Sport Nutrition Knowledge, Dietary Intake and Quality of Life Status of Curling Athlete Populations

by

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ABSTRACT

Dietary Intake can impact sport performance and may be influenced by Nutrition Knowledge (NK). Stressors related to competitive sport also affect Dietary Intake and athlete Quality of Life (QOL). This is the first study to explore NK, Dietary Intake and QOL of curlers. Part 1 of the study assessed the NK (n=320) and QOL (n=240) of Canadian curlers using an author-derived questionnaire for NK and the WHOQOL-BREF and Athlete Life Quality Scale for QOL. Part 2 of the study explored the dietary intake of elite female curlers (n=4) using a 3-day food record. Data were analyzed using Mann-Whitney U, Spearman's Correlation, Kruskal-Wallis, and Chi-Square tests. Overall, curlers had an average NK score of 69.7%, which is relatively high compared to the literature range of 33.2% - 83.7%. Nutrition Requirements, Weight Management and Macronutrients were poorly understood NK categories with Hydration, Protein and Sugar as the most well understood categories. Competitive athletes had significantly lower Total NK and General NK, but not Sport NK scores compared to recreational athletes ($p=0.046$, $p=0.001$ and $p=0.449$, respectively). Participants had high QOL scores with an average of 89.3%, and no differences were found between competitive and recreational athletes ($p>0.05$). Factors influencing QOL were Employment, as Retired participants had higher QOL scores in the Social Relationships, Psychological and Environment Domains; Gender, as male participants had higher Psychological Domain scores than female participants; and Age, that had a significantly positive relationship with the Psychological Domain ($rho=0.165$, $p=0.011$) and Environment Domain ($rho=0.270$, $p<0.001$). Dietary Intake data showed trends of low energy and carbohydrate intake, while protein and fat intake were within, and above recommendations, respectively. While this thesis concluded that Canadian curlers had high QOL scores and relatively high NK, it remains unknown how NK influences Dietary Intake, thus requiring further research in this area.

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LIST OF ABBREVIATIONS

ACSM: American College of Sports Medicine

ALQS: Athlete Life Quality Scale

AMDR: Acceptable Macronutrient Distribution Ranges

BMI: Body Mass Index

BMR: Basal Metabolic Rate

BW: Body Weight

CDC: Center for Disease Control and Prevention

CESE: Centre for Elite Sport and Education

CTRS: Canadian Team Ranking System

DRI: Dietary Reference Intakes

EAR: Estimated Average Requirement

EI_{rep}: Reported Energy Intake

FAO: Food and Agriculture Organization of the United Nations

FFQ: Food Frequency Questionnaire

GNK: General Nutrition Knowledge

HrQOL: Health-Related Quality of Life

ISSN: International Society of Sports Nutrition

MiniRQLQ: Mini Rhinoconjunctivitis Quality of Life Questionnaire

NCAA: National Collegiate Athletic Association

NHANES: National Health and Nutrition Examination Surveys

NK: Nutrition Knowledge

NTP: National Team Program

PAL: Physical Activity Level

QOL: Quality of Life

RDA: Recommended Dietary Allowance

RDI: Reference Daily Intake

SD: Standard Deviation

SF-36: Short Form Health Survey - 36

SNK: Sport Nutrition Knowledge

SNKQ: Sport Nutrition Knowledge Questionnaire

SPSS: Statistical Package for Social Sciences

TNK: Total Nutrition Knowledge

UL: Tolerable Upper Intake Level

WHO: World Health Organization

CHAPTER I: LITERATURE REVIEW

Introduction

Curling is a skill-based team sport played on ice. The sport has unique physical demands involving sliding stones down a sheet of ice with sweeping as the most physical aspect of the sport. Hard sweeping is a high-intensity activity, where 20 seconds of hard sweeping can result in 600-2500 kilojoules of work (Bradley, 2009; Buckingham, Marmo, & Blackford, 2006). While not every stone will be swept with maximal intensity, the ability to recover quickly and sustain sweeping intensity throughout a game is important to success (Bradley, 2009). A typical game lasts two and a half hours, with about 75 minutes per team of four players. At the Olympic and World level, it can take up to 35 hours of competitive play to get to the podium, which consists of up to 14 games; usually up to two games per day (Bradley, 2009). Consequently, the long duration of curling games, bonspiels, and championships also requires mental stamina and alertness to make appropriate strategic decisions and ensure success. In general, the sport requires appropriate training for cardiovascular fitness, musculoskeletal conditioning, core, flexibility and balance to optimize performance and help reduce the risk of injuries (Behm, 2007; Bradley, 2009).

In curling, athletes often enter the sport at a very young age and remain in the sport at a highly competitive level much longer than many other Olympic sports. A competitive team, those competing at national or international championships, can have a range of ages most often from the early twenties to upper fifties. Additionally, modifying certain aspects of the sport, individuals with disabilities and older adults can curl for fun in recreational leagues or competitively in Paralympic or senior's championships and events. Thus, given the physical and mental demands of curling, appropriate nutrition is a critical factor to help enhance training and

maximize performance and be inclusive of lifestyle and health indicators as the sport engages athletes from a wide range of ages as well as of varying levels of physical capacity.

It is well known that proper nutrition is important for overall health as well as physical performance. Nutrition can affect areas related to performance such as an athlete's body composition, mental focus, perceived fatigue, and recovery (Thomas, Erdman, & Burke, 2016). Optimal nutrition intake practices for sport or physical activity are multi-faceted, changing depending on age and gender, but may also differ depending on the amount, frequency, intensity and type of exercise or sport being performed (Thomas et al., 2016). Thus, an appropriate sport nutrition plan, which accounts for foods and fluids to optimize athletic performance, recovery and overall health, is important to consider for curling athletes.

Although the benefits of an appropriate diet for athletes are well-known, adhering to a well-balanced diet may be difficult for any athlete as dietary intake is affected by many different factors. Food choices can be affected by psychological, social and economic factors such as body image satisfaction, nutrition knowledge (NK), cultural or religious beliefs, food availability, and disposable income (Alaunyte, Perry, & Aubrey, 2015; Andrews & Itsiopoulos, 2016; Birkenhead & Slater, 2015). Sport nutrition knowledge (SNK), the awareness of concepts and practices of a diet that are associated with health and sport performance, may be an area of interest to both the athletes and any professionals working on a sport nutrition plan to improve dietary intake. Furthermore, assessment of quality of life (QOL) may also be an area of interest for athletes and sport professionals. QOL encompasses many areas in life that may affect food choices such as physical health, environmental health, psychological health and social relationships (Birkenhead & Slater, 2015; Power & Kuyken, 1998). In addition, it has been reported that participation in recreational sport leads to a higher perceived QOL compared to people who do not participate in

sports (Omorou, Erpelding, Escalon, & Vuillemin, 2013). As such, many studies have evaluated QOL and its associated factors in athletic populations between two sports and in individual sports such as volleyball, baseball and football (Correia et al., 2017; Sinnott, Maddela, Bae, & Best, 2012; Tanimaru & Dos Santos, 2016). Overall, QOL is also an important factor to consider in assessing participation in curling at varying levels and its potential impact on dietary intake.

A literature review yielded zero studies addressing QOL in curling at either the recreational or competitive level. Likewise, there is no information on the SNK level of curlers or their usual dietary intakes. For this reason, this review will explore and discuss the current literature in other sports regarding evaluating SNK, dietary intake, and QOL in athletic populations.

For SNK, some of the main key terms used to search scientific databases were “nutrition knowledge,” “attitudes,” “beliefs,” “athlete,” “sport,” and “collegiate”; for dietary intake they were “dietary intake,” “dietary habits,” “nutrition intake,” “nutrition,” “athlete,” “sport,” and “collegiate”; for QOL they were “quality of life,” “QOL,” “sport,” “athlete,” “WHOQOL-BREF,” and “collegiate.” All studies included in the literature review were available in English and published from 2008 to 2019, with exception of commonly used SNK questionnaires published prior to 2008. Studies evaluating coaches or adolescent athletes or specific areas of NK only, such as supplementation, were excluded.

Sport Nutrition Knowledge

Knowledge can be defined as the awareness of facts, information, and skills acquired by a person through experience or education (Merriam-Webster, 2018). Within the realm of nutrition, the distinction between general nutrition knowledge (GNK) and SNK is imperative as the concepts are not identical. GNK focuses on knowledge acquisition for healthy eating and nutrition-related disease prevention (Parmenter & Wardle, 1999). Conversely, SNK involves the

acquisition of knowledge regarding practices and dietary habits related to general health, but also with an emphasis on sport performance. This distinction, with an emphasis on sport performance, is the basis for the evaluation of SNK in athletic populations. Theoretically, possessing greater SNK would lead to improved dietary intake, health, and consequently sport performance (Alaunyte et al., 2015; Spronk, Kullen, Burdon, & O'Connor, 2014). Thus, nutrition education interventions have been used to improve SNK (Nascimento et al., 2016; Rossi et al., 2017; Valliant, Pittman, Wenzel, & Garner, 2012). Various questionnaires to measure NK before and after the interventions have been used to evaluate the effectiveness of the questionnaires as well as to identify potential gaps in NK. This section will highlight SNK assessment tools and research that contribute to evaluating SNK within athletic populations, as well as identify the current gaps in SNK.

SNK Assessment Tools

There is no single SNK questionnaire (SNKQ) that has been validated and used consistently in the literature. The tools used to evaluate SNK over the past several decades are numerous, diverse, and continue to change as sport nutrition recommendations evolve. The length, categories, appropriateness of survey questions, as well as the validity and reliability of questionnaires used, are varied. However, there are underlying consistencies in nutrition categories covered in many SNKQs. Comparing previously used SNKQs will allow for a better understanding of what SNK encompasses and what should be considered when creating or modifying a SNKQ.

Evolution of SNKQs. As more researchers conduct studies on sport nutrition, the evolution of sport nutrition recommendations used in the development of SNKQs has grown. For example, one of the first SNKQs by Werblow, Fox, and Henneman (1978) only evaluated three

categories related to SNK: GNK, carbohydrates, and protein. However, a more recent study by Devlin and Belski (2015) incorporated more specific categories of sport nutrition including hydration, recovery, supplement use, and alcohol intake. A recent systematic review by Trakman, Forsyth, Devlin, and Belski (2016) also evaluated SNK categories covered in SNKQs to assess their relevance and listed the following 11 categories as important aspects related to sport nutrition:

- GNK
- Carbohydrates
- Protein
- Fat
- Micronutrients
- Pre-Nutrition
- During Nutrition
- Recovery
- Fluids
- Supplements
- Alcohol

From this list, two SNKQs showed the highest scores for the inclusion of these categories in their SNKQs for athletic populations (Devlin & Belski, 2015; Rash, Malinauskas, Duffrin, Barber-Heidal, & Overton, 2008). Altogether, this list and its use in more recent SNKQ studies highlight that more recent SNKQs may be more appropriate in evaluating SNK as they have included more questions related to the evolution in sport nutrition research and practices.

Question Bank. Another feature that differs between SNKQs is the number and types of questions in each questionnaire. Trakman et al. (2016) evaluated the number of questions asked within each SNKQ and reported a range of seven to 124 questions. A large range of questions demonstrates not only inconsistency between SNKQs but also with the evaluation of specific SNK categories. For instance, the SNKQ by Supriya and Ramaswami (2013) asked two questions regarding hydration compared to four questions used by Devlin and Belski (2015) (Supriya & Ramaswami, 2013). The high variability in the number of questions per questionnaire and per category suggests that there is a discrepancy in what is being assessed when trying to quantify SNK in the literature.

Additionally, the structure of the questions used in each questionnaire also varies. A SNKQ that has been frequently used, often with numerous modifications, was developed by Zawila, Steib, and Hoogenboom (2003) (Eskici & Ersoy, 2016; Hoogenboom, Morris, Morris, & Schaefer, 2009; Nascimento et al., 2016). This SNKQ utilizes a five-point Likert scale that ranges from "strongly disagree" to "strongly agree," which has also been used in other SNKQs like the one developed by Nazni and Vimala (2010). Another SNKQ by Torres-McGehee et al. (2012) also used a Likert scale but with 10 items instead of five. Other styles of questions include multiple choice, like that developed by Zinn, Schofield, and Wall (2005) and Shifflett, Timm, and Kahanov (2002), and a combination of Likert scale, true and false, and open-ended questions like Devlin and Belski (2015) used. Finally, as previously mentioned, the SNKQ by Zawila et al. (2003) has been replicated but with a "yes" and "no" answer scale rather than the Likert scale (Hoogenboom et al., 2009). Overall, what is evident is that although similar SNK categories and overall SNK may be assessed, style and amount of questions within these categories varies widely in the literature and is an area of concern for comparison and measuring overall SNK.

SNKQ Focus. SNKQs also vary depending on the type of sport being assessed. In Zawila et al.'s (2003) study, female cross-country runners were their target population, and this is reflected in the wording and categories of questions used. Questions regarding specific Recommended Daily Allowances (RDA) of calcium for females were incorporated into the survey and were specific to ages 15-24 years old as the SNKQ was aimed at female collegiate level runners (Zawila et al., 2003). Kondric, Sekulic, Uljevic, Gabrilo, and Zvan (2013) also used sport-specific language in their survey aimed at tennis athletes. Kondric et al. (2013) asked specifically if "between tennis sets a banana is a better choice than an apple" (p. 293). Similarly,

Zinn et al. (2005) differentiated the types of exercise being evaluated, such as "training" and "running," when asking about nutrition strategies regarding recovery. This further highlights the fact that sport nutrition practices differ depending on multiple factors such as gender and exercise types and that different SNKQs may emphasize one area over another.

Conversely, many of the questionnaires utilized general questions. Shifflett et al. (2002) was one group that did not specify gender or sport while asking sport nutrition-related questions. For example, Shifflett et al. (2002) asked if "when weight gain is desired, athletes should…" (p. 360). Similarly, Rosenbloom, Jonnalagadda, and Skinner (2002) asked if athletes knew whether "dehydration decreases performance" (p. 419) or not.

Overall, many of the developed SNKQs include questions that are general and may be answered by anyone, in any sport. However, if targeted towards a specific group, it is not uncommon to see questions worded or modified to address gender or sport-specific knowledge within a SNKQ.

Modification of Surveys. Some SNKQs have been re-used and/or modified in later studies. As previously mentioned, the survey by Zawila et al. (2003) has been used numerous times through author-derived modification or selection of specific questions. For instance, Nascimento et al. (2016) described using the Zawila et al. (2003) questionnaire but have included only 14 questions compared to the original 76 questions used and translated in another language. Similarly, Hoogenboom et al. (2009) used a survey that was modified and validated by Bailey (2004) but that was originally developed by Zawila et al. (2003). Hoogenboom et al. (2009) still had 76 questions in their SNKQ, but questions or answers were modified by other researchers.

In recent cases, SNKQs have been developed by combining and/or modifying multiple previously constructed SNKQs. An example is a study by Folsaire, Akomolafe, and Sanusi

(2015) incorporated questions from both Zawila et al. (2003) and Supriya and Ramaswami (2013) to evaluate SNK. As well, Devlin and Belski (2015) used questionnaires by Hendrie, Cox, and Coveney (2008) and Parmenter and Wardle (1999) for their GNK category and a SNKQ by Shifflett et al. (2002) for the remainder of their questionnaire. Since there is no singular SNK measurement tool, the current trend in evaluating SNKQ involves utilizing and modifying previously developed questionnaires.

Beyond SNK- Evaluating Nutrition Beliefs, Attitudes, and Practices. Many of the surveys used to measure SNK also evaluate more than facts and recommendations. Evaluation of nutritional beliefs, attitudes, and practices are also common within SNKQs. For example, Rosenbloom et al. (2002) evaluated nutrition beliefs by asking whether athletes believed "eating carbohydrates makes you fat", and found that 74% of male and 75% of female collegiate athletes disagreed with this statement, while Nikolaidis and Theodoropoulou (2014) found 50.8% of semi-professional soccer players disagreed with the statement. Additionally, studies such as Hoogenboom et al. (2009) evaluated whether the participants believe that it is the coach's responsibility to enforce good nutritional practices. From their study on female collegiate swimmers, Hoogenboom et al. (2009) discovered that 36.5% of athletes disagreed that it was the coach's responsibility, which is similar to the results found by Eskici and Ersoy (2016) who reported 68.8% of female basketball athletes agreed with this statement.

Nutrition practices are also often evaluated in many sport nutrition studies by asking participants questions regarding their nutritional habits instead of analyzing their food intake. For example, Folasire et al. (2015) asked a cohort of Nigerian undergraduate athletes if their pattern of eating changed at the time of competition, with 53.6% of athletes agreeing with this statement, while Nazni and Vimala (2010) found that 63.3% of Indian collegiate athletes also said yes to

this statement. Other nutrition practice areas questions include the practice of skipping a meal before a competition, wherein Folasire et al. (2015) found that 40.9% of athletes did skip meals before a competition, similar to the results of Oladunni and Sanusi (2013) who reported that 49% of Nigerian athletes did not eat before an athletic competition.

Lastly, many SNKQs incorporate questions related to sources of nutrition education and information in order to help understand where athletes may be learning NK and what sources may further influence nutrition beliefs and practices (Barr, 1987; Hoogenboom et al., 2009; Weeden, Olsen, Batacan, & Peterson, 2014). Barr (1987) evaluated sources of nutrition information in a cohort of varsity and collegiate female athletes and found that categories such as university/school education, magazines, books, and friends were the most popular sources used for nutritional information. However, since 1987, several other sources of nutrition information are also important to evaluate such as health food stores and the internet (Hoogenboom et al., 2009). Asking questions regarding nutrition sources and where the onus is to learn about and implement nutrition practices will be critical to evaluate as they may affect dietary intake (Heaney, O'connor, Michael, Gifford, & Naughton, 2011).

In summary, questions related to beliefs, attitudes and practices surrounding nutrition continue to appear in SNKQs to help identify nutrition-related problems beyond SNK and to help identify targets for nutrition education for athletes and those that provide nutrition information.

SNK Outcomes

Although there are many differences between SNKQs and their direct comparison may not always be possible, certain trends from studies evaluating other sports may help to shape hypotheses regarding SNK in curling athletes. Table 1 below is a summary of studies evaluating SNK in various sports. This table includes studies aimed at individuals over the age of 18 years

old and participating in sport as an athlete (results for coaches and trainers were not included). Some studies have evaluated SNK on its own or in addition to GNK. For these studies, a SNK and GNK score was provided as a total nutrition knowledge (TNK) score in the Table.

