similar lack of reporting occurs for confidence intervals and effect sizes around results. Unfortunately, the absence of these interesting metrics prevents a valuable interpretation of the practical significance of survey results. Confidence intervals assess the precision of a sample statistic and its accuracy in estimating the respective population parameter. For example, they can be used to provide ranges of values within which it is likely (e.g., 90% or 95%) for an unknown population parameter to fall (Attia, 2005). They are appropriate for parametric and nonparametric analyses and are strongly recommended for enhancing statistical inference (Sim & Reid, 1999). Only 3% of the analyzed studies reported confidence intervals; this is comparable to the low rates of reporting of 3–13% found in medical research (Megwalu & Piccirillo, 2008; Schechtman et al., 1995). Similarly, 97% of the studies did not report effect sizes, another metric that allows an interpretation of the practical significance of an outcome (Keppel & Wickens, 2004). However, lack of this information is common in research in the fields of medicine (Sullivan & Feinn, 2012), sociology–psychology (Ferguson, 2009), and education (Chatoupis & Vagenas, 2011). It is likely that the failure to report confidence intervals reflects the inability of many new and even some established researchers to understand the inferential value of this statistical property (Belia et al., 2005). This statistical deficit in the current field of sports nutrition leaves considerable space for improvement.

Conclusions, Limitations, and Recommendations

The current research that assesses athletes' and coaches' knowledge and attitudes toward nutrition is flawed because of problems with the methods, research tools, and statistical analyses. Methodological problems refer mainly to the lack of stated hypotheses, the poor sampling of research populations, the low response rates, and the failure to identify limitations in the current study and recommendations for future work. Problems with the research tools include the lack of information about the origin of the survey questionnaire, as well as failure to test its validity and reliability or to undertake pilot testing. Statistical problems refer mainly to the lack of calculations of sample size and power, the use of small samples sizes, the failure to test the characteristics of the data, and the failure to report confidence intervals and effect sizes.

A few methodological problems may limit the impact of the current work. Potential relevant studies published in journals using a language other than English were not searched. Four relevant studies were not extractable at the time of the study, and several other studies assessing dietary intake by tools other than questionnaires were not included (Appendix I).

Future research on assessing cognitive–behavioral attitudes of athletes and coaches toward nutrition may be substantially improved by addressing the major problems related to methodological design, research tools, and statistical analysis revealed in this review. That includes the issues of ethical acceptability and informed consent, and the option of applying semi-experimental techniques of selecting cognitive–attitude related information from athletes and coaches, by implementing control groups for comparison purposes. Future systematic reviews of the same nature may focus on assessing the substantive results of the research (i.e., effect sizes), or even revisiting questionnaire construction and modes of administering questionnaires.

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Appendix I—Abbreviated Bibliographic Data for Some of the Excluded Relevant Studies

No.	Author(s)	Year	Title Keywords: Main Subjects, Participants	Journal	Vol.(Issue), Pages
1	Aerenhouts et al.	2008	Nutritional habits, adolescent sprint males	*Int J Sp Nutr Ex Met*	*18*, 509–523
2	Armstrong et al.	1990	Dietary practices, adult recreational exercisers	*J Nutr Ed*	*22*, 220–225
3	Berning et al.	1991	Nutritional habits, young adolescent swimmers	*Int J Sp Nutr*	*1*, 240–248
4	Cole et al.	2005	Dietary practices, collegiate football players	*J Str Cond Res*	*19*(3), 490–494
5	Farajian et al.[a]	2004	Dietary intake, nutritional practices, aquatic athletes	*Int J Sp Nutr Ex Met*	*14*, 574–585
6	Georgiou et al.	1996	Dietary changes, choices, young adult exercisers	*Int J Sp Nutr*	*6*, 402–413
7	Hamilton et al.[b]	1994	Nutrition knowledge, elite distance runners	*N Zel J Sp Med*	*22*, 26–29
8	Hassapidou & Manstrantoni[a]	2001	Dietary intake, elite female athletes	*J Hum Nutr Dietet*	*14*, 391–396
9	Khoo et al.[b]	1987	Nutritional intake, eating habits, triathletes	*Ann Sports Med*	*3*, 144–150
10	Mullinix et al.[a]	2003	Dietary intake, female soccer players	*Nutr Res*	*23*, 585–593
11	Musaiger & Ragheb[b]	1994	Dietary habits, athletes	*Nutr Health*	*10*(1), 17–25
12	Rastmanesh et al.	2007	Nutritional knowledge, attitudes, disabled athletes	*J Athl Train*	*42*(1), 99–105
13	Raymond-Barker et al.	2007	Nutritional knowledge in, athletes, triad syndrome	*J Occ Med Tox*	*2*(10)
14	Reading et al.[b]	1999	Nutritional knowledge, education, hockey players	*Can J Diet Pract Res*	*60*(3), 166–169
15	Van Erp Baart et al.	1989	Nutritional habits (minerals, vitamins), elite athletes	*Int J Sports Med*	*10*(S3–10), 11–16

[a]Did not use questionnaires. [b]Not extractable at the time of the study.

