

Journal of Human Performance in Extreme Environments

Volume 16 | Issue 1

Article 1

Published online: 12-31-2020

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Recommended Citation

Mahoney, Sara E.; Wójcicki, Thomas R.; and Carnes, Andrew J. (2020) "Sources of Nutrition Information in Recreational Ultra-marathon Runners: A Mixed Methods Analysis," *Journal of Human Performance in Extreme Environments*: Vol. 16 : Iss. 1, Article 1.

DOI: [10.7771/2327-2937.1131](https://doi.org/10.7771/2327-2937.1131)

Available at: <https://docs.lib.purdue.edu/jhpee/vol16/iss1/1>

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Sources of Nutrition Information in Recreational Ultra-marathon Runners: A Mixed Methods Analysis

Sara E. Mahoney, Thomas R. Wójcicki, and Andrew J. Carnes

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Abstract

Ultra-marathon events (i.e., >42.2-km) continue to grow in popularity; however, little is known regarding the sources of nutrition information which inform their beliefs and habits. The objective of this study was to characterize the acquisition of sport-specific nutrition information among ultra-endurance athletes using a mixed methods design. Qualitative data were collected through focus groups and analyzed using thematic analysis. Three primary higher order themes were identified: Optimal Diet for Ultra-Endurance Athletes, Common Sources of Information, and Barriers to Scientific Information. Then, a self-report inventory (Sources of Nutrition Information- SONI questionnaire) was developed to assess common sources of nutrition information and characterize their beliefs about those sources. Likert-type questions were used, and primary sources were scored out of 3, sub-questions out of 5. Differences between sources were assessed using RM-ANOVA. Participants ($N = 224$) accessed, responded to, and submitted the survey via a secure, study-specific web-based link. Peer reviewed literature was reported as the most frequently used (mean score = 1.64, $p < 0.001$), credible (3.02, $p < 0.001$), and interesting (2.62, $p = 0.002$). Social media was the most accessible (2.81, $p < 0.001$), but the least credible (1.87, $p < 0.001$). While social media was perceived less credible than other sources, its accessibility could make it a promising tool to provide evidence-based nutrition information to this population.

Keywords: ultra-endurance, sport nutrition, ultra-marathon, sources of nutrition information

1. Introduction

The popularity of ultra-marathon running events, which entail distances ≥ 50 kilometers, has surged internationally over the past decade (Rüst et al., 2013). The extreme duration of such events (several hours to several days) imposes unique physiologic stresses relative to traditional endurance events (Gimenez et al., 2013). Specifically, nutrition plays a crucial role in ultra-marathon performance, as total energy expenditure and in-competition nutritional intake requirements can be several times greater than in marathon (42.2 km) or shorter events (Stuempfle et al., 2013). While there is a recognized need for additional research on the specific nutritional needs of ultra-marathon athletes (Mahoney et al., 2016), current endurance nutrition recommendations mainly call for daily carbohydrate (CHO) intake of 5–12 $\text{g}\cdot\text{kg}^{-1}$, adjusted to match individual training load, and 30–90 $\text{g}\cdot\text{hr}^{-1}$ during training and/or competitions exceeding one hour (Burke et al., 2011; Costa et al., 2019; Thomas et al., 2016). According to the literature, it is largely accepted that meeting these recommendations may maintain energy availability, promote desired training adaptations, and optimize performance. Still, some authors argue that because ultra-marathons require lower relative intensity ($<50\%$ VO_2max) and rely more heavily on fat as a metabolic fuel source (Linderman & Laubach, 2004; Rontoyannis et al., 1989) than traditional (<5 hr), CHO-dependent endurance events (Davies & Thompson, 1986; O'Brien et al., 1993), a low-CHO and high-fat (LCHF) diet is better suited to ultra-marathon athletes (Volek et al., 2015). However, claims of the efficacy of LCHF fueling strategies for endurance and/or ultra-endurance sport thus far lack empirical evidence of a performance benefit (Burke, 2015; Costa et al., 2019; Stellingwerff, 2016).