Overall scores SNKQs ranged from 20% to 84.5% with a calculated average of 55.6% for SNK and 59.5% for TNK (See Table 1). These SNKQs include those studying multiple sports or specific sports such as football and swimming. The most common population studies were athletes at the collegiate/university level. To note, none of these studies reported evaluating curling athletes. Finally, trends for reporting SNK scores were in percentages (%) and standard deviations, with one point being awarded for a correct answer, except for Werblow et al. (1978) which awarded points for the correct answer based on the degree of certainty (i.e. most certain was five points).

To note, two studies that evaluated SNK using a SNKQ from Reilly and Maughan (2007) also implemented an intervention to increase SNK. Rossi et al. (2017) assessed the effects of a 90-minute sports nutrition education intervention in a group of collegiate baseball players. The researchers reported that the group SNK scores significantly increased from 56.7% ± 11.4 to 70.0% ± 9.4 after the intervention ($p<0.001$). Similarly, Valliant et al. (2012) evaluated SNK in a group of collegiate volleyball players after four individual visits with a registered dietitian. In this group, SNK scores significantly increased from 44.9% ± 10.7 to 57.3% ± 11.1 after the intervention ($p<0.001$). A third study, by Nascimento et al. (2016) also incorporated nutrition education in a group of 11 elite multi-sport athletes with similar results ($p<0.001$). These results suggest that nutrition education, with an emphasis on sport nutrition, may help increase SNK in athletes of different sports and at the same competitive level.

Table 1 – Review of Sport Nutrition Knowledge Questionnaire Results from Various Sports

Reference	Sport	N, Gender	Questionnaire Used	N of Questions	Question Type	Mean Correct Score %(SD)
Werblow et al. (1978)	Multi	94 F	AD	n = 31	5-point Likert Scale (Strongly Disagree to Strongly Agree)	67.74 (NR)
Barr (1987)	Multi	100 F	AD	TNK: 87 and SNK: 23	True/False/Don't Know	TNK: 34 (NR) and SNK: 20 (NR)
Jonnalagadda et al. (2001)	Football	31 M	Rosenbloom (2000), mod	n = 11	Agree/Disagree/Don't know	50.5 (15.6)
Rosenbloom et al. (2002)	Multi	328 (237 M; 91 F)	AD Rosenbloom (2000)	n = 11	Agree/Disagree/Don't know	52.7 (NR)
Shifflett et al. (2002)	Multi	65	AD	n = 20	Multiple choice, Open-ended	55.0 (NR)
Zawila et al. (2003)	Cross-Country Running	60 F	AD	n = 76	5-point Likert Scale (Strongly Disagree to Strongly Agree)	57.2 (NR)
Rash et al. (2008)	Track and Field	113 (61 M, 53 F)	Jonnalagadda et al. (2001) and Zawila et al. (2003)	n = NR	NR	58.0 (13.0)
Hoogenboom et al. (2009)	Swimming	84 F	Zawila et al. (2003), mod	n = 76	5-point Likert Scale (Strongly Disagree to Strongly Agree)	71.8 (5.7)
Dunnigan (2010)	Multi	95 (48 M, 47 F)	AD and Zawila et al. (2003), mod	n = 35	5-point Likert (Strongly Disagree to Strongly Agree)	46.3 (12.6)
Torres-McGehee et al. (2012)	Multi	185 (74 M, 111 W)	AD	n = 20	10-point Likert Scale (1 = not at all, 5 = fairly well, 10 = extremely well)	54.9 (13.5)
Valliant et al. (2012)	Volleyball	11 F	Reilly & Maughan (2007), mod	n = 55	Close-ended	Pre-I: 44.9 (10.7) and Post-I: 57.3 (11.1)
Kondric et al. (2013)	Tennis	64 (21 M, 43 F)	AD	n = 18	Multiple Choice	M = 53.7 (20.5), F = 48.9 (16.4)
Supriya & Ramaswami (2013)	Track and Field	178 (71 M, 107 F)	AD	n = 10	5-point Likert Scale (Strongly Disagree to Strongly Agree)	52.6 (15.0)
Nikolaidis & Theodoropoulou (2014)	Soccer	185 (NR)	Rosenbloom (2000)	n = 11	Agree/Disagree/Don't know	49.1 (15.5)
Weeden et al. (2014)	Multi	174 (86 M, 88 F)	AD	n = 65	Yes/No/Unsure	56.4 (13.4)
Folasire et al. (2015)	Multi	110 (63 M, 47 F)	Zawila et al. (2003) & Supriya & Ramaswami (2013), mod	n = 14	Closed and Open-ended	65.7 (NR)
Devlin & Belski (2015)	Football	46 M	Parmenter & Wardle (1999)& Shifflett et al. (2002), mod	TNK: 123 and SNK: 38	Multiple Choice, Open-ended, Less/More/Not Sure/Same	60.5 (NR)

Table 1 – Review of Sport Nutrition Knowledge Questionnaire Results from Various Sports (continued)

Reference	Sport	N, Gender	Questionnaire Used	N of Questions	Question Type	Mean Correct Score %(SD)
Alaunyte, et al. (2015)	Rugby	21 M	Parmenter & Wardle (1999)	n = 28	Multiple Choice, Open-ended, Likert style - Agree/Disagree/Not Sure	GNK: 72.82 (6.11)
Andrews, M. et al. (2016)	Soccer	73 M	Devlin & Belski (2015), Zinn et al. (2005) & Burke (2010), mod	TNK: 87 and SNK: 28	NR	TNK Pro: 56.9 (15.5), Semi-Pro: 61.3 (15.9)
Andrews, A. et al. (2016)	Multi	123 (76 M, 47 F)	Torres-McGehee et al. (2012), mod	n = 19	10-point Likert scale (1 = not at all, 5 = fairly well, 10 = extremely well)	56.9 (14.3)
Nascimento et al. (2016)	Multi	11 M	Zawila et al. (2003) & Gonçalves (2009), mod	SNK: 14	NR	84.5 (11)
Eskici & Ersoy (2016)	Basketball	22 F	Zawila et al. (2003)	n = 76	5-point Likert Scale (Strongly Disagree to Strongly Agree)	37Qs = >50% correct 39Qs = <50% correct
Abbey, Wright, & Kirkpatrick (2017)	Football	88 M	Torres-McGehee et al. (2012), mod	n = 17	10-point Likert scale (1 = not at all, 5 = fairly well, 10 = extremely well)	55.2 (16.3)
Rossi et al. (2017)	Baseball	30 M	Reilly & Maughan (2007)	n = 46	Close-ended	Pre-I: 56.7 (11.4) and Post-I: 70 (9.4)
Simpson et al. (2017)	Field Hockey	17 M	Burkhart (2010)	n = 47	True/False, MC, Open-ended, Yes/No/Unsure, 10-point Likert Scale (non-existent to excellent)	Pre-I: 54.7 (14.3) and Post-I: 61.1 (11.45)
Trakman et al. (2018a)	Australian Football	177 (69 M, 108 F)	Trakman et al. (2017)	n = 89	Agree/Disagree/Not Sure, MC, Effective/Not Effective/Not Sure	Nut. Ed = 64.65 and No Nut. Ed = 52
Trakman et al. (2018b)	Australian Football	99 M	Trakman et al. (2017)	n = 89	Agree/Disagree/Not Sure, MC, Effective/Not Effective/Not Sure	Elite = 46 (16) and Non-Elite = 51 (11)
Blennerhassett et al. (2018)	Multi (Endurance)	101 (74 M, 27 F)	Zinn et al. (2005), mod	n = 76	Agree/Disagree/Not sure, MC, True/False	Total = 68.3 (9.5)
Sekulic et al. (2019)	Multi	912 (556 M, 356 F)	Sajber (2013)	n = 10	True/False	Total = 45.8 (22.7)
Citarella et al. (2019)	Ultra Marathon	10 (6 M, 4 F)	da Vico (2010)	n = 15	MC, Yes/No/Unsure	Total = 77.5 (16.9)

AD = Autor Developed, M = male, F = Female, NR = Not Recorded, mod = modified, SNK = Sport Nutrition Knowledge, TNK = Total Nutrition Knowledge, I = Intervention, SD = Standard Deviation, Multi = Multiple Sports, Nut. Ed = Nutrition Education, Qs = Questions. Average NK scores = 59.33%.

SNK Question Categories. SNK can be broken down into themes or categories regarding different areas of nutrition that impact sport performance, such as hydration, macronutrients, weight management, alcohol intake, etc. Thus, in the literature, many of the studies report the category scores or specific questions that were answered correctly by their participants, and which categories saw the most incorrect answers. For example, many sport nutrition studies that assess SNK reported that the questions in the hydration category were well answered (Abbey et al., 2017; Nikolaidis & Theodoropoulou, 2014; Weeden et al., 2014), although others did not (Jessri, Rashidkhani, & Zinn, 2010; Torres-McGehee et al., 2012) as described in the review by Trakman et al. (2016). A more recent study, by Blennerhassett et al. (2018), reported that hydration was the lowest scoring category. The discrepancy among these studies in their responses to hydration is possibly due to the different SNKQs that were used in these studies and/or the number of questions asked within each category. For example, some studies assessed the importance of hydration (Weeden et al., 2014; Zawila et al., 2003) while others discussed the types of fluids, including sport drinks (Folasire et al., 2015; Rosenbloom et al., 2002).

Additionally, in the study by Blennerhassett et al. (2018), questions regarding hydration were sport-specific such as “in an ultra-endurance race, what is the recommended amount of sodium per litre of fluid?” This question evaluates more advanced hydration knowledge compared to the basic importance of hydration frequently evaluated in SNKQs. It is possible that ultra-endurance athletes have a more advanced understanding of their hydration needs which is reflected in the type of questioning. Therefore, it may not only be the type of question, but also the complexity and potentially the type of athlete or sport that may be influencing these results.

Another category evaluated in SNK is Macronutrients. For example, a question commonly asked is to correctly identify if “protein is the primary source of muscular energy for the athlete”

(Zawila et al., 2003) or “protein is the main energy source for the muscle” (Rosenbloom et al., 2002). Zawila et al. (2003) reported that only 31.7% of athletes correctly answered this question while Rosenbloom et al. (2002) found that only 37% of men and 28% of women correctly disagreed that protein was the main energy source for muscles. More recently, Nascimento et al. (2016) found that only 3.8% of participants correctly answered this protein question as worded by Rosenbloom et al. (2002). Additionally, macronutrients other than protein are also assessed for their roles in energy metabolism and their food sources (Trakman et al., 2016). An example is a question on the role of carbohydrates in the body, with a common question being aimed at identifying carbohydrates as the main source of energy for the body. The review by Trakman et al. (2016) reveals that this question is frequently answered correctly in various sport populations (Folasire et al., 2015; Hamilton, Thomson, & Hopkins, 1994; Rosenbloom et al., 2002).

Micronutrients is another SNK category evaluated in SNKQ. Heaney, O’connor, Michael, Gifford, and Naughton (2011) reported in their systematic review that most of the studies that they evaluated reported that most athletes had the misconception that vitamins and minerals provided energy, which was also a result seen by Folasire et al. (2015) in their evaluation of NK in a group of Nigerian collegiate athletes. This misconception about micronutrients has been consistent among athletes across studies as further shown with the example from Hamilton, Thomson, and Hopkins (1994) who described that elite distance runners also believed that multivitamins would increase energy. Although vitamins and minerals questions are included in the Micronutrients category in SNKQ, their supplementation beyond the diet is included in the Supplementation category in some studies, which also include questions on nutritional ergogenic aids and protein supplementation (Trakman et al., 2016).

Lastly, weight management is also one section that many researchers discussed in their studies evaluating SNK. For example, Hoogenboom et al. (2009) reported that 100% of female collegiate swimmers disagreed that skipping meals was justifiable to lose weight. While Abbey et al. (2017) simply reported that the body composition section was correctly answered <50% of the time in a group collegiate football players, which was similar to Torres-McGehee et al. (2012) who found that Weight Management was the second lowest average NK score for all participants in their study.

Overall, the literature shows that most SNK tools include common SNK categories, such as Hydration, Macronutrients, Micronutrients and Weight Management, and that studies evaluating SNK typically provide broken down scores for each of these sections above and beyond overall SNK scores (Heaney et al., 2011; Trakman et al., 2016). However, there are some categories that have not been evaluated as much in the literature, including Pre-/During/Post- Competition Nutrition, and Alcohol. The review by Trakman et al. (2016) found that only one study on SNK included questions related to during competition nutrition, and zero out of seven studies asked post-competition nutrition questions.

In conclusion, some common misconceptions on specific categories of SNK can be found in the literature. As the results from literature on SNK categories have not come from evaluating curlers directly, they may still allow for the creation of hypotheses when evaluating SNK in this group of athletes, such as the expectation of high scores in hydration and low scores in protein-specific SNK. As previously mentioned, there is a variety of SNKQs used in the literature reviewed, therefore paying careful attention to the types of questions used, the NK evaluated, and the amount of questions in each category of SNK must be taken into consideration when comparing the various literature results.

Conclusions

In summary, there is no single SNKQ that exists to evaluate SNK in athletic populations. As recommendations on sport nutrition practices and dietary intake change with ongoing research, so do the SNKQs used to assess such NK, beliefs, and practices. However, reviewing the evolution of SNKQs over time is beneficial to clarify what knowledge or facts may be considered as SNK and what methods or question types may be important to include in a SNKQ.

The review of existing SNKQs highlights the importance of ensuring questions in SNKQ continue to reflect advances in sport nutrition research and updated recommendations through incorporating current SNK categories that been shown to affect sport performance. As well, designing a SNKQ involves including questions regarding general SNK but may also have sport-specific questions. Differentiating between general SNK and sport-specific SNK would be helpful in future studies to better compare SNK results since many studies may evaluate one sport or multiple sports at once. Incorporating both closed and open-ended questions into a SNKQ will allow for a better understanding of SNK but also beliefs and attitudes towards foods and nutrition that may also impact health and performance. Allowing the use of open-ended questions within SNKQ will enable the researchers to gather more information from participants that will help to further explain SNK that may impact dietary intake practices and beliefs.

Overall, the review of the literature to evaluate sport nutrition misconceptions and SNK trends from various sports may provide insight into what to expect in the curling community. Additionally, SNKQs from the past two decades indicate that athletes do not have a high level of SNK or TNK, with an average score of 55.6% and 59.5%, respectively, and therefore may benefit from nutrition education interventions to improve SNK and TNK.

Dietary Intake

Diet is one of the few modifiable lifestyle factors that can improve overall health. Measuring dietary intake is a crucial component to evaluate in athletic populations as nutrition and sport performance are also interconnected. As intake for performance is the focus of this review, there was an exclusion of studies focusing on recreational athletes; thus only studies including elite, professional, amateur and collegiate athletes were considered. As well, as recommendations for dietary intake changes from adolescence to adulthood, and between able-bodied and disabled athletes, only studies evaluating able-bodied and adult participants (over 18 years of age) were included. This section highlights the different instruments used to report dietary intake (Table 2), markers used for evaluating nutritional adequacy, reporting measurements for macro- and micro-nutrients, overall trends in dietary intake of athletic populations (Table 3), and finally dietary intake's relationship with NK.

Methods of Evaluation for Dietary Intake

Dietary intake is a crucial component in nutrition-related research, but it is also difficult to measure. Unfortunately, controlling an individual's diet or accurately measuring it is extremely time-consuming and expensive. Therefore, self-reported dietary intake measures have been the norm in evaluating dietary intake in studies assessing athletic populations (Capling et al., 2017) (See Table 3). As with other self-reported measures, there are downfalls to this approach when assessing dietary intake. Nonetheless, several tools have been developed to evaluate dietary intake to estimate dietary patterns and intake in various populations. The three diet assessment tools that have been used most often within athletic populations are: food frequency questionnaires (FFQ), 24-hour food recalls and multiple day food records (Capling et

al., 2017). Table 2 (Larson-Meyer, Woolf, & Burke, 2018; Walton, 2015) provides a brief description of commonly-used dietary assessment tools.

Table 2 – Summary of the Advantages and Disadvantages of Dietary Intake Assessment Tools

Method	Advantages	Disadvantages
24Hour Diet Recall	• Present day's intake is accurate • Short time to complete • Inexpensive • Low participant burden • Suitable for large scale surveys • Self-administered	• Memory dependent • Difficulty recalling portion sizes • Does not represent usual intake • Under-reporting tendencies
Food Frequency Questionnaire	• Cost effective for large groups • Self-administered • Electronic or paper modalities • Low-Medium participant burden	• Memory dependent • May not represent usual food intake • Multiple foods are grouped together making intake data compromised • Portion size difficult to estimate
Diet History	• Very detailed • Measures habitual past intake • Useful for meal patterns and intakes • Less memory dependent (typical day versus specific day)	• High participant burden (time) • Requires a highly trained interviewer • Semiquantitative • Requires cooperation from subjects
Food Record	• Detailed data • Meal patterns can be assessed • Portion sizes can be assessed • Multiple days can represent usual intake • Weighed FR provides more accurate intake • Not dependent on memory • Self-administered (if not weighed)	• High participant burden • Attention to detail required • Participant may alter intake • Weighing food is not convenient (time consuming and expensive) • Variability on under-reporting

Food Records. Food records are the most detailed evaluation method for estimating dietary intakes as all foods, beverages and supplements consumed are recorded or weighed. As such, this requires more time and effort on behalf of participants as described in Table 2. Unfortunately, underestimation of energy intake using food records has been demonstrated in athletic populations (Hill & Davies, 2001; Magkos & Yannakoulia, 2003). Factors affecting under-reporting can be high participant burden to record all foods, which are amplified by changing meal patterns, high daily energy intake and a large time commitment (Larson-Meyer et al., 2018; Walton, 2015). Furthermore, psychological factors such as body dissatisfaction and weight consciousness may also contribute to under-reporting using food records (Larson-Meyer

et al., 2018). As with non-weighed food records, these psychological factors also play a role when weighing foods. Weighing food creates another opportunity for under- or over-reporting when serving sizes or weights are not measured accurately (Daugherty et al., 2012). Overall, using food records gives the most detail, if accurate, for what athletes eat at one point in time.

Food Frequency Questionnaires. FFQs are intended to evaluate an individual's dietary pattern over the long-term rather than at one specific point in time. FFQs provide reports on how often participants consume specific foods and beverages, but also information regarding food groups (grains, dairy, etc.), by day, month or year.