Appendix II—Abbreviated Bibliographic Data for the 60 Included Studies

No.	Author(s)	Year	Title Keywords: Main Subjects, Participants	Journal	Vol.(Issue), Pages
1	Azizi	2010	Nutritional knowledge, attitudes, athletes	*Braz J Biomotr*	*4*(2), 105–112
2	Barr	1987	Nutritional knowledge, athletes, students	*J Am Diet Ass*	*87*(12), 1660–1664
3	Barr	1986	Nutritional knowledge, practices, athletes	*J Nutr Ed*	*18*(4), 167–174
4	Beals	2002	Eating behaviors, status, volleyball players	*J Am Diet Ass*	*102*(9), 1293–1296
5	Bedgood & Tuck	1983	Nutritional knowledge, athletic coaches	*J Am Diet Ass*	*83*, 672–677
6	Campbell & MacFadyen	1984	Nutritional knowledge, beliefs, swimmers	*Can Home Econ J*	*34*(1), 47–51
7	Chapman et al.	1997	Nutritional knowledge, athletes	*Adolescence*	*32*(126), 437–446
8	Cho & Fryer	1974	Nutritional knowledge, physical education majors	*J Am Diet Ass*	*65*, 30–34
9	Clark et al.	1988	Nutritional education, runners	*Phys Sp Med*	*16*(2), 124–134
10	Corley et al.	1990	Nutritional knowledge, practices, athletes	*J Am Diet Ass*	*90*(5), 705–709
11	Croll et al.	2006	Eating patterns, intakes, adolescents	*J Am Diet Ass*	*106*(5), 709–717
12	Cupisti et al.	2002	Nutritional knowledge, diet, athletes	*Int J Sp Nutr Ex Met*	*12*, 207–219
13	Douglas & Douglas	1984	Nutritional knowledge, practices, athletes	*J Am Diet Ass*	*84*(10), 1198–1202
14	Dunn et al.	2007	Nutritional knowledge, attitudes, athletes	*Sport Journal*	*10*(4), 45–53
15	Dwyer et al.	2012	Eating attitudes, intakes, figure skaters	*J Int Soc Sp Nutr*	*9*(53)
16	Enns et al.	1987	Eating attitudes, male college athletes	*Phychosom Med*	*49*(1), 56–64
17	Graves et al.	1991	Nutritional attitudes, knowledge, coaches	*J Am Diet Ass*	*91*(3), 321–324
18	Griffin & Harris	1996	Weight, attitudes, knowledge, coaches	*Sport Physiol*	*10*, 180–194
19	Harrison et al.	1991	Nutritional knowledge, habits, athletes	*Aus J Nutr Diet*	*48*(4), 124–127
20	Hoogenboom et al.	2009	Nutritional knowledge, behaviors, swimmers	*N Am J Sp Phys Ther*	*4*(3), 139–148
21	Jacobson & Aldana	1992	Nutritional practice, knowledge, athletes	*J App Sp Sc Res*	*6*(4), 232–238
22	Jacobson et al.	2001	Nutritional knowledge, athletes	*J Str Cond Res*	*15*(1), 63–68
23	Jazayeri & Amani	2004	Nutritional knowledge, attitudes, trainers	*Pak J Nutr*	*3*(4), 228–231
24	Jessri et al.	2010	Nutritional knowledge, athletes	*Int J Sp Nutr Ex Met*	*20*, 257–263
25	Jonnalagadda et al.	2001	Dietary practices, attitudes, football players	*J Str Cond Res*	*15*(4), 507–513
26	Jonnalagadda et al.	2004	Dietary behaviors, preferences, figure skaters	*Int J Sp Nutr Ex Met*	*14*, 594–606
27	Juzwiak & Ancona-Lopez	2004	Nutritional knowledge, recommendations, coaches	*Int J Sp Nutr Ex Met*	*14*, 222–235
28	Knechtle et al.	2007	Nutritional practices, endurance swimmers	*Pak J Nutr*	*6*(2), 188–193
29	Lakin et al.	1990	Eating behaviors, practices, wrestlers	*J Com Health Nurs*	*7*(4), 223–234
30	Loosli et al.	1986	Nutritional habits, knowledge, gymnasts	*Phys Sp Med*	*14*(8), 118–130