Although current endurance nutrition recommendations have been widely adopted by numerous professional associations (Thomas et al., 2016), emerging research questions the compliance of endurance runners at various performance levels with these recommendations (Wardenaar et al., 2015). In fact, survey research utilizing dietary recall suggests that recreational ultra-marathoners barely meet the minimal daily CHO intake of 5–7 $\text{g}\cdot\text{kg}^{-1}$ recommended for 1 $\text{hr}\cdot\text{d}^{-1}$ of training, despite reporting significantly higher training volume (Mahoney et al., 2016; Wardenaar et al., 2015). Furthermore, a surprisingly large percentage of recreational marathoners (Wilson, 2016) and ultra-marathoners (Mahoney et al., 2016) report following low-CHO or other specified diets (e.g., gluten free, “Paleolithic”) which contrasts with evidence-based recommendations. Of note, education and access to information do not solely determine nutritional intake. Food choice is complex, and influenced by cultural, psychosocial, and socioeconomic factors (Stephoe et al., 1995). Additionally, factors such as sensory appeal, price, perceived health, mood, and convenience have been shown to significantly influence food choice (Rankin et al., 2018). For athletes in particular, food choices are also mediated by performance and body composition goals, as well as team culture (Birkenhead & Slater, 2015).

The sources of information influencing the nutritional practices of both traditional distance and ultra-marathon runners are likewise unclear. As even elite-level endurance athletes only show partial compliance with and knowledge of consensus recommendations (Heikura et al, 2017), it is arguably doubtful that recreational ultra-marathon runners base their nutritional practices on scientific literature. Previously, Wilson (2016) reported on the nutrition information sources utilized and perceptions of their credibility by recreational marathoners. These athletes were most likely to obtain information from a coach, while they found social media to be the least credible and peer-reviewed literature to be the most credible sources of nutrition information (Wilson, 2016). Likewise, Lis et al. (2015) showed that nonpeer-reviewed and anecdotal information procured from online resources, fellow athletes, and coaches influenced the adoption of a gluten-free diet by endurance athletes. In the United States, collegiate athletes have reported using parents/family, athletic trainers, and media/internet most frequently for nutrition information (Zuniga et al., 2017). Australian team sport athletes reported preference for dietitians, nutritionists, and the internet (Trakman et al., 2019). However, no previous research has specifically examined where ultra-marathon runners in particular are accessing nutrition information, nor what sources they find most credible. Such investigation is warranted given that few empirical data exist regarding ultra-marathon-specific training diets, and previous studies suggest that endurance athletes may readily utilize sources to inform their nutritional beliefs and habits which may not reflect the latest scientific knowledge (Lis et al., 2015; Wilson, 2016). While many athletes successfully complete ultra-endurance events, dropout rates are high and the most commonly cited reason is related to nutritional intake (gastrointestinal distress, nausea, vomiting (Hoffman & Fogard, 2011; Stuempfle et al., 2013)) Additionally, adequate nutritional intake is highly important to ultra-endurance athletes; because of their high training load, this population is particularly at risk for low energy availability, leading to RED-S (relative energy deficiency in sport) (Folscher et al., 2015). RED-S is associated with significant health concerns (Mountjoy et al., 2018) and is not solely found in elite athletes, but is a concern for recreational athletes as well (Slater et al., 2016). Therefore, it is imperative that both practitioners and scientists understand how ultra-athletes are consuming nutrition information to better communicate scientifically sound advice.

The purpose of this study was therefore to describe the utilization of nutrition information among ultra-endurance athletes.

2. Materials and Methods

This study was conducted using an explanatory sequential design; qualitative data were collected through two

focus groups, and then quantitative data were collected through an electronic survey. This study was approved by the Institutional Review Board at Bellarmine University (#640).

2.1 Qualitative Strand

Ultra-endurance athletes ($n = 8$) were recruited from the local area through word of mouth and social media to participate in two researcher-led focus groups, based on commonly accepted practices (Edmunds, 1999), regarding their use of nutrition information in training and competition. Participants were required to be at least 18 years of age, English speaking, able to attend the center-based, in-person discussion, and have completed an ultra-endurance event in the past two years, or currently in the process of training for their inaugural ultra-event. Participants provided written informed consent prior to the start of each focus group.