Additionally, some FFQs include questions on serving sizes which allows for a specific nutrient or food analysis, such as with antioxidant intake seen in the study by Braakhuis, Hopkins, Lowe, and Rush (2011). FFQs are normally tailored to the population being evaluated as habitual food patterns may change depending on multiples factors; such as religion, culture, regional differences, and urbanization (MacIntyre, Venter, & Vorster, 2001; Shu et al., 2004). FFQs can also be used to estimate energy intake, although less common, as it is not as accurate for this measurement compared to 7-day food records, but has been used in athletic populations (Imamura et al., 2013; Magkos & Yannakoulia, 2003). Overall, Table 2 describes that this tool may be useful to evaluate dietary patterns rather than specific food intake in large groups.

24-Hour Food Recalls. Table 2 provides insight into the use of 24-hour food recalls which collects dietary intake information from the previous day. Although dependent on participant memory, a 24-hour recall can provide a more accurate snapshot of food eaten in one day. 24-hour recalls can be administered on paper, by internet, or through the phone, with web-based recalls taking up a shorter amount of time (Walton, 2015; Wardenaar et al., 2017). Multiple 24-hour recalls have also been used in athletic populations (Andreato et al., 2016;

Devlin, Kingsley, Leveritt, & Belski, 2017; Wardenaar et al., 2017). This technique allows for multiple collections, which helps to increase accuracy with usual energy intake and increases participant's skill to complete the recall (Larson-Meyer et al., 2018). However, this method is also time-consuming, as it requires multiple passes to obtain a reliable recall.

Overall 24-hour recalls have been used in studying dietary intake in athletic populations (see Table 3) and continue to be used to assess large populations as web-based and computer-based recalls have made this method even easier for participants.

Instruments Used for Assessing Dietary Intake in Athletic Populations

In athletic populations, the majority of studies assessing dietary intake utilize a food record (see Table 3). Historically, 3-day food records were used, whereas more recently up to 7 days of intake data is collected (Burke, 2015). As well, 24-hour diet recalls and FFQs are also seen in studies assessing intake in athletic populations. This section will briefly describe studies and sports that have used different methods to evaluate dietary intake including sport-specific trends, variability in data collection quantities, and the combination of instruments.

Food records have been commonplace in specific sports, such as cycling, for many years. A review by Burke (2001) reported that studies evaluating cyclists' intake used 3, 5 or 7-day food records and that some were weighed, and others were not. A more recent evaluation of ultra-endurance cyclists' nutritional intake by Kunces et al. (2016) also used a 3-day food record, showing that food records continue to be commonplace in sport-related research and specifically in cycling. Other sports that have used multiple-day food records include rugby, tennis, volleyball, fencing, skiing and aerobic sports (see Table 3).

FFQs have also been used to report overall dietary patterns of elite athletes. A study by Noda et al. (2009) evaluated a group of Japanese male collegiate soccer players and their nutrient

intake. Noda et al. (2009) used a FFQ developed specifically for the Japanese population and an estimated intake for the past 1-2 months. Kokubo et al. (2016) used this same FFQ in a group of elite Japanese female collegiate gymnasts. Similarly, Alaunyte et al. (2015) also used a FFQ when assessing the nutritional habits of professional English rugby players. The specific FFQ used within this study was selected as it was specific to the region (Alaunyte et al., 2015). FFQs continue to be used in the literature with soccer and rugby, as well as in multiple sports such as endurance events, combat sports, racket sports, and track and field (see Table 3).

As well, 24-hour recalls have been used in athletic populations including jiu-jitsu, canoeing and multi-sport studies (See Table 3). Often 24-hour recalls are used with large groups such as in a study by Burkhart and Pelly (2016) evaluating 44 multi-sport athletes at the 2010 Delhi Commonwealth Games. Finally, Wardenaar et al. (2017) utilized a web-based 24-hour recall to reach 553 Dutch athletes to evaluate their nutrition intake.

Furthermore, it is also common for nutrition research to include multiple instruments to assess dietary intake within the same study. For example, a study by Mielgo-Ayuso, Zourdos, Calleja-González, Urdampilleta, and Ostojic (2015) utilized both a FFQ and 7-day dietary recalls with a group of 22 elite female volleyball players. Folasire et al. (2015) also used both a FFQ and a 24-hour food recall throughout their study on 110 undergraduate student-athletes, which was the same combination used by Dos Santos, Da Silveira and Cesar (2016) with 21 professional women soccer players. By using mixed methods, these researchers can report on patterns of eating using a FFQ, but also on current intake of athletes with the diet recalls and records.

Overall, studies evaluating dietary intake of athletes have used various methods. Patterns do exist in certain sports, such as cycling, while others do show consistency. This literature

review helps to highlight the large variability in tools used to collect dietary intake and the importance of study design in deciding which instrument to use.

Dietary Intake Evaluations

An important aspect in interpreting research on dietary intake is to make note of the recommendations or macronutrient distributions that are being used as references to evaluate dietary intake and/or quality. Both sport-specific and population-wide recommendations have been used in the literature as reference points. Additionally, depending on the methods used, other strategies may be incorporated to determine dietary intake adequacies, such as utilizing physical activity level (PAL) factors to estimate sport-specific energy requirements and measuring actual energy expenditure through doubly labelled water techniques or wearable technology. Lastly, some studies evaluating dietary intake use a control group to compare dietary patterns of athletes to the general population or similar athletes. This section will review the changing sport nutrition recommendations and provide examples for the vast amount of strategies used in studying dietary intake in athletic populations.

Firstly, sport-specific recommendations, such as activity level or sport-specific macronutrient recommendations, have changed in the past few decades with updated sport nutrition research. For example, a study by Farajian, Kavouras, Yannakoulia, and Sidossis (2004) evaluating 31 elite Greek swimmers reported requirements for protein to be adequate if they fell into the range of 1.2-1.4 g/kg Body Weight (BW) as described by Lemon (1998). However, a more recent study also evaluating 18 elite swimmers in Brazil, by Montenegro, Schneider, Trindade, Castro, and Baroni (2017), used protein recommendations of 1.5-1.7 g/kg BW as suggested by Stellingwerf, Maughan, and Burke (2011) as a level of adequacy. This increase in protein requirements from 1998 to 2011 reflects the updated research and

recommendations on protein requirements in athletic populations. It is now commonly believed that athletes, regardless of the type of sport, require higher protein intakes than the average individual or RDA (Thomas et al., 2016). This is only one example of the limitations in assessing dietary intake across sports and decades as others have also used different recommendations and calculations for energy, carbohydrates, protein and fat intake in many sports.

The study by Mielgo-Ayuso et al. (2015) evaluated dietary intake in 22 elite female volleyball players and compared their intake for energy, protein, fat and carbohydrate to specific recommendations from the International Society for Sport Nutrition (ISSN). Dietary intake and carbohydrate intake recommendations of 50-80 kcal/kg/day and 5-8 g/kg/day, respectively, were used (Kreider et al., 2010). To evaluate protein intake, Mielgo-Ayuso et al. (2015) used a range of 1.6-1.8 g/kg/day suggested by Phillips and Van Loon (2011) and a range of 20-35% of total calories for fat intake as markers of adequacy (Rodriguez, Di Marco, & Langley, 2009). Thus, researchers have used multiple sources to evaluate dietary intake.

On the other hand, some researchers tend to use only one source of recommendations for their evaluations. As an example, Lun, Erdman, and Reimer (2009) compared all dietary intake data of 357 multi-sport athletes to macronutrient recommendations outlined in the American College of Sports Medicine (ACSM) Position Stand (Rodriguez et al., 2009), defined as 6 to 10 g/kg BW carbohydrate, 20-35% total fat, 1.6 to 1.7 g/kg BW total protein for power athletes and 1.2 to 1.4 g/kg BW protein for endurance athletes. The researchers were able to provide specific recommendations according to the sport by separating athletes into power, endurance, intermittent and judged sports as it is well known that different sports require different energy and macronutrient distributions due to different energy demands, nutrition periodization periods and individual physical goals of the athletes (Lun et al., 2009).

Calculating energy requirements for athletes also sees a lot of variability in the literature. There are two ways in which energy requirements are calculated: manually and physically. Manual calculations utilize generally accepted equations to calculate energy needs for the general population. Then, PAL factors are used in conjunction with these equations to determine energy intake to account for their added energy expenditure related to sport.

For example, Lun et al. (2009) utilized three equations for energy intake: Recommended Daily Intakes (RDI), World Health Organization/Food and Agriculture Organization of the United Nations (WHO/FAO) and the Harris-Benedict equations. Similarly, Ghloum and Hajji (2011) and Wierniuk and Wlodarek (2013) also used the Harris-Benedict equation for estimating energy requirements when evaluating a group of national-class fencing athletes and aerobic athletes, respectively. Other equations that have been used for estimating energy intake include the Mifflin St-Jeor equation (Dolan et al., 2011; Sousana K Papadopoulou et al., 2012) and the Schofield equation for resting metabolic rates (Bogdanis, Veligekas, Selima, Christofi, & Pafili, 2013; Wardenaar et al., 2017). As well, as new population-based recommendations are updated over time, such as the RDAs, some researchers have compared their results to both old and new recommendations. For example, Clark, Reed, Crouse, and Armstrong (2003) utilized RDA references from 1997, 1998, 2000 and 2001 in their study.

The PAL used to determine the additional energy requirements related to sport and training vary in the literature, as expected, as different sports contribute varying levels of added energy expenditure. For example, the study by Ghloum and Hajji (2011) reported the use of a PAL factor of 1.5 with fencing athletes while Wierniuk and Wlodarek (2013) used a different PAL of 1.75 as the study participants were aerobic athletes. The trend is thus to use a PAL that is appropriate to the sport or training being studied.

Conversely, physical calculation strategies have also been used to determine if energy intake meets energy needs in athletic populations. These include both doubly labelled water techniques and wearable technology, such as armbands and heart rate monitors (Anderson et al., 2017; Beis et al., 2011; Bradley et al., 2015; Drenowatz, Eisenmann, Carlson, Pfeiffer, & Pivarnik, 2012). The researchers compare actual energy expenditures and compare them to the estimated energy intake. This technique involves a higher participant burden and considered invasive, while manual calculations reduce participant burden and are easy to use.

Finally, certain studies have elected to evaluate dietary intake compared to the regular population or other study results, rather than calculated estimates. For example, Noda et al. (2009) utilized data from the Japanese National Nutrition Survey of 2007 as a control group to compare dietary intakes of Japanese soccer players. Similarly, a study evaluating 615 professional Hungarian athletes to non-athletes used the 3rd Hungarian National Dietary Survey of 2003 to evaluate dietary intake (Gábor, Kovács, Fajcsák, & Martos, 2010). Lastly, Anderson et al. (2017) reported adequate protein intake in their study evaluating 6 professional soccer players compared to recent findings in a professional Dutch soccer league without comparison to nutrition recommendations (Bettonviel, Brinkmans, Russcher, Wardenaar, & Witard, 2015).

In summary, recent research studies evaluating dietary intake in athletic populations have not been uniform. There are large discrepancies in energy and macronutrient reference sources and calculations used, adoption of historical changes references overtime, and incorporation of different levels of invasiveness within their data collection strategies. Determining the appropriate PAL and reference sources for a sport and tools to use for the sample size may help to determine best practices moving forward as no uniform strategy has been set.

Table 3 – Review of Dietary Intake Results from Various Sports

Authors	Sport	Level	N, Gender	Method	Trends	Micronutrients
Hoogenboom et al. (2009)	Swimming	College	84 F	24HR	↓EI, CHO, ↑Fat ↔PRO	Yes
Lun et al. (2009)	Multi	Elite	103 M, 181 F	3DFR	↓EI, CHO, ↑FAT, ↔PRO	Yes
Noda et al. (2009)	Soccer	College	31 M	FFQ	↑EI, PRO, Fat & CHO	Yes
Gomes et al. (2009)	Tennis	AM/PROF	24 M	3DFR	↓EI, CHO, ↑PRO, ↔Fat	Yes
Heaney et al. (2010)	Multi	Elite	72 F	FFQ	↓CHO, ↔Fat, PRO, EI (NR)	Yes
Gábor et al. (2010)	Multi	Elite	306 M, 309 F	3DFR	↓EI, CHO, ↑Fat, ↔PRO	Yes
Papadopoulou et al. (2010)	Multi	Elite	69 F	3DFR	↓EI, CHO, PRO, ↑Fat	Yes
Doumtsios et al. (2010)	Sailing	ND	91 M	3DFR (w)	↓EI, CHO, ↑Fat, ↔PRO	Yes
Beis et al. (2011)	Endurance	Elite	8 M, 2 F	7DFR (w)	EI = EE, CHO, ↔ PRO, Fat	No
Dolan et al. (2011)	Jockeys	PROF	27 M	7DFR	EI = EE, ↓CHO, ↔ PRO, Fat	Yes
Ghloum & Hajji (2011)	Fencing	National-Class	15 M	3DFR	↑EI, Fat & CHO, ↓PRO	Yes
Anderson (2010)	Volleyball	College	8 F	3DFR	↓EI, CHO, PRO, ↑Fat	Yes
Drenowatz et al. (2012)	Endurance	Competitive	15 M	FFQ	↓EI, CHO, ↑Fat, ↔PRO	No
Valliant et al. (2012)	Volleyball	College	11 F	3DFR	↓EI, CHO, PRO, Fat (NR)	No
Papadopoulou et al. (2012)	Skiing	Elite	23 M, 10 F	4DFR	↓EI, CHO, ↑Fat, ↔PRO	Yes
Shriver et al. (2013)	Multi	College	52 F	3DFR, 24HR	↓EI, CHO, ↔PRO, Fat	No
Wierniuk & Wlodarek (2013)	Aerobics	College	25 M	3DFR	↓EI, CHO, PRO, ↑Fat	Yes
Bogdanis et al. (2013)	High Jump	Elite	7 M, 7 F	3DFR	EI = EE, ↓CHO, ↑Fat, ↔PRO	Yes
Imamura et al. (2013)	Rugby	College	34 M	FFQ	↓CHO, PRO; EI (NR), Fat (NR)	Yes
Zapolska et al. (2014)	Volleyball	PROF	17 F	24HR (x3)	↓EI, CHO, ↑Fat, ↔PRO	Yes
Filaire et al. (2015)	Tennis	PROF	26 F	7DFR	↓EI, CHO, PRO (DE group only), ↔Fat	No
Wardenaar et al. (2015)	Endurance	ND	55 M, 13 F	24HR (w) (x3)	↓CHO, PRO, ↔Fat, EI (NR)	Yes
Bradley et al. (2015)	Rugby	Elite	14 M	6DFR, 24HR	EI = EE, ↑Fat, ↔CHO, PRO	Yes
Mackenzie et al. (2015)	Rugby	Elite	25 M	7DFR	↓EI, CHO, ↑PRO, Fat (NR)	No
Baranauskas et al. (2015)	Multi	HP	41 (NR)	24HR	↓EI, CHO, ↑Fat, ↔PRO	Yes

Table 3 – Review of Dietary Intake Results from Various Sports (continued)

Authors	Sport	Level	N, Gender	Method	Trends	Micronutrients
Mielgo-Ayuso et al. (2015)	Volleyball	Elite	22 F	7DFR, FFQ	↓EI, CHO, ↑Fat, PRO	No
Folasire et al. (2015)	Multi	College	63 M, 47 F	24HR (x3), FFQ	↓EI, CHO, Fat, PRO	Yes
Andrews, M. et al. (2016)	Soccer	PROF	73 M	3DFR	↓EI, CHO, ↔Fat, PRO	No
Nowacka et al. (2016)	Canoeing	PROF	29 M, 8 F	24HR (x3)	↓EI, CHO, Fat, ↔PRO	No
Ai (2016)	Wrestling/Boxing	High Level	13 FW, 14 FB	3DFR (w), 24HR	↓EI, ↑Fat, PRO, ↔CHO	Yes
Andreato et al. (2016)	Jiu-Jitsu	ND	15	24HR (x2)	↓CHO, ↑PRO, ↔Fat, EI (NR)	No
Burkhart & Pelly (2016)	Multi	Elite	26 M ,18 F	24HR	↓EI, CHO, ↔Fat, PRO	Yes
Sánchez-Muñoz et al. (2016)	Cycling	PROF	6 (NR)	4DFR (w)	↑CHO, PRO, ↔Fat, EI (NR)	Yes
Dos Santos et al. (2016)	Soccer	PROF	21 F	24HR (x3), FFQ	↓EI, CHO, ↑PRO, ↔ Fat	No
Nepocatych et al. (2017)	Basketball/Softball	College	20 F	3DFR	↓EI, CHO, ↔PRO, Fat	Yes
Abbey et al. (2017)	Football	College	9 M	3DFR, FFQ	↓EI, CHO, ↑PRO, Fat,	No
Wardenaar et al. (2017)	Multi	(Sub) Elite	553 MF	24HR (x3)	↓EI, CHO, ↔PRO, FAT (NR)	No
Marsh et al. (2017)	Rugby	Elite	16 F	4DFR	↓EI, CHO, ↑Fat, ↔PRO	No
Anderson et al. (2017)	Soccer	PROF	6M	7DFR, 24HR, RFPM	EI = EE, ↓CHO, ↔PRO, Fat	No
Rossi et al. (2017)	Baseball	College	30 M	3DFR (x2)	↓EI, CHO, PRO, ↔Fat	No
Raizel et al. (2017)	Soccer	PROF	19 M	3DFR	EI = EE, ↓CHO, ↑Fat, PRO	Yes
Devlin et al. (2017)	Soccer	Elite	18 M	24HR (x4)	↓EI, CHO, ↑PRO, Fat (NR)	No
Brown et al. (2017)	Dancers	College/ Pre-PROF	25 F	7DFR (w), 24HR (x2)	↓EI, ↑Fat, ↔ CHO, PRO	No
Montenegro et al. (2017)	Swimming	Elite	10 M, 8 F	2DFR (x8)	↓EI, CHO, ↑PRO, ↓Fat	No
Mielgo-Ayuso et al. (2017)	Volleyball	Elite	22 F	7DFR (x4), FFQ	↓EI, CHO, ↑PRO, Fat	No
Papadopoulou et al. (2018)	Swimming	ND	24 M	3DFR	↓EI, CHO, PRO, ↔Fat	Yes
Condo et al. (2019)	Football	Elite	30 F	24HR (x3)	↓CHO, ↔PRO, Fat, EI (NR)	Yes
Jenner et al. (2019)	Football	PROF	46 M	7DFR	↓EI, CHO, ↔PRO, FAT	Yes
Lohman et al. (2019)	Football	Elite	66 M	24HR (x3)	↓CHO, ↑PRO, ↔Fat, EI (NR)	Yes

Multi = Multiple Sports, AM = amateur, PROF = Professional, ND = Not Described, HP = High Performance, MF = Male and Female, M = Male, F = Female, FB = Female Boxer, FW = Female Wrestler, DE = Disordered Eating, w = weighted, DFR = Day Food Record, 24HR = 24-Hour Recall, FFQ = Food Frequency Questionnaire, RFPM = Remote Food Photographic Method, ↓ = lower, ↑ = higher and ↔ = within recommendations, CHO = Carbohydrate, PRO = Protein, NR = Not Recorded, x = repeated # of times, EI = Energy Intake, EE = Energy Expenditure.