Appendix II (continued)

No.	Author(s)	Year	Title Keywords: Main Subjects, Participants	Journal	Vol.(Issue), Pages
31	Marquart & Sobal	1994	Weight loss beliefs, practices, wrestlers	*J Adol Health*	*15*, 410–415
32	Mullins et al.	2001	Nutritional status, elite female heptathletes	*Int J Sp Nutr Ex Met*	*11*, 299–314
33	Nazni & Vimala	2010	Nutritional knowledge, attitude, sportsmen	*As J Sport Med*	*1*(2), 93–100
34	Nichols et al.	2005	Hydration knowledge, attitudes, athletes	*Int J Sp Nutr Ex Met*	*15*, 515–527
35	Nogueira & DaCosta	2004	Nutritional intake, habits, diet, triathletes	*Int J Sp Nutr Ex Met*	*14*, 684–697
36	Ozdogan & Ozcelik	2011	Nutritional knowledge, sports department students	*J Int Soc Sport Nutr*	*8*(11)
37	Parr et al.	1984	Nutritional knowledge, practice, coaches, athletes	*Phys Sp Med*	*12*(3), 127–138
38	Perron & Endres	1985	Knowledge, attitudes, practices, athletes	*J Am Diet Ass*	*85*(5), 573–576
39	Pessi & Fayh	2011	Nutritional knowledge, track athletes	*Rev Bras Med Esp*	*17*(4), 242–245
40	Rash et al.	2008	Nutritional knowledge, attitude, track athletes	*Sport J*	*11*(1), 48–54
41	Rockwell et al.	2001	Nutritional knowledge, opinions, practices, coaches	*Int J Sp Nutr Ex Met*	*11*, 174–185
42	Ronsen et al.	1999	Nutritional habits, elite athletes	*Scand J Med Sc Sp*	*9*, 28–35
43	Rosenbloom et al.	2002	Nutritional knowledge, collegiate athletes	*J Am Diet Ass*	*102*(3), 418–420
44	Schroder et al.	2004	Dietary habits, basketball players	*Eur J Sp Sc*	*4*(2), 1–15
45	Shifflett et al.	2002	Nutritional needs, athletes, coaches, trainers	*Res Quart Ex Sp*	*73*(3), 357–362
46	Shoaf et al.	1986	Nutritional knowledge, interests, athletes	*J Nutr Ed*	*18*(6), 243–245
47	Shriver et al.	2013	Dietary intakes, habits, athletes	*J Am Coll Health*	*61*(1), 10–16
48	Sossin et al.	1997	Nutritional beliefs, attitudes, wrestling coaches	*Int J Sp Nutr*	*7*, 219–228
49	Spendlove et al.	2012	Nutritional knowledge, elite athletes	*Brit J Nutr*	*107*, 1871–1880
50	Torres-McGehee et al.	2012	Nutritional knowledge, athletes, coaches	*J Athl Train*	*47*(2), 205–211
51	Valliant et al.	2012	Nutritional education, knowledge, volleyball	*Nutrients*	*4*, 506–516
52	Walsh et al.	2011	Nutritional knowledge, attitudes, behaviors, rugby	*Int J Sp Nutr Ex Met*	*21*, 365–376.
53	Werblow et al.	1978	Nutritional knowledge, attitudes, athletes	*J Am Diet Ass*	*73*, 242–245
54	Wiita et al.	1995	Nutritional knowledge, practices, athletes	*J Phys Ed Rec Dan*	*66*(3), 36–41
55	Wiita & Stombaugh	1996	Nutritional knowledge, practices, runners	*Int J Sp Nutr*	*6*, 414–425
56	Worme et al.	1990	Nutritional knowledge, recreational athletes	*Am J Clin Nutr*	*51*, 690–697
57	Zawila et al.	2003	Nutritional knowledge, attitudes, X-country runners	*J Athl Train*	*38*(1), 67–74
58	Ziegler et al.	1998	Eating attitudes, skaters	*Med Sc Sp Ex*	*30*(4), 583–586
59	Ziegler et al.	1998	Dietary behaviors, figure skaters	*Int J Eat Dis*	*24*(4), 421–427
60	Zinn et al.	2006	Nutritional knowledge, rugby coaches	*Int J Sp Nutr Ex Met*	*16*, 214–225