Each group was led by a member of the research team who utilized scripted questions to ensure consistent guidance between focus groups. Discussions were recorded and a second researcher was present to take notes during the discussion. Before the discussion began, participants were instructed on focus group etiquette (allow others to finish before speaking, etc.) and were encouraged to voice their own opinions. The discussion began with general questions about ultra-endurance nutrition, allowing the participants to discuss their own experiences in searching for this type of information. Questions then focused on specific information sources (such as particular organizations or websites), nutritional guidelines for endurance athletes (Thomas et al., 2016), and then barriers to accessing information.

Thematic analysis was conducted as described by Nowell et al. (2017). Briefly, the digital audio recording was transcribed verbatim and reviewed by two research team members. Following an initial review of the data set, a codebook was created to organize meaningful units of text. The transcripts were coded, reviewed using peer debriefing, and recoded as necessary. Themes emerged through review of frequent codes and recurring ideas, and subthemes were subsequently identified following development of primary themes. Inductive analysis (Thomas et al., 2015) was used to organize codes into higher and lower order themes to describe the data. Peer debriefing and researcher triangulation were used to ensure the themes accurately reflected the original data set.

2.2 Quantitative Strand

A survey was developed to measure common sources of nutrition information in ultra-endurance athletes based on the results of the qualitative analysis. The Sources of Nutrition Information (SONI) questionnaire is designed to

assess seven common sources of sport-related nutritional information (i.e., friends/training partners, social media/blogs, coaches (or other training professionals), peer-reviewed literature, elite athletes, popular books/magazines, and health professionals), as well as various beliefs and practices associated with each (i.e., accessibility, interest, credibility, and utilization). Participants were asked to rate how likely they were to use each source of information on a three-point Likert scale (i.e., Yes, Sometimes, or Never). If participants responded Yes or Sometimes, they were subsequently asked to answer associated questions regarding beliefs and utilization of said source by responding on a 5-point Likert scale, ranging from 1 (i.e., poor/never) to 5 (i.e., good/often).

Participants were recruited to take part in an electronic survey battery through targeted posts on ultra-endurance social media communities with members across the United States and the inclusion criteria were the same as the qualitative strand ($n = 224$ completed). This battery included a demographic questionnaire, which also obtained information regarding general eating patterns and training habits, and the SONI questionnaire. Differences between sources in the SONI questionnaire were assessed using a repeated measures ANOVA ($\alpha = 0.05$), and demographic differences were measured using non-paired t -tests.

3. Results

3.1 Qualitative Analysis

Focus groups were comprised of 8 participants (4 females) with an average age of 38.2 years, 100% reported white, non-Hispanic ethnicity, and all had at least 1–3 years of higher education (Table 1).

Higher order themes and subthemes are summarized in Table 2. Three primary higher order themes were identified: optimal diet for ultra-endurance athletes, common sources of information, and barriers to scientific information.

3.1.1 Optimal Diet for Ultra-Endurance Athletes

Participants did not come to a consensus on one optimal diet, but rather they highlighted individual differences in response to diet and emphasized the role of trial and error for determining the optimal diet.

“I think it really depends on the person. I think everyone processes food a little differently.”

“If I feel good, I’ll continue to do it, and if I don’t feel good, I don’t. So, I don’t know if that’s the appropriate method to go about it, but...”

They believed that just because a particular way of eating was successful for one athlete, it may not be successful for them. However, when discussing specific food choices, consuming foods that were “whole” or “unprocessed” garnered much agreement.

“For me, I like to think of whole foods, like not necessarily packaged, lot of produce, lot of rice...but anything with the least amount of ingredients is where I tend to go.”

When discussing the role of carbohydrates and fats for ultra-endurance performance, the participants were not in agreement. Some believed that relatively high levels of carbohydrate were optimal, whereas other believed low carbohydrate and high fat were a superior method.

3.1.2 Common Sources of Nutrition Information

Athletes had a varied response to where they accessed nutrition information. The most consensus was around friends or other athletes, books/magazines, and web-based searches. Emphasis was placed on sources they knew personally or could communicate directly with.

“If I have a question, I can reach out to someone I know and trust and ask them what they did.”