Trends in Dietary Intake

As previously mentioned, there are multiple ways of capturing dietary intake, and results reported also vary. For example, studies using FFQs may only report trends in intake of food groups or specific foods over time and whereas dietary records or recalls will use numerical reporting such as g/kg, kilocalorie (kcal), %total energy, etc. Lastly, as recommendations change over time, evaluating trends over the past few decades may not be appropriate. For this reason, studies evaluating energy intake using the most recent sport nutrition (ACSM, ISSN, etc.) and general population recommendations like the Acceptable Macronutrient Distribution Ranges (AMDR), after 2000, are included in this review.

Total Energy Intake. Most studies evaluating dietary intake report total energy intakes for participants, in kcal/day or kcal/kg. Overall, studies report the underconsumption of energy in many different sports when using both manual and physical energy requirement calculations (see Table 3). For example, a study by Mielgo-Ayuso et al. (2015) reported that elite female volleyball players consumed fewer calories than recommendations overall and that none of the athletes ate more than suggested energy intakes. Similarly, Dos Santos et al. (2016) also reported a low energy intake for professional soccer players. Other sports that have reported this trend include rugby, football, skiing, endurance, and sailing (see Table 3).

There are instances where energy intake is claimed to be equal to the estimated needs. For example, three research groups that also physically measured energy expenditure in their studies reported that energy intake was equal to energy expenditure (Anderson et al., 2017; Beis et al., 2011; Bradley et al., 2015). Bradley et al. (2015) evaluated energy expenditure by having professional male rugby players wear an armband that provides more accurate estimates of energy expenditure in low or moderate PA. This was the same procedure used by Beis et al.

(2011) that evaluated energy expenditure in professional aerobic sports. The average, from both studies, of energy expenditure was similar to the amount of caloric consumption in both groups. This same trend was also found when Anderson et al. (2017) compared energy intake to energy expenditure calculated by doubly labelled water. This group determined that energy intake was not different than energy expenditure overall in a group of professional soccer players over a 7-day in-season period.

Overall, when energy expenditure has been estimated through recommendations or equations, energy intake reported by athletes of various sports seem to be low, whereas when wearable technology or doubly labelled water is used to calculate energy expenditure, results show adequate dietary intake.

Carbohydrate Intake. Generally, it has been found that carbohydrate consumption in athletes is also below recommendations. First, the review by García-Rovés, García-Zapico, Patterson, and Iglesias-Gutiérrez (2014) reported that 3 studies evaluating elite female soccer players dietary intake demonstrated a below-recommendation of 5-7 g/kg intake of carbohydrate (Burke, Loucks, & Broad, 2006). Similarly, Mielgo-Ayuso et al. (2015) stated that carbohydrate consumption was lower than 5-8 g/kg/day in elite female volleyball athletes, which was also found in many other sports including swimming, rugby, basketball, softball, jiu-jitsu, endurance, canoeing, skiing, high jump, etc. (Kreider et al., 2010) (See Table 3).

One study, by Ghloum and Hajji (2011), reported carbohydrate intake above recommendations in a group of professional fencing athletes. However, this study used a reference of 300g/day, which does not account for individual differences related to body mass. Most recommendations are based on a percentage of total energy intake or grams of carbohydrate per kg of body weight which may explain this different result.

Lastly, two studies reported adequate carbohydrate consumption. The first, by Ai (2016), which evaluated 27 professional female boxers and wrestlers, utilized general population standards; the Chinese Dietary Reference Intakes (DRI), which may not account for the higher than average intake necessary for athletes. The only study to find adequate carbohydrate consumption by athletes according to sport nutrition recommendations is a study by Bradley et al. (2015) evaluating 14 professional rugby players. In this study, their results fall under the recommendations cited by Burke, Hawley, Wong, and Jeukendrup (2011) of 6-10 g/kg BW for moderate- to high-intensity exercise lasting 1-3 hours. Overall, carbohydrate consumption seems to be below recommendations when compared to both sport-specific estimates evaluated by g/kg BW or the AMDR.

Fat Intake. Fat intake differs slightly from carbohydrate and protein intake as most studies and current ACSM position stands support using AMDR of 20-35% for fat intake rather than g/kg BW (Thomas et al., 2016). The rationale suggested by the ACSM position stand is that the 20% minimum allows athletes to obtain essential fat-soluble vitamins and essential fatty acids while also keeping in consideration that high-fat diets have shown to be detrimental to performance in high-intensity exercise. Fat may also be manipulated to change body composition when performance is not preferred, therefore suggesting a range may be appropriate depending on the athlete's periodization goals (Thomas et al., 2016).

Although most studies utilized this range, a few still use g/kg BW as a marker of adequacy. For example, the study by Bradley et al. (2015) did use 0.9-1.2 g/kg BW of fat intake per day, taken from Bishop, Walsh, and Gleeson (1999), as their marker of adequacy. Per the ACSM position stand, Montenegro et al. (2017) stated in their discussion stating that "food consumption data should preferentially show considering the individual's body mass (g/kg/day)

than the total energy intake percentage" (p. 7) as they used a range of 1.5-2.0 g/kg BW suggested by Stellingwerf et al. (2011). Therefore, although presenting data for fat intake in g/kg BW may be useful to some degree, this was an example of misinterpretation of information and therefore may affect results reported and interpreted from these studies.

Over 50% of the studies reviewed in Table 3 reported overconsumption of dietary fat by athletes in many different sports. Baranauskas et al. (2015) reported high intakes of dietary fat and saturated fat in a group of 146 multi-sport athletes. Average fat intakes in this study were 44.8% ±9.8, 35.9% ±7.1, 41.0% ±6.9, 38.1% ±7.3, 41.8% ±4.6, and 43.1% ±5.6 for rowers, highway cyclists, swimmers, skiers, biathletes and long-distance runners, respectively. Similarly, Papadopoulou et al. (2012) also reported high fat intake, but only for male participants. Out of the 33 elite skiers, the 23 male skiers had an average fat intake of 39.2% ±5.3 and where the female skiers reported 33.0% ± 3.7 fat intake (Papadopoulou et al., 2012).

On the other hand, Montenegro et al. (2017), and Nowacka et al. (2016) were the only research teams that suggested their participants, swimming and canoeing athletes respectively, had low dietary fat intakes (See Table 2). Nowacka et al. (2016) used a range of 15-30% total energy intake from fat as their marker of adequacy in a study evaluating 37 professional canoe athletes. In this study, the researchers reported that 50% of female participants and 34% of male participants had below 15% fat intake in 2009. As their cut-off value of 15% is below current recommendations, it cannot be directly compared to other sports or results but may also indicate an even lower percentage of canoe athletes meeting fat intake requirements. The other study suggesting a low dietary fat intake was by Montenegro et al. (2017) in which their rationale for using g/kg BW is not supported by current sport nutrition recommendations, which makes it hard to interpret adequacy.

Additionally, there are other studies that have not reported their intake appropriately. For example, Marsh et al. (2017) evaluated fat intake in 16 elite female rugby players and reported adequate fat intake that fell within the 20-35% AMDR range. However, data reported suggest they were slightly above the AMDR recommendation as their 3-day averages were 35.6% ± 6.8, 38.5% ± 6.4, 35.9% ± 5.4 respectively. Additionally, Wardenaar et al. (2015) used a minimum of 20% energy intake for fat as a marker of adequacy, instead of a range, according to the Health Council of the Netherlands DRI (2001). Their averages for men and women ultramarathon runners were within the 20-35% range at 31.0% ± 8.8 and 32.1% ± 8.3, respectively but were not discussed in the paper (Wardenaar et al., 2015).

Overall, there seems to be adequate or more likely overconsumption of fats in the diet of athletes, especially when considering common under-reporting. A range of 20-35% intake for fat is accepted as the most common marker of fat intake adequacy, while others still use g/kg BW to report their data. As well, gender trends in dietary fat intake may help identify gaps in NK or potential effects in our study on elite curlers. The last lesson learned is that when considering fat intake adequacy in sport, clarifying "adequacy" is important. Researchers may interpret "adequate" as athletes meeting minimum requirements (i.e. above 20%) and not identifying if they are over 35% or meaning they fall into the recommendation range. This definition of adequacy is not only important for fat intake but should also apply to all macronutrient intake data presented in a research paper.

Protein Intake. As previously discussed, recommended intakes and requirements for protein has changed over the past few decades as research on the benefit of an increase in dietary protein for athletes is becoming widely accepted. From the literature search, there is no clear trend in protein intake across sports with most studies reporting adequate or above target protein

intakes (Table 2). For soccer players, the trend is that athletes either have adequate protein intake (Anderson et al., 2017; Dos Santos et al., 2016) or high protein intake (Devlin et al., 2017; Raizel et al., 2017). All four studies used different sources for protein recommendations which may account for the differences between studies. For example, Raizel et al. (2017) used a range of 1.2 – 1.7 g/kg BW as described by Hernandez & Nahas (2009) as their reference and a reported mean intake of 1.91 ± 0.75 g/kg BW while Devlin et al. (2017) reported intakes that ranged between 1.6 to 2.1 g/kg BW throughout an entire season and reported that this was above recommendations by Phillips et al. (2011).

Studies assessing multiple sports, on the other hand, report adequate protein intake (see Table 3). Only one study by Papadopoulou and Papadopoulou (2010) evaluating 69 professional multi-sport female athletes reported inadequate protein intake compared to recommendations of 1.4-2.0 g/kg BW (Position of the American Dietetic Association, 2000). Overall, there were only 20% of studies reporting inadequate protein intake, while the remainder supports an adequate or above recommendation protein intake. As there are no clear trends more research is needed to determine why protein intake is variable across the different sports. As mentioned, additional information on dietary patterns, beliefs or attitudes may also help clarify why there is no clear pattern regarding protein intake in athletic populations.

Micronutrient Intake. Micronutrients also play a large role in health, in nutritional deficiencies, and sport performance (Thomas et al., 2016). Micronutrients have been evaluated in athletic populations on numerous occasions and Table 2, shows that this occurs in roughly 50% of the studies examined. Most of the studies examining the micronutrient intake of athletes compare their intakes to public health guidelines, or RDAs, as there are no increases in

micronutrient needs for athletes and no benefits of supplemental micronutrient intake on performance outside of correcting already present deficiencies (Thomas et al., 2016).

Dietary Intake and Nutrition Knowledge

It has been hypothesized that increased NK, both general and sport specific, would be associated with an improved diet; however, this hypothesis has been met with mixed results (Rash et al., 2008). This section will discuss the relationship trends between overall NK and dietary intake, methods used to compare the two outcomes and other elements of dietary intake related to NK.

Many studies have evaluated the relationship between NK and dietary intake in general populations as well as with athletes. A review by Spronk et al. (2014) found 7 studies evaluating GNK, SNK and dietary intake which, together, reported a positive, but weak correlation between higher NK and dietary intake adequacy in athletes ($r<0.5$). Similarly, Rash et al. (2008) reported very weak correlations between dietary intake and NK ($r=0.001$); this means that dietary intake was predicted by NK only by 1%. However, Andrews, M. et al. (2016) reported that high NK scores did not associate with better dietary patterns among semi- and professional soccer players.

As well, studies evaluating both dietary intake and NK have different methods for comparing the two results. Some, like Folasire et al. (2015) determined a Nutrition Practices (NP) score and compared it to NK scores. Here, the authors gave 1 point to those that answered correctly to the nutrition practice questions in the NK survey and found a significant association between NK and nutrition practice scores (Folasire et al., 2015, $p=0.000$). Studies evaluating both dietary intake and NK look at not only the quality of the diet in general but also at specific elements: energy intake, macronutrient intake and any changes over time. For example, a study by Andrews, M. et al. (2016) reported a moderately positive relationship between SNK and

dietary intake (rho=0.32, $p<0.05$), carbohydrate intake (rho=0.35, $p<0.05$) and that the nutrition education intervention positively increased both NK and dietary patterns (Andrews, M. et al., 2016).

Studies using FFQs are also able to report trends in food intake patterns and its relationship to NK. For example, Spronk et al. (2014) reported that most studies in their review reported a positive relationship between nutrition knowledge and a higher intake of vegetables and fruit and lower dietary fat intake. Similarly, Alaunyte et al. (2015) reported that there was a significant relationship between fruit and vegetable consumption and overall nutrition knowledge ($p<0.05$).

Lastly, some studies do not report any relationship between NK and dietary intake although both outcomes have been evaluated. An example is Valliant et al. (2012) that only reported relationships between pre- and post-intervention NK and dietary intake, separately and not NK and dietary intake.

Overall, from most of the studies reviewed, there seems to be a weak but positive relationship between NK and dietary intake. The type of data collection instrument is important to consider when deciding how to best represent the relationship between NK and dietary intake. It appears that there is no commonly accepted strategy for scoring dietary intake as this may vary between instrument types. As well, separate relationships can be drawn between NK and specific macronutrients to further highlight areas of education that may be needed.

Conclusions

Overall, three methods of evaluating dietary intake continue to be utilized within athletic populations: FFQs, 24-hour recalls, and multiple day food records. Multiple factors contribute to the use of all three methods, including assessing dietary patterns over time or a specific period,

over and under-reporting, sample size, and study design. Thus, these factors should be considered when deciding which method to employ. As well, comparing intake results to recommendations and estimates of energy intake and macronutrient distributions are not consistent throughout the literature, but continue to change as sport-specific recommendations evolve with research findings. Utilizing the most recent sport nutrition recommendations would be advisable when evaluating dietary intake adequacy in athletic populations.

Overall, trends in many sports suggest that athletes may be below recommendations for energy intake and carbohydrates while reaching or consuming above recommendations for protein and fat. Finally, the relationship between nutrition intake and nutrition knowledge is unclear. There seems to be a weak and positive correlation between these two variables, but more information is needed to clarify if increasing NK will lead to better dietary intake habits.

Quality of Life

Quality of Life (QOL) is defined as "a broad multidimensional concept that includes subjective evaluations of both positive and negative aspects of life" (Centers for Disease Control and Prevention, 2018, para. 3). Evaluating QOL involves many factors as this is a wide-ranging definition. In general, QOL evaluation incorporates diverse domains including the physical, social, spiritual, economic and psychological status of an individual (Parsons & Snyder, 2011). However, as these domains themselves are also multidimensional, evaluating QOL can be complex. Therefore, clearly defining QOL and the domains that are to be evaluated is crucial in its interpretation and use in a research study.

A review of the literature demonstrated that there are many different types and formats of validated QOL surveys available for use. For example, surveys can range from general QOL, sport-specific QOL, or health-related QOL questionnaires (Centers for Disease Control and

Prevention, 2000; Ware & Sherbourne, 1992; WHOQOL Group, 1998) and depend on the study design and type. This means that QOL can be compared between sports, between athletes and non-athletes, or using other specific parameters, such as injuries, living condition, or supplementation as the independent variables. As well, there are situations where multiple instruments are used in combination to evaluate QOL within one study. Due to these multiple factors, determining the key aspects of QOL specific to the study and its target population is crucial in determining the appropriate instrument to use. This section will discuss the different types of QOL instruments used in athletic populations and, as there is currently no literature on QOL in the sport of curling, the findings in other sports.

General QOL

A general QOL instrument is one that incorporates an analysis of all major aspects of life and all domains; it can be considered a subjective evaluation of life in general. In this category, the World Health Organization (WHO) has contributed two validated and reliable QOL instruments to be used in the general population (WHOQOL Group, 1998). The WHOQOL-100 and WHOQOL-BREF were validated at measuring four key domains of QOL: Physical Health, Environmental Health, Psychological Health, and Social Relationships. The WHOQOL-BREF was created to provide a shorter version of the 100-question survey. The WHO was able to create a 26-question survey that reliably measured all four of these domains with a lower burden on participant time. These two instruments were created to measure QOL in multiple countries, making it a global measuring tool. The instrument is available in multiple languages and WHO provides specific instructions for its use and statistical evaluation (World Health Organization, 1996).

Although also used to assess QOL in diseased states, the WHOQOL-BREF is used as a general evaluation of QOL and used in epidemiological studies or with healthy adults (Paskulin & Molzahn, 2007). This demonstrates that the WHOQOL-BREF and WHOQOL-100 are all-purpose instruments and can give an overarching view of QOL in the general global population. In Canada, the WHOQOL-BREF scores were collected and then compared to other countries such as Brazil (Paskulin & Molzahn, 2007) to help showcase its use globally and to provide normative data. The use of normative data in each country allows for comparisons to the national population compared to a specific independent variable or intervention.

Lastly, it is important to note that there are also qualitative studies that use a general QOL question when using an interview format with a smaller participant group. This question is normally worded as: How satisfied are you with your current QOL? Therefore, study design and sample size also impact which general QOL tool to use.

General QOL in Sport. The WHOQOL-BREF has been used in many research studies involving athletes. For example, Tanimaru (2016) evaluated the QOL of male baseball athletes that were living either at a training center or off-campus. Here, the QOL was evaluated to showcase whether their living conditions affected QOL. Off-campus athletes had higher QOL scores (68.0) compared to on-campus athletes (66.9); however, no statistical significance was reported. Similarly, Verkooijen, van Hove, & Dik (2012) also evaluated the living condition in a group of Dutch elite athletes. Athletes that lived at their Centre for Elite Sport and Education (CESE) had lower psychosocial domain scores compared to non-CESE athletes (Verkooijen et al., 2012).

Evaluating the effects of nutrition on QOL is also used in sport populations. Sinnott (2012) evaluated the use of dietary supplements in a group of retired football players to see its

effect on QOL. The use of dietary supplements increased QOL compared to the control group. Correspondingly, Boldt et al. (2018) evaluated a group of distance runners and the athlete's QOL. The variables of interest in that study were whether being vegetarian or meat-eaters affected QOL and/or if the distance they ran also affected QOL. These researchers found that overall QOL was high regardless of diet choice or distance ran. As well, an evaluation of gender showed that men had higher QOL scores than women.

For a general QOL, evaluating athletes compared to non-athletes has also been seen in the literature. Correia et al. (2017) used normative data from Brazil to evaluate QOL in a group of volleyball athletes. The researchers found that all QOL domain scores were higher in the volleyball athletes compared to the national average. The only exception was the Environmental Health domain, which was almost equivalent between groups. The results from this study help to contribute to the literature on whether or not athletes have higher QOL perception than non-athletes.

Lastly, interview-style QOL questions were used in two studies. Filbay, Bishop, Peirce, Jones, and Arden (2017) evaluated QOL in a group of cricket players and Gouttebarge and Kerkhoffs (2017) evaluated the QOL of professional, retired hockey players. Themes of whether the sport has played a role in QOL can be determined. Overall, a general QOL tool can be used in many ways to help highlight the impact of sport or sport environment on QOL.

Health-Related QOL

Health-Related QOL (HrQOL) is another form of a QOL instrument that has an emphasis on how clinical and health outcomes affect QOL. These health factors can be physical, mental or emotional implications of QOL through chronic diseases, injuries, or other illnesses. The most common HrQOL survey is the Short Form Health Survey (SF-36) that is comprised of 26

questions evaluating eight core concepts: Physical Functioning, Bodily Pain, Physical Health Problems, Personal or Emotional Problems, Emotional Well-being, Social Functioning, Energy/fatigue, and General Health Perceptions (Ware & Sherbourne, 1992). These categories are specific to determining the effects of a disease or an illness on perceptions by an individual about their life. The SF-12 is a shorter version of the SF-36 that also evaluate these categories with a smaller question bank and a smaller burden on participant time (Gandek et al., 1998).

Additionally, the US Centers for Disease Control and Prevention (CDC) also has a validated CDC HRQOL-14 instrument that is partly used in the National Health and Nutrition Examination Survey (NHANES; CDC, 2000). This 14-item tool includes questions related to "recent pain, depression, anxiety, sleeplessness, vitality, and the cause, duration, and severity of a current activity limitation an individual may have in his or her life." (Centers for Disease Control and Prevention, 2018b, para. 2) Overall, there is more of a clinical health perspective involved when utilizing HrQOL instruments such as the SF-36 or the CDC HRQOL-14.

Furthermore, there are HrQOL instruments that are disease specific. A general example of this is the WHOQOL-HIV and WHOQOL-HIV BREF. This instrument is similar to the WHOQOL-100 and -BREF in that they evaluate QOL but also created to be used in an HIV population. Another example is the Leicester Cough Questionnaire that is used to assess cough-related QOL and covers physical, psychological and social domains (Birring et al., 2003). These disease specific HrQOL instruments are specific to the disease state and are in addition to the general QOL questionnaire.

HrQOL in Sport. In the literature, the application of a HrQOL instrument is done in multiple ways. First, one use of the HrQOL is to compare QOL between athletes that have been injured and those that have not. For example, in a large sample of 696 collegiate athletes, those

that reported having had an injury had a lower QOL score in all the SF-36 domains, except role limitations due to emotional problems, compared to athletes without injury (Huffman et al., 2008). Similarly, Moreira, Mazzardo, Vagetti, De Oliveira, and De Campos (2015) evaluated HrQOL in a group of basketball masters athletes and discovered that sport injuries can decrease perceived HrQOL in both physical and mental domains for these athletes.

Additionally, the SF-36 can be utilized to evaluate the effect of a condition or specific injury known to a sport and its effect on QOL. Arliani et al (2014) provides an example that evaluated the occurrence of knee osteoarthritis in a group of retired professional soccer players compared to non-professional athletes. The researchers found that the retired soccer players had worse QOL scores than the control when evaluating physical aspects related to knee osteoarthritis. Another example of this is the Mini Rhinoconjunctivitis Quality of Life Questionnaire (miniRQLQ). As rhinoconjunctivitis is a particularly common illness for swimmers, this QOL instrument has been used in that population group (Surda et al., 2018). Surda et al. (2018) used this miniRQLQ to determine if rhinitis might have an impact on training and performance. Surda et al. (2018) found that miniRQLQ scores were lower in elite and non-elite swimmers compared to control and non-swimming athletes.

Lastly, the involvement of physical contact in sport is also an area that is evaluated for its effect on QOL. Simon and Docherty (2016) evaluated HrQOL in a group of former National Collegiate Athletic Association (NCAA) limited-contact, contact, or collision sport athletes. These researchers found that collision sport athletes scored lower on the SF-36 compared to both limited-contact and contact sport athletes in all domains. Overall, HrQOL is an instrument used in research to determine the effects of an injury, illnesses or physical parameters within the sport that may affect an athlete's perception of QOL.

Sport-Specific QOL

Instruments evaluating QOL have also been found to evaluate sport-specific aspects under the major domains. An example of an instrument that was developed with athletes in mind is the Athlete Life Quality Scale (ALQS). This was created by Gentner, Wrisberg, and Lounsbury (2011) with five themes: General Life, Physical, Team/Sport, Primary Social and Recovery/Social Satisfaction. Examples of items that are different from the general QOL instruments include: athletes' relationship with their coaches, an individual's athletic performance, and the amount of free/recovery time athletes have away from their sport. This instrument also includes other general QOL items such as physical health and financial situation, which are like other QOL tools.

Another example is Tanimaru and Dos Santos (2016) who used a QOL Questionnaire for Athletes (in Portuguese) to supplement the use of the WHOQOL-BREF in their study with baseball players. This instrument, although only available in Portuguese, involved categories relating to Social Relations in the Sport Environment, Basic Health Conditions, Sign/Symptoms of Fatigue, Planning and Periodization of Sports Training, and Emotional Athlete States. One last sport-specific instrument is that used by Correia et al. (2017) to also supplement the WHOQOL-BREF, called the Academic-Sports Questionnaire. They evaluated Daily Life and Training, Scholarships, Opinions About University, etc. Overall, studies evaluating the QOL of athletes incorporate aspects specific to athletics that may also affect QOL. However, the development of the sport-specific QOL instruments is currently in its infancy. The literature on these types of instruments is limited, as the other types of QOL instruments seem to be favoured.

Sport-Specific QOL in Sport. The utilization of sport-specific QOL instruments is limited. However, Knust, LaGuerre, Wrisberg, King, and Berggrun (2014) reported that the

ALQS scores and mental toughness scores had a significant positive relationship indicating that mental toughness may impact QOL in a group of NCAA student-athletes. As well, Morgan (2006) used an early version of the ALQS to assess QOL between freshman and non-freshmen collegiate volleyball players. Morgan (2006) reported that there was no difference between years on the volleyball team and QOL scores. Lastly, Correia et al. (2017) reported that there was no relationship between the amount of training time and QOL, showing that participation in sport, regardless of the length of time training, may not affect overall athlete-specific QOL.

Conclusions

Reviewing the literature on QOL and the various ways to assess it brings up important considerations when evaluating this parameter. First, defining what areas related to QOL a study wishes to evaluate, such as general QOL or as an assessment of a disease or supplement interventions, and the use of this measurement are crucial to determine prior to selecting an appropriate tool. Finally, as tools vary in length, question type, validity, and reliability, knowledge of all tools available is also necessary to determine the best instrument for the current study design.

Athlete Definition and Categorizations

An important consideration when reviewing and conducting research in athletic populations is determining the appropriate selection and classification of participants. When describing participants in research for athletic populations, it is common to define the eligibility criteria that would identify participants as “athletes.” However, there are many definitions and criteria that exist to separate “athletes” and those who are not. Additionally, athletes may be further classified for statistical analyses and comparison to the literature. Beyond categorization of athletes by gender and sport, as seen in Table 3, there are many different terms used to

categorize athletes based on position and level of performance, such as “college,” “professional,” “high performance,” “elite,” and “amateur,” all of which may be used interchangeably in a single study. Thus, this section will focus on reviewing the definition of an athlete and the variability in terms and classifications found in the literature.

Definition of Athlete

There are many ways to determine the definition of an “athlete” and thus the eligibility of participants to participate in a study. In the medical community, the need to differentiate between an “athlete” and an “exerciser” aims to help “enable more meaningful and precise associations between exercise & health outcomes” (McKinney, Velghe, Fee, Isserow, & Drezner, 2019, p. 532), such as heart health. Nutrition can impact health outcomes, thus clarifying the definition of an athlete in nutrition research is warranted.

Unfortunately, there have been divergent views on the term “athlete” in the literature. For example, Trakman et. al (2016) vaguely describes athletes as “individuals involved in training and playing competitive sport” in the context of nutrition research. The definition of athletes used by Trakman et al (2016) is similar to many other studies involving collegiate athletes, where their participation in an organized program such as the NCAA qualifies them as athletes and eligible to participate in the study (Abbey et al., 2017; Folasire et al., 2015; Rossi et al., 2017; Shriver et al., 2013).

Other definitions of “athlete” contain greater detail such as the definition by Araújo and Scharhag (2016) in the context of clinical implications of exercise that includes:

> “a) to be training in sports aiming to improve his/her performance or results; (b) to be actively participating in sport competitions; (c) to be formally registered in a local, regional or national sport federation as a competitor; and (d) to have sport training and

> competition as his/her major activity or focus of interest, almost always devoting several hours in all or most of the days to these sport activities, exceeding the time allocated to other professional or leisure activities." (p. 6)

McKinney et. al (2019) suggest using intent to separate "exercisers" and "athletes" with "exercisers" focusing more on health promotion, fitness and improved physique compared to "athletes" who may be playing to win or to improve athletic performance. Some eligibility criteria include an emphasis on the number of hours played in sport or training (Drenowatz et al., 2012; Filaire et al., 2015; Raymond-Barker, Petroczi, & Quested, 2007; Wardenaar et al., 2017) and the intent behind their participation, such as competition in tournaments (Doumtsios et al., 2010), while others do not have a clear definition of "athlete" regarding intent and time devoted to training (Koehler et al., 2010; Wierniuk & Wlodarek, 2013).

To note, the term "recreational" athlete has also been used to describe participants who may not be competing at high levels of competition or without the intent of advancement within the sport at a higher level according to the definitions of intent mentioned above and can be easily interchanged with "exercisers" (Laquale, 2009). However, the term "recreational" is not always clear as is seen in a study by Raymond-Barker et. al, (2007) which used recreational athletes as controls to evaluate NK and other parameters. The criteria used by Raymond-Barker et. al (2007) was that controls were non-athletes but were still able to participate in "recreational sports and daily activities." Evidently, the differentiation of the term "athlete" from "recreational" or "exerciser" is not clear in the literature and is important to identify as the interpretation of what an "athlete" consists of may impact who is eligible to participate in studies evaluating athletic populations and how data may be interpreted and/or analyzed.

Athlete Categories

Further categorization of athletes is also seen in the literature. For example, categories of female and male athletes, or adolescent or adult athletes, are used to compare groups of participants and are clearly based on gender identification and age. However, the level of performance is one of the categories that see the most variability in the literature as is evident from Table 3. For example, Lemez and Baker (2015) defined "elite" as individuals who attained "high-performance participation in sport (i.e., national, professional, and international competition such as the Olympics)," but that excluded collegiate athletes. Whereas other studies such as Zapolska et al. (2014) use the word "professional" or "semi-professional" (Andrews & Itsiopoulos, 2016) to describe whether or not the participants were part of an athletic club. In the aforementioned studies (Zapolska et al. and Andrews and Itsiopoulos) the terms were used in reference to football clubs in Australia which are classified as professional or semi-professional. McKinney et. al (2019) suggests a more quantitative approach to differentiating the levels of performance, where "elite athletes" are those participants who exercise >10 hours/week, "competitive athletes" exercise >6 hours/week, "recreational athletes" exercise >4 hours/week and an "exerciser" exercises >2.5 hours/week of PA, in combination with their intent to exercise. Laquale (2009) also distinguishes between "recreational" and "competitive" athletes with "competitive" athletes being those who "participates in 'competitive physical activities' or sports/games that require physical strength, agility, or stamina." (p. 12)

Another example of classification based on intent and level of performance is the Long-term Development in Sport and Physical Activity Framework by Sport for Life (Higgs et al., 2019). Using a Canadian framework, the authors identify the complexity of using the word "athlete" and set forth to further identify categories of classification for athletes who are "Active

for Life" in two major categories: a) Fit for Life as "those who participate simply because they get satisfaction from sport or physical activity" and may compete at the recreational level; and b) Competitive for Life category who are "those who compete within the formal structure of their sport… and differs from Fit for Life because competitive athletes are striving to improve to win, and they train accordingly" (Higgs et al., 2019, p. 35). The Sport for Life framework also goes one step further to differentiate those who are Competitive for Life and high-performance athletes in their Podium Pathway category. Here, high-performance athletes are said to be "capable of winning at the highest levels of international competition" such as the Olympics or World Championships (Higgs et al., 2019). Not only does this framework capture all physically active individuals, and people potentially playing in organized sport, but it can also differentiate based on the level of performance, the potential for success and dedication to their sport.

In summary, a review of the literature shows that the definition of an "athlete" is diverse ranging from a focus on the participation in a specific sport or activity, the intent behind their sport participation and competition, the amount of time dedicated to the sport, and/or their registration in sports federations or organizations. Additionally, the classification of athletes into groups or segments such as gender, age, sport type, and position played, is also diverse in the literature, with Level of Performance seeing the most variability. In conclusion, defining the term "athlete" and the classifications used to group the athletes can help to better illustrate the exact population being studied and the eligibility of participants to partake in the study. Lastly, defining these terms will help with comparison of results between studies and their athletic populations as variability in terms used could lead to inaccurate comparisons.

Chapter II: STUDY RATIONALE, OBJECTIVES AND HYPOTHESES

Rationale

Curling is a very popular Canadian sport with close to 1000 curling clubs across the country and approximately 1.7 million Canadians playing annually (Curling Canada, 2018a). Curling is a unique sport where there is a wide range of participants, from children to individuals in their late 80s, as it is modifiable for disabilities and old age. As well, at the national and international levels, curling athletes are also older than many other sports with athletes in their 20s to 50s, which adds to the uniqueness of the sport. Overall, curling is not just a popular sport, but it is also an age- and mobility-inclusive sport, at both the recreational and international levels.

Canada's best curling teams have topped the podium at World and Olympic level competitions in almost every competitive category. Curling Canada informed the public that they "have every intention of being the No. 1 curling nation in the world in all disciplines on a consistent basis. To achieve this, we need to be actively engaged and invested in many aspects of our long-term development models for both athletes and coaches" (Curling Canada, 2018a). This emphasis on world class athleticism and development does not stop at only practicing curling. All aspects related to performance are important to consider when trying to achieve the vision set out by Curling Canada, and nutrition is certainly one of them. Thus, it is important to discuss not just how nutrition may affect sport performance, but also the factors that influence dietary intake and the need for research in this area.

In the hope of gaining a performance advantage, manipulation of the diet has become commonplace in the lives of many recreational and competitive athletes, which has prompted research in this area to grow exponentially (Close, Kasper, & Morton, 2019). Much of the

research in sport nutrition points towards the necessity to implement sport-specific nutritional strategies as part of an athlete's training plan. For example, the timing, quantity, and composition of foods ingested have been directly associated with athletic performance, as well as with numerous factors affecting athletic performance such as body composition, immune function, and post-exercise recovery (Thomas et al., 2016). As these factors also affect general health, it is no wonder that dietary intake and sport-specific nutrition strategies are becoming more important to implement and monitor at all levels of athletes.

Dietary intake has been widely studied in a variety of sports by using several different dietary intake instruments (see Table 3). In this present study, a 3-day food record was used to assess dietary intake because it allows for more specific nutrient intake calculations compared to a FFQ, avoids memory errors associated with 24-hour recalls and reduces participant burden compared to a 7-day food record.

Additionally, there are multiple factors that can affect an athlete's dietary intake including, but not limited to, income, food security, nutrition education, stress, social surroundings and religious beliefs (Alaunyte et al., 2015; Andrews, & Itsiopoulos, 2016; Birkenhead & Slater, 2015; Oliver & Wardle, 1999). An area that may be manipulated more readily is an individual's understanding of SNK as theoretically, possessing greater SNK would lead to improved dietary intake, health, and subsequently sport performance (Alaunyte et al., 2015; Spronk et al., 2014). Therefore, many nutrition education interventions have been used to improve SNK and downstream athletic performance (Nascimento et al., 2016; Rossi et al., 2017; Valliant et al., 2012).

Assessing that an athlete understands the current findings on nutritional strategies and if it enhances dietary intake and/or athletic performance is an area that has been researched through

questionnaires in many sports such as baseball, soccer, track and field, volleyball and rugby (Andrews, & Itsiopoulos, 2016; Trakman et al., 2016; Valliant et al., 2012). However, to date, there has been no reported investigation on SNK or current dietary intake practices amongst any athletic level of curlers; recreational or competitive. Following trends in the literature, this study utilized a questionnaire that included questions from multiple SNKQs previously used to assess SNK (Folasire et al., 2015; Hull et al., 2016; Kondric et al., 2013; Nazni & Vimala, 2010; C. A. Rosenbloom et al., 2002; Shifflett et al., 2002; Zawila et al., 2003). As previously mentioned, sport nutrition research has evolved; therefore, using updated questions from more recent questionnaires was necessary to update those from the early 2000s. There was a small pilot study reviewed and trialed by four registered dietitians and five athletes to help complete and support the use of the SNKQ. The dietitians all agreed that this questionnaire covered SNK concepts and all participants agreed that it was easy to read and complete. This pilot study confirmed the feasibility of the survey for the target population.

Furthermore, psychological factors also play an important role in making food choices and consequently affect performance. Stress, which is defined as a state of mental or emotional strain or tension resulting from adverse or demanding circumstances, is a psychological factor that can disturb an individual and has been shown to negatively affect food choices (Oliver & Wardle, 1999; Oxford Dictionary, 2018). Stress can manifest from many different aspects of life, including work, family, friends and economic conditions. One way to assess psychological well-being, that encompasses all these major aspects of life, is through a QOL survey. A QOL assessment, a subjective evaluation of positive and negative aspects of life (WHOQOL Group, 1998), has been used to describe general and athletic populations. Reliable and valid tools to evaluate QOL have been developed, assessing both physical and psychological health. Notably,

it has been found that adults participating in recreational sports have a better perceived QOL than those who do not (Omorou et al., 2013). However, it is currently unknown whether curling participation would increase perceived QOL and its associated factors. As this study did not specifically evaluate athletes with health-related concerns like many QOL surveys mentioned earlier, and more generally the entire population of curlers, the WHOQOL-BREF was used to evaluate QOL. The WHOQOL-BREF is a shorter validated survey that provides similar and reduced participant burden compared to the WHOQOL-100 and evaluates general QOL for this varied population.