When discussing web-based information and popular media, the participants were wary of information that was sponsored by a corporation, seemed to be encouraging quick weight loss, or did not have direct links to scientific information.

Table 2
Results of thematic analysis from focus groups.

Higher order themes	Subthemes
Optimal diet for ultra-endurance athletes	Individual difference Best by trial and error Whole, unprocessed foods
Common sources of nutrition information	Friends/other athletes Books/magazines Google
Barriers to access/use of nutrition information	Confusing Not specific to ultras Too much time/work

Table 1
Demographic data from focus groups.

	Sex	Age	Employment	Race/ethnicity	Education
Male	50%	43.5 (12.4)	75% Full time	100% White, non-Hispanic	50% four-year college degree
Female	50%	33 (12.5)	50% Full time	100% White, non-Hispanic	75% four-year college degree

3.1.2 Barriers to Access/Use of Scientific Information

Athletes were aware of the recommendations from ACSM/AND/DC (Thomas et al., 2016) for endurance performance, but generally acknowledged they did not follow them. Translating the numeric values into specific foods to consume each day was reported as too much work, too confusing, or too time consuming.

“Constant calculations. It seems so overwhelming to measure and calculate your food all the time. It’s just too much. It also seems like there is too much information out there.”

Additionally, the athletes perceived scientific information to be contradictory at times, and they were unsure as to how to manage the apparent contradiction. They generally did not utilize health professionals as a resource for information, citing perceived lack of specific knowledge and cost.

“You are not sure what to do when the information is contradictory. Do I think to this source or this source? It seems like people are just trying to keep a job by putting out more information. It can all just be too much and make you want to throw in the towel.”

3.2 Quantitative Results

For the quantitative survey battery, a total of 224 participants responded. The sample was 61% male and 93% white. As part of the demographic survey, participants described their overall diet, as well as their typical carbohydrate intake (Table 3).

The SONI questionnaire results are summarized in Table 4. Overall, participants were most likely to use peer-reviewed literature, and least likely to use a health professional for nutrition information. Additionally, participants reported that social media was the most accessible and least credible source, whereas peer-reviewed literature was rated as the most interesting, credible, and frequently used. Health professionals were reported as the least interesting and accessible, as well as used the least often.

Finally, the SONI primary questions were analyzed by age, gender, and education level to determine if specific subgroups preferred different sources (Table 5). Women ($n = 88$) reported using friends, social media, and coaches more often than men, but used health professionals significantly less. Those younger than 40 ($n = 127$) used friends and elite athletes more than those who were over

Table 3
Demographic data from quantitative strand. Data are self-reported.

Self-described typical diet	Typical carbohydrate intake		
Healthy	54%	High carbohydrate	15%
Paleo or ketogenic	6%	Mixed (about 50%)	62%
Vegetarian or vegan	18%	Periodized	9%
Traditional American	20%	Low carbohydrate	15%
Other	12%		

Table 4
Summary of SONI questionnaire data, including primary question (out of 3) and four sub-questions (out of 5). Highest values (indicative of greater use and/or value) are bolded and significantly higher than all other categories at $p < 0.01$.

	Likely to use (out of 3)	Accessible	Interesting	Credible	Often
Friends	1.34 (0.98)	2.45 (1.03)	2.19 (0.98)	2.14 (0.83)	1.74 (0.94)
Social media	1.43 (1.07)	2.82 (0.97)	2.27 (0.85)	1.87 (0.72)	1.67 (0.79)
Coaches	1.12 (1.26)	2.13 (1.27)	2.39 (1.66)	2.60 (1.15)	1.76 (1.13)
Peer-reviewed literature	1.64 (1.1)	2.20 (0.98)	2.66 (0.92)	3.06 (0.77)	2.20 (0.92)
Elite athletes	1.27 (1.04)	1.94 (0.97)	2.35 (1.0)	2.07 (0.94)	1.54 (0.84)
Books/magazines	1.39 (1.07)	2.52 (0.94)	2.28 (0.80)	2.0 (0.77)	1.67 (0.78)
Health profession	0.86 (1.02)	1.80 (1.04)	2.04 (0.99)	2.41 (1.1)	1.45 (0.94)

Table 5
Primary SONI questions analyzed by demographic. Significant differences ($p < 0.05$) are bolded.