Lastly, competitive athletes may encounter additional stressors compared to those experienced in regular daily life. For example, competing internationally not only places an athlete in unknown living conditions but also unquestionably impacts food choices through challenges encountered with food availability, foreign foods and languages, and lodging. Organizational stressors such as the pressure to perform from coaches and sport politics may also contribute to additional stress and further impact dietary intake while in a competition (Dugdale, Eklund, & Gordon, 2002; Kristiansen & Roberts, 2010). As well, increased QOL has been associated with improved athletic performance in competitive athletes. As described by Ledochowski, Unterrainer, Ruedl, Schnitzer, and Kopp (2012), QOL was positively associated with regulation of competition anxiety and subsequently performance. As these factors are unique to a competitive athlete in competition, assessing the effects of sport-related stress on food choices and QOL is warranted.

Overall, QOL continues to be evaluated in many sports, but as with SNK, no information is available regarding the QOL status of recreational or competitive curlers. Thus, it is important

to investigate the current level of, and differences in QOL of recreational and competitive curlers in Canada.

Delimitations

This study aims to explore three major content areas: NK, QOL and Dietary Intake in the athletic populations of curlers, only. Inclusion criteria for Part 1 of the study included being over the age of 18 years old, currently residing in Canada, and participating in curling. I chose to focus on the adult population as the NK and Dietary Intake literature is quite large for both adults and adolescents. This allows for a more focused evaluation and discussion. Although the age of participant was limited to adults, the level of performance of the athletes was open to all levels. Therefore, this study took into consideration NK and QOL for recreational and competitive athletes. As dietary intake data collection does have higher participant burden, a focus solely on elite level curling athletes was decided for Part 2.

In this study, a quantitative approach was used for data collection of Part 1 with close-ended questions as well as open-ended questions to provide additional context to the assessment of NK. For Part 2, a quantitative approach was used to assess dietary intake. Interview style questionnaires were not utilized to assess QOL as this would not have been feasible to assess the Canadian population due to travel and monetary restrictions. For assessing NK, GNK and SNK were both chosen to be assessed. As all adults that participate in curling were invited to participate, including recreational athletes, GNK was seen as important to include as nutrition for health is also important. Dietary Intake would assess Energy, Macronutrient and Micronutrient intake as software to evaluate each of these parameters was available in our lab.

Research Objectives

Part 1 – Nutrition Knowledge & Quality of Life

Study Objectives. The main objectives of Part 1 of this research study were to determine the current NK, nutrition practices, nutrition beliefs, and QOL of both competitive and recreational Canadian curlers. The specific objectives included: determining what factors influence the NK level (both SNK and GNK) of Canadian curlers; elucidating the current trends in nutrition practices and nutrition beliefs of Canadian curlers; and reporting if there is a difference in NK and QOL between recreational and competitive curlers in Canada.

Study Hypotheses. For this study, the hypotheses were:

- Overall NK scores will have a positive relationship with Nutrition Qualification and higher levels of Education, but not with Years Played or Age.
- SNK scores will be higher in competitive compared to recreational athletes.
- QOL will be higher in recreational athletes compared to the competitive curlers.
- QOL will have a positive relationship with Years Played and Training Hours.

Study Question. Will the curlers have similar NK, NP, and beliefs as other athletes?

Part 2 – Dietary Intake

Study Objectives. The main objective of Part 2 is to evaluate the dietary intake in Canadian elite-level curlers and explore the relationships between dietary intake and QOL and NK. Specific objectives include evaluating if any trends exist between SNK and dietary intake of competitive curlers in Canada and assessing dietary intake adequacy and tendencies based on current sport nutrition recommendations for competitive curlers.

Study Questions. Questions for this study included:

- Will elite curlers with higher SNK scores tend to have higher nutritional adequacy based on sport nutrition recommendations?
- Will dietary intakes of elite curlers be inadequate in energy and carbohydrate, but adequate in fat and protein intake, compared to recommendations, as with other athletic populations?

CHAPTER III: Part 1: Evaluation of Nutrition Knowledge and Quality of Life in Canadian Curling Populations

Methods

Participants

The participants in Part 1 included curling athletes of all levels, over the age of 18, and who resided in Canada as the eligibility criteria. Curling "athletes" are defined as individuals who participate in the organized sport of curling. For this study, the terms "participants" and "athletes" are used interchangeably and they will be categorized according to the Sport For Life Long-Term Development in Sport and Physical Activity model, in the Canadian context, for their Level of Performance (Higgs et al., 2019). "Fit for Life" athletes, those who engage in sporting activities but do not have the intent to spend the majority of their time training and competing at higher levels, will comprise of the athletes competing solely at the Local Level and will be referred to as the "recreational" participants (Higgs et al., 2019). All "Competitive for Life" athletes, those who compete with the intent of improvement and success, and "Podium Pathway" athletes, those who are competing at the international or Olympic level or "elite" athletes, are all considered to be "competitive" athletes. They are identified in the survey as competing at the Regional, Provincial, National and National Team Program (NTP) Levels. The NTP is a Canadian Program for athletes identified as having potential to represent Canada at International events such as the World Championships or the Olympics (Curling Canada, 2019).

Participants were recruited through various social media streams on Twitter, Instagram and Facebook; emails and posters sent to Curling Associations and Curling Clubs across the country; email or in-person with the help of Curling Canada personnel; and in-person at various curling tournaments (Manitoba only). Recruitment at curling tournaments used primarily paper

copies of the SNKQ and QOL surveys, while all other entries were completed using an online survey platform (Qualtrics, 2019).

An estimated number of total participants, including both recreational and competitive, required for Part 1 was calculated based on the formula below. Using a 95% Confidence level (z = 1.96), a margin of error of 5% (0.05), and SD of 0.5 to ensure the sample size was large enough (Kotrlik & Higgins, 2001), a sample of 385 participants was suggested.

$n = (\text{Z-score})^2 \times SD*(1-SD) / (\text{margin of error})^2$

$n = (1.96)^2 \times 0.5(1-0.5) / (0.05)^2$ n = ~385 participants

Study Design

Overall, this was a cross-sectional study composed of two questionnaires, a SNK and a QOL questionnaire, that were distributed during the data collection period of September 2017 to March 2019**.** Participants were asked to fill out both questionnaires at the same time; however, some participants did not complete both surveys. Time could have contributed to only one of the surveys being completed, or through online recruitment where 2 links were provided, and one may have been missed. All participants signed, by hand or virtually, an informed consent form before completing the survey. Ethics approval was obtained from the University of Manitoba Joint-Faculty Research Ethics Board (see Appendix D).

Sport Nutrition Knowledge Questionnaire (SNKQ)

Before administering the SNKQ to curling athletes, small changes were made based on the evaluation from a small pilot testing of the SNKQ. Minimal spelling errors were discovered, and one question was added to cover the topic of calcium and its importance in sport. Calcium is important for athletes, not only for its role in bone density and the risk of stress fractures associated with Relative Energy Deficiency Syndrome (RED-S), but also in the regulation of

muscle contraction and nerve conduction (Thomas et al., 2016). Therefore, adding this question to the SNKQ was warranted for practical reasons but is also seen in the literature (Arazi & Hosseini, 2012). This was the only author-derived question as all other questions were taken from previously validated surveys (Folasire et al., 2015; Hull et al., 2016; Kondric et al., 2013; Nazni & Vimala, 2010; Parmenter & Wardle, 1999; Rosenbloom et al., 2002; Shifflett et al., 2002; Zawila et al., 2003).

The SNKQ is an 82-question semi-structured, self-administered, anonymous questionnaire assessing GNK, SNK, NP, nutrition beliefs, and demographic information. This survey contains close-ended questions (multiple-choice and Likert-scale questions) and open-ended questions to further specify certain beliefs and practices (See Appendix A for a copy of the SNKQ). All NK-related questions included a Not Sure answer. NK areas that were addressed in this survey are presented in Table 4 and categorised by SNK or GNK. The survey was considered completed if >90% of questions were answered.

Table 4 – Nutrition Knowledge Categories in the SNKQ

Nutrition Category	**NK Type**	**Total Questions**
Sugar	GNK	5
Salt	GNK	6
Fibre	GNK	6
Protein	GNK	6
Fat	GNK	5
Calories	GNK	1
Food Choices	GNK	6
Macronutrients	SNK	7
Micronutrients	SNK	6
Fluids	SNK	5
Dietary Requirements	SNK	5
Weight Management	SNK	3

Quality of Life Questionnaire

A 32-question QOL survey was used in this study, which comprised of the 26 items from the WHOQOL-BREF (WHOQOL Group, 1998) and six questions from the ALQS (Gentner et al., 2011). The WHOQOL-BREF survey evaluates overall QOL as defined by four domains as summarized in Table 5 (World Health Organization, 1996). This survey utilizes a 5-point Likert scale for each question and was scored out of 100 points, with 100 representing a better QOL. The six questions from the ALQS (Gentner et al., 2011) addressed areas related to QOL specific to athletic populations, such as relationships with coaches and teammates, that would not have been evaluated in the general QOL survey. (See Appendix C for a copy of the QOL survey).

Table 5 – Domain Summary from the WHOQOL-BREF Questionnaire

Domain	Facets Incorporated within the Domain
Physical Health	Activities of daily living Dependence on medicinal substances and medical aids Energy and fatigue Mobility Pain and discomfort Sleep and rest Work Capacity
Psychological	Bodily image and appearance Negative feelings Positive feelings Self-esteem Spirituality / Religion / Personal beliefs Thinking, learning, memory and concentration
Social Relationships	Personal relationships Social support Sexual activity
Environment	Financial resources Freedom, physical safety and security Health and social care: accessibility and quality Home environment Opportunities for acquiring new information and skills Participation in and opportunities for recreation / leisure activities Physical environment (pollution / noise / traffic / climate) Transport

Data Analysis

To evaluate NK, each correct answer was given one point leading to a calculation of an overall score TNK (61 points), and individual scores for GNK (35 points) and SNK (26 points). Questions that were answered incorrectly (selecting two answers or not chronologically feasible) or not answered were left as blank.

Scoring of the WHOQOL-BREF portion of the QOL survey followed guidelines outlined by the creators of the survey (World Health Organization, 1996). Briefly, an average in each of the four domains is determined by calculating the mean score of all items in that domain. Question 1 (overall QOL) and Question 2 (overall perception of health) are examined separately. The raw score provides scores in a range from 4-20 which is used to compare to the WHOQOL-100 (the long version of the QOL survey) while the second transformation allows scores to be reported on a 0-100 scale (World Health Organization, 1996). The second transformation uses the equation: TRANSFORMED SCORE= (SCORE-4) x (100/16) to calculate scores out of 100. For this study, the second transformation was used for statistical analysis (out of 100).

Statistical Analysis

All online survey data was transferred to Excel and hard copy responses were entered in Excel to merge both sets of data. Then, data were transferred to Statistical Package for Social Sciences (SPSS) Version 25 (IBM, 2019). To test for significance, the p-value was set at 0.05.

Demographics are presented in frequencies and mean ± standard deviations (SD). Some demographics were also categorized as followed: 1) the provinces participants resided in were grouped into Western (British Columbia and Alberta), Prairies (Manitoba and Saskatchewan), Central (Ontario and Quebec) and Eastern (New Brunswick, Nova Scotia and Prince Edward Island) as some of the provinces had very little representation. 2) Education levels were grouped

into ≤ High School (Some High School, No Diploma and High School or less), Some Post-Secondary (Technical or Trade Certificate and Diploma), Bachelor's Degree and ≥ Graduate Degree (Graduate Degree and Post-Graduate Degree) as categories were very similar with some having very small representation (ex: Some High School, No Diploma). 3) Employment was collapsed into five categories, Full Time, Part Time, Retired, Student and Other (Other, Unemployed, Homemaker) for similar reasons as Education and Province.

Participants' responses to an open-ended question on Supplements usage were categorized into 3 groups: Vitamins and Minerals (individual vitamins or minerals, multivitamins, complexes, etc.), Protein (powders, bars and Branch Chained Amino Acids) and Other (Omega 3's, Creatine, etc.) for those with a very small representation. Additionally, the question addressing Sources of Nutrition Information was a "Select all that apply" format, therefore frequencies for each individual answer are presented as a percentage of the entire population.

NK scores are presented in mean ± SD. Individual or SNK responses, as well as nutrition practice and beliefs, are presented in frequencies and percentages. Chi-square (x^2) test of independence was used to assess differences between groups for categorical data.

For both SNKQ and QOL data, Spearman's correlation was used for the analysis of continuous variables and Mann Whitney-U tests for categorical variables with two groups. These statistical tests were used because tests for normality showed that the data did not display normal bell-shaped curves, indicating the need for the use of nonparametric tests (Pallant, 2010). Additionally, Kruskal-Wallis test was used to evaluate differences between three or more groups with the use of a Bonferroni adjustment to assess significance between groups. Two-way Analysis of Variance was also used to further analyze between-subject factors such as gender

differences for TNK scores according to education level and QOL scores for each domain as compared by group (age, education, etc.). For the ALQS portion of the QOL survey, each question was evaluated individually. The descriptive statistics provided in mean ± SD.

Results

Participant Characteristics - SNKQ

A total of 320 participants completed the SNKQ with a summary of all participants' characteristics shown in Table 6. Overall, there were similar proportions of male and female participants at 50.0% and 49.7%, respectively, with a small representation from the transgender/other category at 0.3%. The age of the participants ranged from 18 to 84 years old with a mean of 44.7 ± 17.9 years. Most of the participants lived in the Prairies (70.4%), with the Western, Central and Eastern participants representing 14.0%, 13.6% and 2.0%, respectively.

Participants spent on average 6.9 ± 5.9 hours a week on curling training. Overall, participants reported having been involved in the sport of curling for a mean of 22.0 ± 15.1 years. Of these participants, 63.5% are "recreational" athletes, while the remaining are "competitive" athletes at 36.5% (Table 6).

Table 6 – Participant Characteristics of Curlers Who Completed the NK Questionnaire

	Overall, Mean (SD)	**Min**	**Max**
Age (years), n = 317	44.7 (17.9)	18.0	84.0
Body Mass (kg), n = 314	77.0 (16.5)	47.7	136.4
Height (cm), n = 320	171.7 (9.7)	142.2	198.1
BMI (kg/m^2), n = 313	25.9 (3.9)	17.2	38.9
Years Played (years), n = 309	22.0 (15.1)	0.1	66.0
Training Hours (weekly), n = 305	6.9 (5.9)	1.0	40.0
	Sub-category	**Sample (n)**	**N (%)**
Gender*		**n = 320**	
	Female	159	49.7
	Male	160	50.0
	Transgender/Other	1	0.3
Region†		**n = 250**	
	Prairies	176	70.4
	Central	34	13.6
	Eastern	5	2.0
	Western	35	14.0
Education		**n = 316**	
	≤ High School	65	19.3
	Post-Secondary	73	21.7
	Bachelor's Degree	115	34.2
	≥ Graduate Degree	63	18.8
Nutrition Qualification		**n = 316**	
	Yes	21	6.6
	No	295	93.4
Level of Performance		**n = 315**	
	Recreational	200	63.5
	Competitive	115	36.5
Children		**n = 317**	
	Yes	159	50.2
	No	158	49.8
Employment		**n = 315**	
	Full-Time	146	46.3
	Part-Time	27	8.6
	Retired	81	25.7
	Student	47	14.9
	Other	14	4.4

SD = Standard Deviation, kg = kilogram, cm = centimeter, BMI = Body Mass Index, * due to small sample size, all evaluations using gender are based on male & female categories. †The Region question in the SNKQ was added after the data collection period had already started.

Nutrition Knowledge Scores

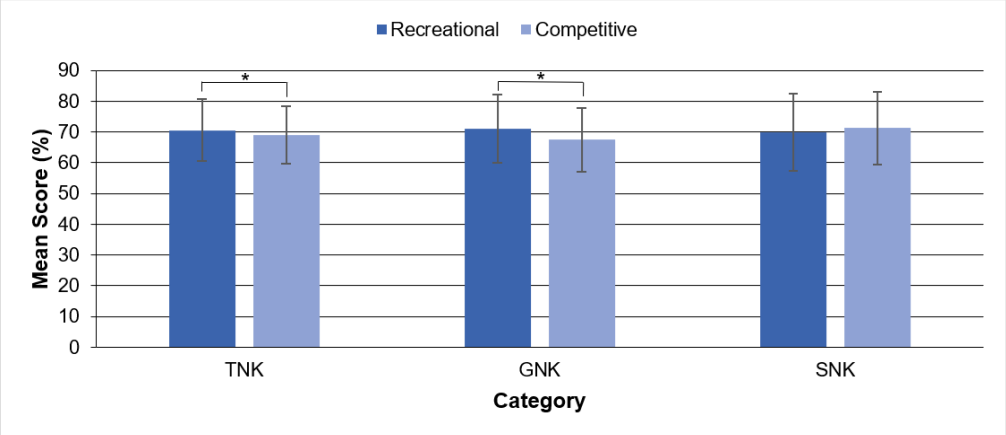
As seen in Table 7, the TNK score for the entire population is 42.5 ± 6.3 (69.6% as a score out of 61); with SNK at 17.5 ± 3.2 (67.3% as a score out of 26); and GNK at 25.0 ± 4.0 (71.4% as a score out of 35). A significant difference was found between TNK and GNK scores of males and females with females having higher scores in both categories ($p=0.002$, $p<0.001$, respectively). For the Level of Performance "recreational" athletes had significantly higher TNK and GNK but not SNK scores compared to "competitive" athletes (Figure 1, $p=0.046$, $p=0.001$, and $p=0.449$, respectively). Participants with Nutrition Qualifications had higher TNK, SNK and GNK than those who did not (Figure 2**,** $p=0.002$, $p=0.005$, $p=0.004$, respectively). There were no significant differences between NK scores for any Regions in Canada.

Table 7 – Overall Nutrition Knowledge Scores of Curlers

Category	Percentage (SD)	Overall Mean (SD)	Min	Max
TNK	69.7 (10.3)	42.5 (6.3)	16.0	57.0
GNK	69.5 (11.2)	25.0 (4.0)	12.0	33.0
SNK	70.1 (12.8)	17.5 (3.2)	4.0	24.0

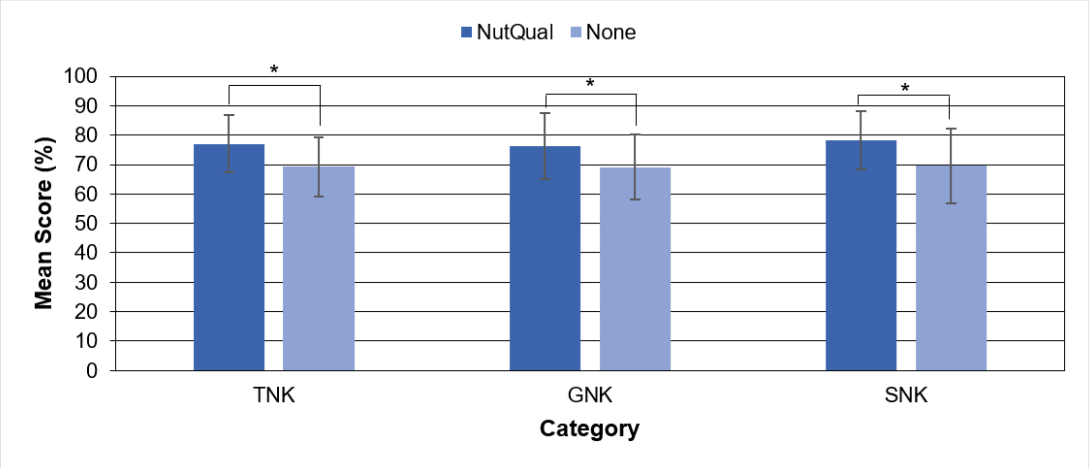
SD = Standard Deviation, TNK = Total Nutrition Knowledge, GNK = General Nutrition Knowledge, SNK = Sport Nutrition Knowledge. N = 320.