	Friends	Social media	Coaches	Peer-reviewed literature	Elites	Books	Health profession
Male	1.12	1.29	0.93	1.59	1.37	1.41	1.04
Female	1.69	1.64	1.40	1.72	1.12	1.36	0.85
<40	1.60	1.50	1.15	1.58	1.41	1.37	0.81
40+	1.10	1.35	1.08	1.71	1.10	1.40	0.91
Without college degree	1.12	1.84	0.96	1.64	1.36	1.52	0.88
With college degree	1.37	1.36	1.13	1.65	1.24	1.36	0.86

40. Those without a college degree ($n = 28$) reported using social media significantly more than those with a college degree or higher.

4. Discussion

The purpose of this study was to understand how recreational ultra-endurance athletes access and utilize sport-specific nutrition information. Generally, these athletes do not report following accepted scientific recommendations for daily intake during training, even though qualitative data support participants' familiarity with the recommendations. Supporting this idea, the quantitative data (SONI questionnaire) demonstrate that scientific literature is viewed as interesting and credible, but not accessible. Social media is viewed as highly accessible, but less credible than scientific research and health professionals are used least often for this type of information, as participants reported expense and perceived lack of ultra-marathon-specific expertise as barriers.

4.1 Response to Peer-Reviewed Literature

Participants rated peer-reviewed literature as highly interesting and credible, as well as the source they used most frequently. Others who have investigated common sources of nutrition information in runners found that social media (Wilson, 2016), web-based information (Lis et al., 2015), or coaches (Lis et al., 2015; Wilson, 2016) were utilized more frequently than peer-reviewed literature. However, this discrepancy from our work may be due to the target population of previous research, which included marathon and elite middle-distance runners who may have easier access to summarized nutrition information or nutrition professionals. Recreational ultra-marathon runners tend to be highly educated (Mahoney et al., 2016), and perhaps inclined to take a scientific approach to their training. In our sample, 87.5% had a college degree or higher, and 40.6% held a master's or PhD degree. However, only 9% of respondents reported periodizing their carbohydrate intake to their training session, which reflects the most current consensus recommendations for endurance athletes (Thomas et al., 2016). It therefore appears that while participants report reading peer-reviewed literature, they are not able to synthesize and apply the information. The qualitative data may provide some insight to this discrepancy; while the athletes expressed interest in finding scientific information, they struggled to evaluate the evidence and properly apply it. They expressed that the articles they found were difficult to understand, difficult to apply to their daily intake, and at times appeared contradictory. While most of the participants completed a college degree or higher, that does not necessarily indicate they have training in sport nutrition or the scientific background to evaluate and apply a body of

literature. When stratified by education level, those with and without a college degree were equally likely to report using peer-reviewed literature; however, those without a college degree did utilize social media for nutrition information significantly more than their college-educated peers. Additionally, the reported lack of access may exacerbate this issue; many scientific studies require journal subscriptions or fees to access entire articles and athletes who only access abstracts may be more likely to misinterpret or misapply the results. Finally, it is possible that the high response rate is due to social desirability (Crowne & Marlowe, 1960); this effect has been demonstrated in self-reported food intake (Mossavar-Rahmani et al., 2013), but it has not been well documented in the reporting of sources of nutrition information.

4.2 Response to Healthcare Professionals

Healthcare professionals (e.g., dietitians, doctors, nurses, etc.) were rated least accessible and interesting and used the least often. Additionally, women reported that they used healthcare professionals significantly less often than men; however, discrepancies between the genders were not discussed in the focus groups. The low use of medical professionals is supported by the qualitative data; participants did not speak favorably about using healthcare professionals for nutrition information most commonly because the participants did not believe the healthcare professionals had experience prescribing nutrition to ultra-endurance athletes. One participant explained that his doctor repeatedly requested he run less often, and therefore he was not eager to take advice on nutrition from someone who did not appear to understand his athletic endeavor. Participants also cited cost as a reason not to seek help from a medical or healthcare professional.