Figure 1 – Results for NK Scores Overall and by Level of Performance of Curlers



TNK = Total Nutrition Knowledge, GNK = General Nutrition Knowledge, SNK = Sport Nutrition Knowledge. *Mann Whitney U test shows a significant difference between Recreational and Competitive athletes for TNK and GNK ($p=0.046$ and $p=0.001$) but not SNK ($p=0.449$). N = 315.

Figure 2 – Results for NK Scores by Nutrition Qualification of Curlers

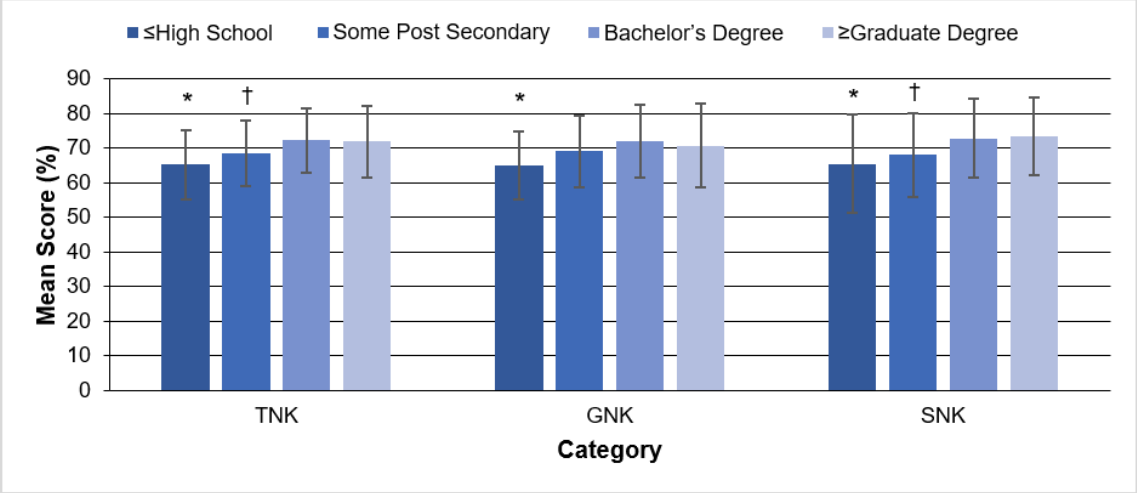


NutQual = Nutrition Qualification TNK = Total Nutrition Knowledge, GNK = General Nutrition Knowledge, SNK = Sport Nutrition Knowledge. *Mann Whitney U test shows a significant difference between participants with Nutrition Qualifications and those who have none for all areas of NK; TNK, SNK and GNK ($p=0.002$, $p=0.005$, $p=0.004$). N = 316.

No significant relationship between TNK, SNK and GNK and Body Mass Index (BMI), Years Played or Training Hours was revealed using Spearman's Correlation. There was a small, positive correlation between Age and TNK and GNK (rho= 0.121 and p= 0.031, and rho= 0.200 and $p<0.001$, respectively).

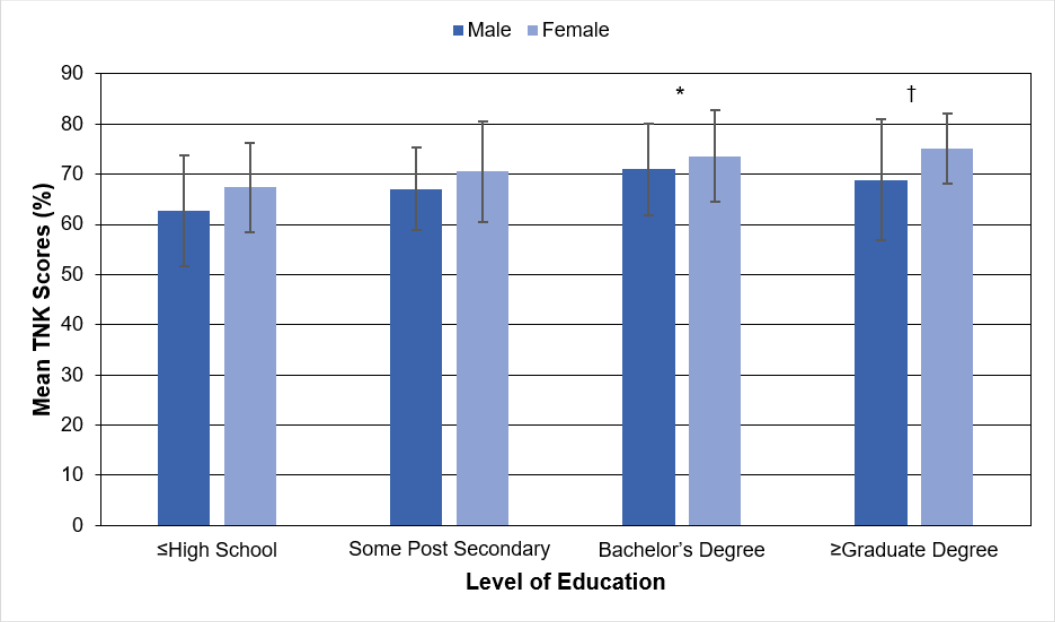
As seen in Figure 3, Kruskal-Wallis test reveals that Education was significantly different in all three NK categories. Analysis via Two-Way Analysis of Variance revealed differences between education based on Gender (Figure 4) and Nutrition Qualification (Figure 5)**.** The ≤High School group had significantly lower TNK scores than Bachelor's Degree and ≥Graduate Degree for both genders ($p<0.001$ and $p=0.001$) and Nutrition Education ($p<0.001$, $p=0.001$, respectively).

Figure 3 – Results for NK Scores by Education Level of Curlers



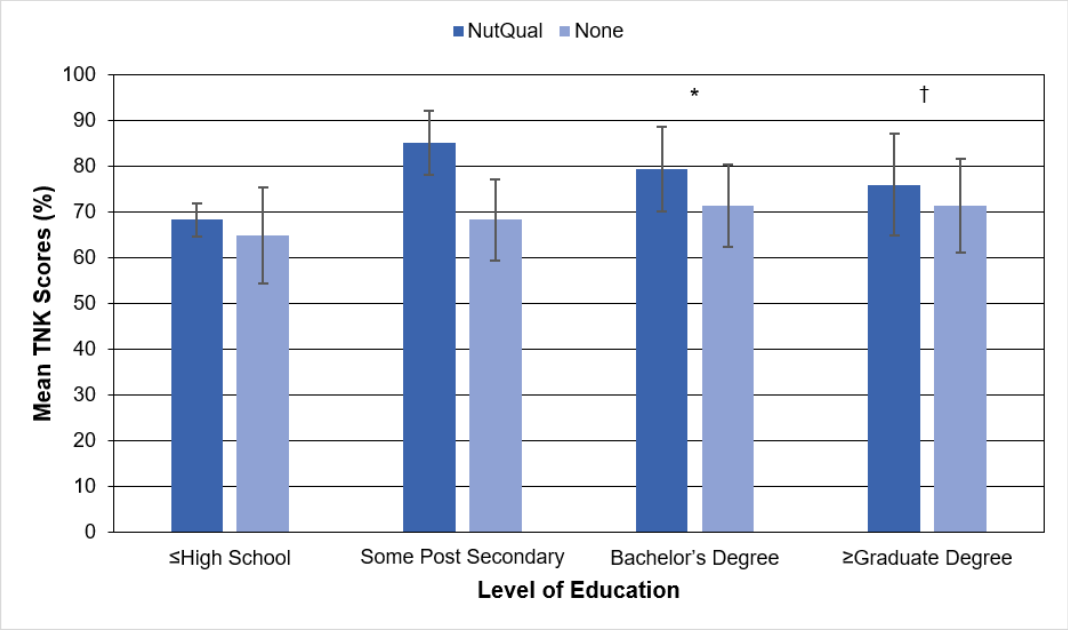
TNK = Total Nutrition Knowledge, GNK = General Nutrition Knowledge, SNK = Sport Nutrition Knowledge; Kruskal-Wallis test showed significant differences between groups ($p<0.05$) and a pairwise comparison with Bonferroni correction shows that the significant differences are between *≤High School and both Bachelor's Degree and ≥Graduate Degree ($p<0.001$ and $p=0.001$), and †Post-Secondary and Bachelor's Degree for TNK ($p=0.025$). Between *≤High School and Bachelor's Degree and ≥Graduate Degree ($p<0.001$, and $p=0.008$) for GNK. Between *≤High School and Bachelor's Degree and ≥Graduate Degree ($p=0.007$ and $p=0.003$) and †Post-Secondary and ≥Graduate Degree ($p=0.044$) for SNK. N = 316.

Figure 4 – Results for TNK Scores by Education Level and Gender of Curlers



TNK = Total Nutrition Knowledge; Two-way Analysis of Variance shows a significant difference between the ≤High School group and both the Bachelor's Degree* and ≥Graduate Degree† groups ($p<0.001$; $p=0.001$), respectively. N = 315.

Figure 5 – Results for TNK Scores by Education Level and Nutrition Qualification of Curlers



NutQual = Nutrition Qualification, TNK = Total Nutrition Knowledge. Two-way Analysis of Variance shows a significant difference between the ≤High School group and both the Bachelor's Degree* and ≥Graduate Degree† groups ($p<0.001$; $p=0.001$), respectively. N = 313.

GNK and SNK Categories

Table 8 displays the NK Scores in each category of GNK and SNK, respectively. Categories that were well understood for GNK were Sugar, Protein and Food Choices, whereas Fat and Calories were poorly understood. For SNK, categories that were well understood were Fluids and Micronutrients, whereas Nutritional Requirements and Macronutrients were not. Participants were most Not Sure in the Fat category for GNK and Nutritional Requirements for SNK. The least amount of Not Sure was seen in Protein for GNK and Fluids for SNK.

Table 8 – General & Sport Nutrition Knowledge Category Scores of Curlers

Category	N	Correct (%)	Incorrect (%)	Not Sure (%)
General Nutrition Knowledge				
Sugar	319	82.4	13.8	3.8
Salt	315	67.1	27.2	5.7
Fibre	318	76.2	18.3	5.5
Protein	318	85.8	10.6	3.6
Fat	314	37.0	30.7	32.3
Calories	315	30.0	58.7	11.4
Food Choices	319	84.8	10.4	4.7
Sport Nutrition Knowledge				
Macronutrients	319	56.2	31.5	12.3
Micronutrients	319	76.4	13.3	10.3
Fluids	320	92.9	3.8	3.3
Requirements	318	49.1	32.1	18.8
Weight Management	317	63.9	27.1	9.0

Nutrition Beliefs & Practices

Table 9 displays Nutrition Belief questions and are grouped into categories. Some of the highlights from these categories include the weight management beliefs area, where almost all (97.5%) of the participants believed it would be important to seek nutritional counselling if trying to change their weight. In the nutrient intake belief area, more than a quarter of the participants (27.6%) were Not Sure if vitamin supplementation was recommended for athletes. In nutrition knowledge belief area, 95.6% of the participants disagreed that learning about nutrition is not important for athletes even if they eat a lot of food. While 42.3% of participants disagreed that it is the coach's responsibility to stress good nutritional practices, with 69.4% of participants stating that it is the Athlete's responsibility (see Figure 6 and 7).

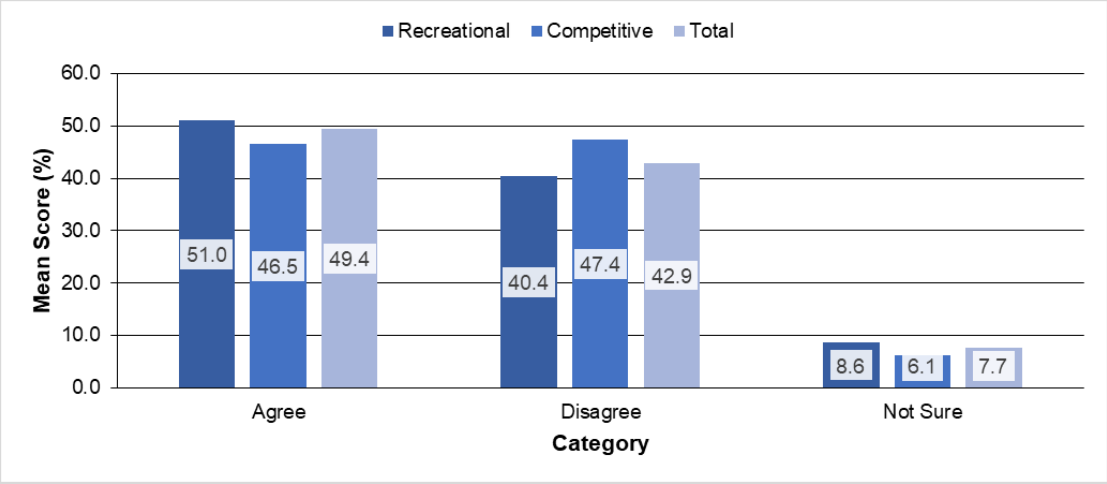
Table 10 shows the nutrition practice responses of the participants. This section revealed that sport drinks were not widely used to help with dehydration, with only 1.6% of participants using sport drinks for this purpose. Responses to a question related to eating habits showed that 92.8% of those who responded did not skipping a meal before competition while 38.4% of participants will eat at least 1 hour prior to competition. As well, 30.1% of participants used

supplements as an athlete. Further analysis of the type of supplementation used by participants who take supplements revealed that 50.0% used Vitamins and Minerals, 40.0% used Protein products, and 10.0% used Others (including Omega 3's, Glucosamine, Creatine, Pre-workout, Probiotics and Nootropics). Figure 8 shows there are significant differences in supplementation use between Levels of Performance (x^2=8.021, p=0.018) with 40.0% of "competitive" athletes, and 25.0% of "recreational" athletes using supplements.

Table 9 – Results for Nutrition Belief Questions of Curlers

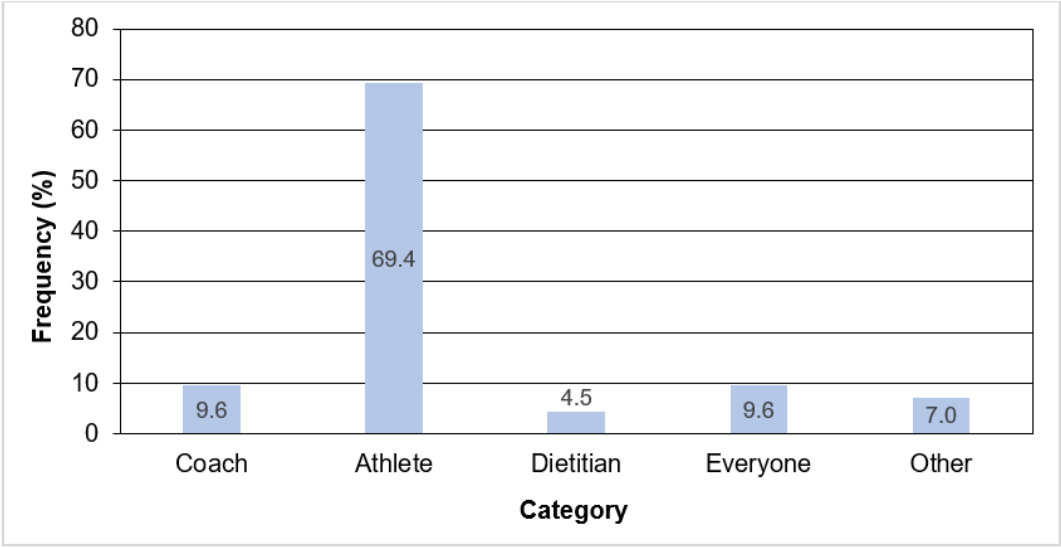
Question	Agree	Disagree	Not Sure
Hydration			
Athletes should rely on thirst to ensure fluid replacement	5.3	91.8	2.8
Sports drinks are the best way to replace body fluids lost during exercise	16.0	71.2	12.9
High amount of water consumption will increase the bodyweight	20.9	66.5	12.7
Dark yellow urine is a sign of proper hydration of the body	4.4	90.6	5.0
During exercise, mass ingestion of fluid is preferred over frequent ingestion of small amounts	2.5	91.2	6.3
Weight Management			
Nutritional counseling would be important to the athlete who is trying to change their weight	97.5	1.6	0.9
Skipping meals is justifiable if you need to lose weight quickly	2.5	96.6	0.9
If trying to lose weight, carbohydrates should come only from fruits and vegetables rather than from breads and pastas	56.9	34.9	8.2
Nutrient Intake			
Eating carbohydrates makes you fat	20.4	71.1	8.5
Vitamin supplementation is recommended for physically active people/athletes	35.7	36.7	27.6
Salt is an essential part of an athlete's diet (increased intake versus normal population)	35.4	39.8	24.8
Dietary Patterns			
The last meal before a competition should be consumed at least 3 hours before a competition	56.0	19.5	24.5
As an athlete, my food intake should increase compared to the normal population	63.5	23.3	13.2
Dietary patterns should change depending on the season and climate	46.9	34.6	18.6
Nutrition Knowledge			
It is the coach's responsibility to stress good nutritional practices	49.8	42.3	7.9
Learning about nutrition is not important for athletes because they eat so much food, they always get the nutrients their bodies need	2.5	95.6	1.9
Other			
Natural and organic foods are more nutritious than foods grown under conventional methods	21.6	64.6	13.8

Figure 6 – Results for Curler's Belief About the Coach's Responsibility for Stressing Good Nutritional Practices and by Level of Competition



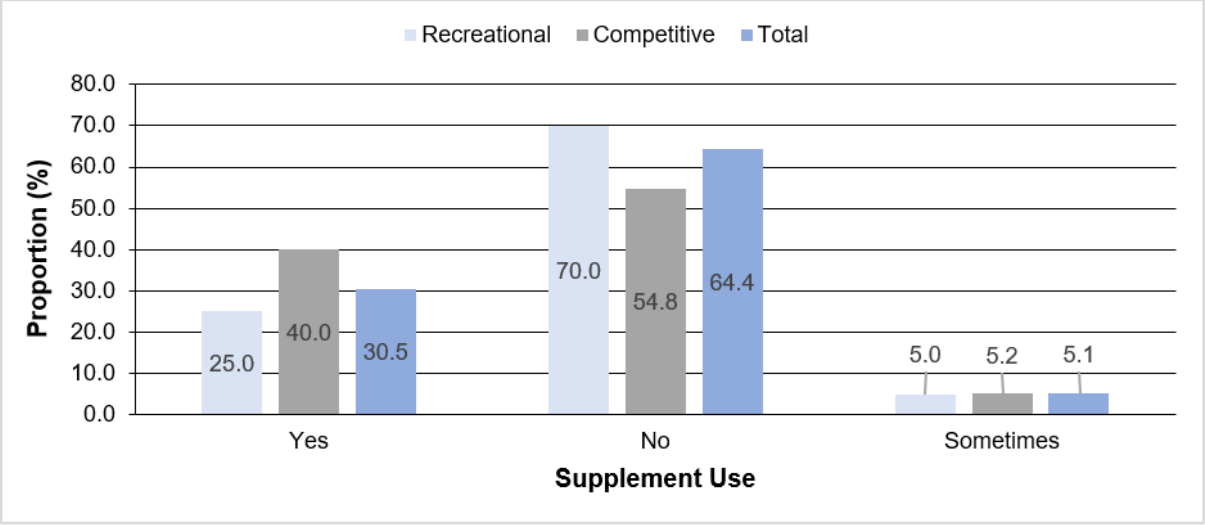
Chi square X^2 (2, n = 315) = 1.679, p=0.432, Cramer's V = 0.073.