4.3 Response to Current Recommendations

While ultra-endurance nutrition is a relatively new field, there are general recommendations for daily intake for endurance athletes (Thomas et al., 2016). The role of macronutrients (particularly carbohydrates and fats) has been controversial in the ultra-endurance community, as some claim that a high-fat, low-carbohydrate diet is optimal for such long races (Noakes et al., 2014; Volek et al., 2015), while many others argue for the role of periodized, but relatively high, carbohydrate intake during training (Burke, 2015; Burke et al., 2011; Stellingwerff, 2016). This disparity was evident in the study; the participants were equally split between routinely consuming high (15%) and low (15%) carbohydrate, with the majority of participants reporting a mixed diet. Of note, while specific "named" diets such as the ketogenic diet or vegan diets may attract quite a bit of media attention, a relatively small percentage of these athletes are attempting to follow such a specific

diet. When discussing macronutrient recommendations in the focus groups, the participants seemed familiar with the recommended ranges from the aforementioned position stand (Thomas et al., 2016), but chose not to follow them for a variety of reasons. Some athletes said that calculating their intake each day was too much work or took up too much time. They also felt confused by what they perceived as contradictory statements from the scientific articles they read, and were hesitant to follow any one recommendation. There was no consensus about one superior diet for an ultra-endurance athlete, but rather a focus on the individual. The participants believed that trial and error was the best way for each athlete to find the diet that worked best for them, although most agreed that “whole, unprocessed foods” would be an effective place to start.

4.4 Use of Social Media

Mixed results were found regarding the participants' use of social media; while it was rated low for credibility, social media was rated the most accessible in the SONI questionnaire and was used with relatively high frequency. Others have documented this discrepancy (Moorhead et al., 2013; Oh & Kim, 2014) between high utilization and low trustworthiness for health and nutrition information on social media. Bourke et al. (2019) report that athletes use this source because it is “convenient, free and fast,” noting that information often “pops up” during social media use without having to look for it. Given the demonstrated interest in scientific information, it may be beneficial for researchers and dietitians to utilize this source as an effective means of directly communicating with athletes.

This study provides important insight into common sources of nutrition information in recreational ultra-marathon runners, particularly emphasizing their beliefs about those sources. We demonstrate the high interest of these athletes in scientific information and highlight the challenges they have in accessing and applying that information. However, this study had several limitations which merit discussion. First, the athletes' dietary intake was not directly measured, but rather relied on self-reporting for the characterization of typical diet. Future research should include a detailed dietary intake measure to directly compare sources of nutrition information to actual intake and determine if athletes are meeting the recommendations. Second, at the time of data collection, no instrument existed to measure nutrition knowledge in ultra-endurance athletes. Future research should utilize the SONI scale in conjunction with validated endurance sport-specific nutrition knowledge assessment to determine the relationship between different sources of information and sport-specific nutrition knowledge. Finally, the sample studied was homogeneous in race/ethnicity and education level; however, this closely reflects the current ultra-marathon population in the United States (Hoffman & Krishnan,

2014). Finally, the quantitative survey did not include an operational definition of peer-reviewed literature, which may play a role in how that question was interpreted by respondents. Future research should further define this term and investigate how athletes are accessing and consulting this source of information.

5. Conclusions

In conclusion, our data suggest considerable variation in the nutritional beliefs, practices, and information sources of recreational ultra-endurance athletes. These athletes are interested in finding nutrition information through peer-reviewed journal articles, which they believe are the most credible source of information, but also inaccessible. Regarding an optimal diet, these athletes appear to value individual differences, trial and error, and “whole, unprocessed foods,” more so than accordance with currently published evidence-based recommendations. While social media was not highly rated for credibility, this mode of information was seen as the most accessible. As such, social media platforms may offer an underutilized resource for the dissemination of evidence-based nutritional information by researchers and practitioners, which is a growing area of interest in the literature (Allen et al., 2013; Cooper, 2014). While engaging with the general population via social media presents challenges, particularly in the field of sport nutrition (Burke, 2017), the evidence suggests that this is an effective mode of dissemination (Wilkinson & Weitkamp, 2013). Therefore, researchers looking for practical ways to disseminate information to a larger audience may consider using social media platforms to share and discuss their research.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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