Figure 7 – Results for Curlers' Perceived Responsibility for Stressing Good Nutritional Practices



Other includes Parents, Doctor, and Trainers. N = 157.

Figure 8 – Results for Supplement Use Overall and by Level of Performance of Curlers



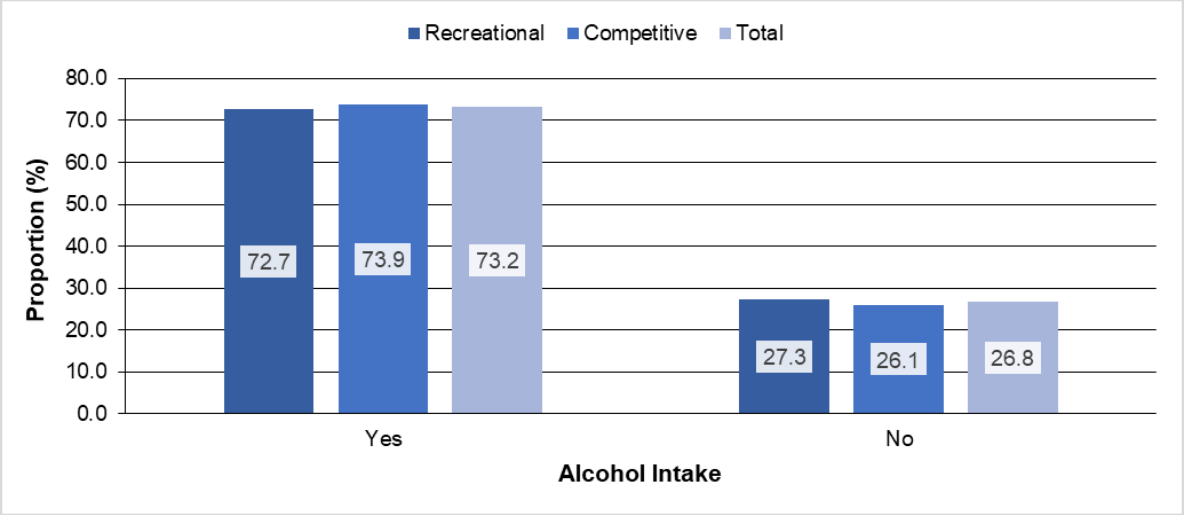
Chi square X^2 (2, n = 315) = 8.021, p=0.018, Cramer's V = 0.160.

Table 10 – Results for Nutrition Practices Questions of Curlers

Question	Yes	No	Sometimes
Does your dietary pattern change at the time of competition compared to the off-season?	26.7	60.4	12.9
Do you skip meals prior to competition?	3.8	92.8	3.5
Do you consume sports drinks every day before practicing/or when you feel dehydrated?	1.6	91.2	7.3
Do you use supplements (ex: multivitamins or protein powder) as an athlete?	30.1	64.9	5.0
I eat just before an event	23.2	47.3	29.5
I eat during an event	20.7	57.7	21.6
I eat just after an event	48.4	16.9	34.7
I always eat at least one hour before competition	38.4	30.2	31.4
I consume milk and alternatives	68.8	14.4	16.9
I consume caffeinated beverages to increase mental alertness during competition	10.3	80.0	9.7

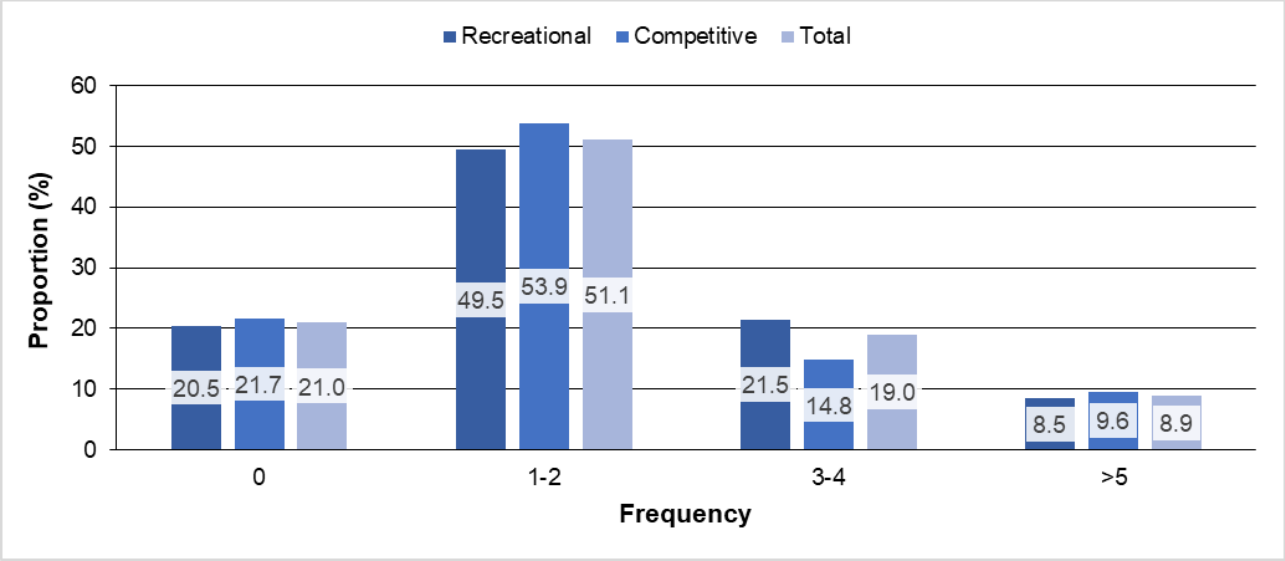
Responses to questions about hydration practices revealed that 65.5% of the participants always consumed water during and after a competition, and as shown in Figure 9, 73.2% of the participants drank alcohol during the competitive season with no significant differences between competitive and recreational athletes. Figures 10 & 11 show that most participants drank alcohol 1-2 days a week and have 1-2 alcoholic drinks in one sitting with no significant differences between competitive and recreational athletes.

Figure 9 – Curlers' Alcohol Intake During the Competitive Season and by Level of Competition



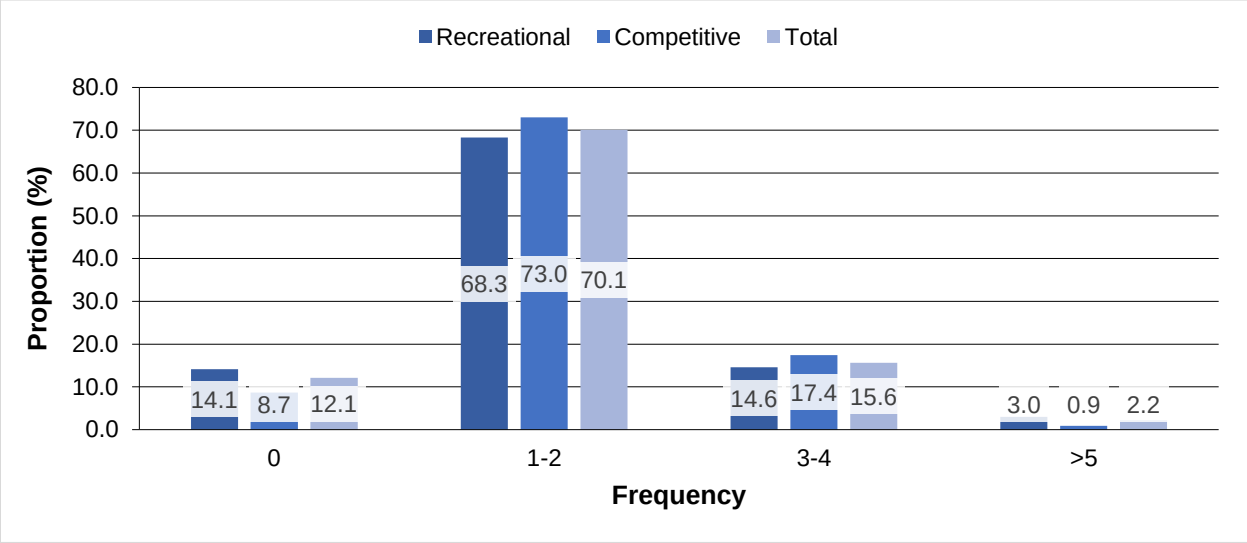
Chi square X^2 (1, n = 313) = 0.052, p=0.819, Cramer's V = 0.013.

Figure 10 – Curlers' Alcohol Intake by Days Per Week and by Level of Competition



Chi square X^2 (3, n = 315) = 2.155, p=0.541, Cramer's V = 0.083.

Figure 11 – Curlers' Number of Alcoholic Drinks in One Sitting and by Level of Competition

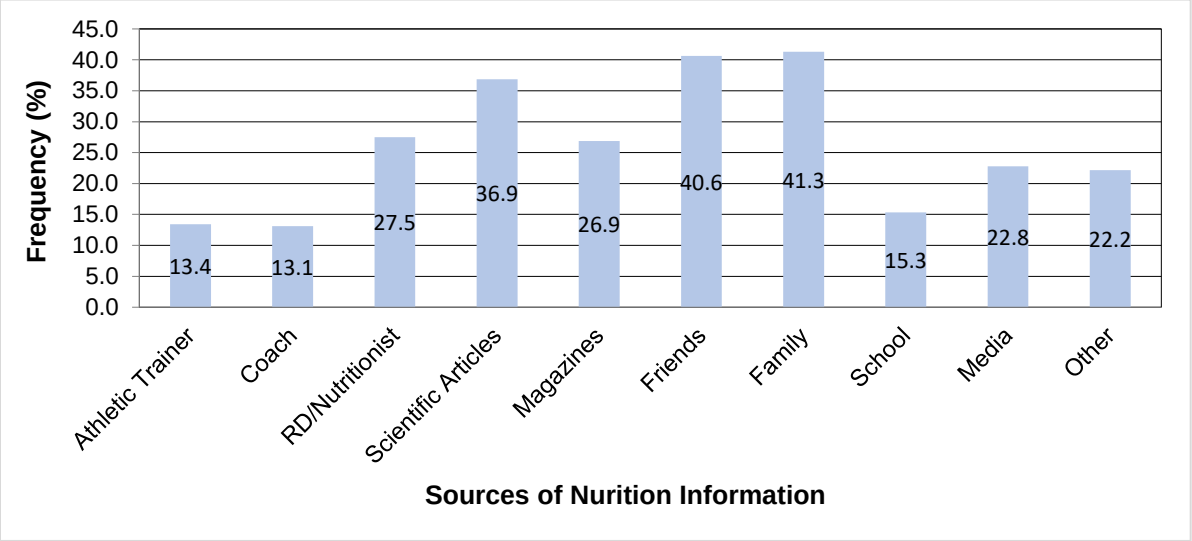


Chi square X^2 (3, n = 314) = 3.846, p=0.279, Cramer's V = 0.111.

Sources of Nutrition Information

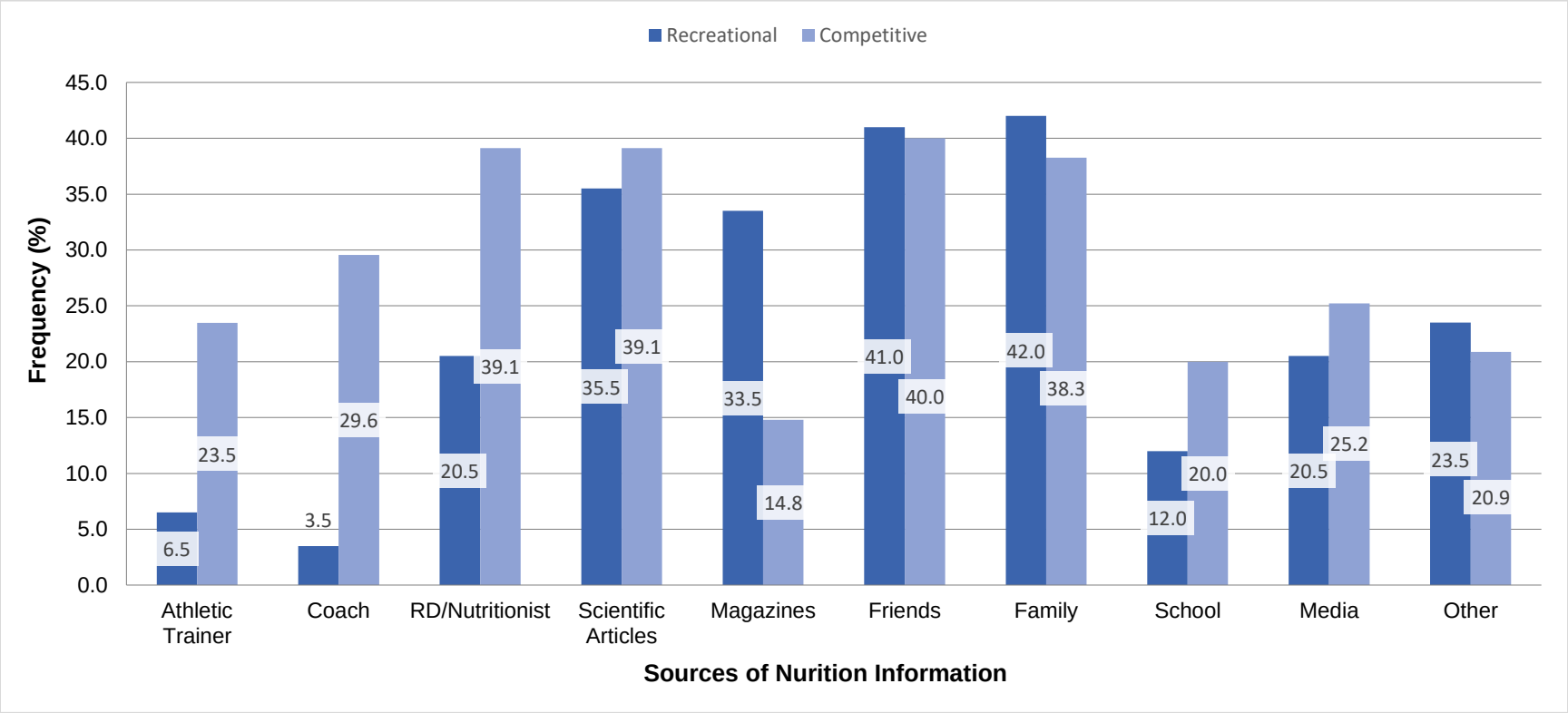
Overall, as shown in Figure 12, Family (41.3%), Friends (40.6%), Scientific Articles (36.9%), Registered Dietitian/Nutritionists (27.5%) and Magazines (26.9%) were the most commonly referenced sources of nutrition information for these participants. The sources that were the least referenced were Athletic Trainers (13.4%) and Coaches (13.1%). By Leve of Performance, ss shown in Figure 13, competitive athletes selected Coach at 29.6% while recreational athletes only selected Coach at 3.5%, which is a similar trend with Athletic Trainers at 23.5% vs. 6.5%, respectively. Competitive athletes also chose Registered Dietitian/Nutritionist more often than recreational athletes at 39.1% and 20.5% respectively.

Figure 12 – Curlers' Sources of Nutrition Information



Others: Doctors, Internet, Canada's Food Guide, Books, Food Labels and Personal Experience.

Figure 13 – Curlers' Sources of Nutrition Information by Level of Competition



Participant Characteristics – QOL

Overall, 240 participants completed the QOL survey and all participant information is displayed in Table 11. The average age of the QOL participants was 44.2 ± 17.4 years with most participants being between the ages of 18 and 79 years old. There were similar proportions of Male and Female participants at 46.7% and 52.9% respectively, with a small representation from the Transgender/Other category with 0.4%. These participants were curling, on average for a total of 21.9 ± 14.8 years and their training hours per week averaged 6.9 ± 6.1 hours. Most of these participants are “recreational” athletes at 60.8%, with the remaining “competitive” athletes at 39.2%. Most of the participants were from the Prairies Region at 74.1% compared to Western (12.4%), Eastern (1.6%) and Central (11.9%) Regions.

Table 11 – Participant Characteristics of Curlers Who Completed the QOL Questionnaire

	Mean (SD)	**Min**	**Max**
Age (years), n = 237	44.2 (17.4)	18.0	79.0
Body Mass (kg), n = 235	75.2 (15.7)	47.7	136.4
Height (cm), n = 238	171.2 (9.7)	149.9	198.1
BMI (kg/m^2), n = 234	25.5 (3.7)	17.2	38.9
Years Played (years), n = 231	21.9 (14.8)	0.2	66.0
Training Hours (weekly), n = 230	6.9 (6.1)	1.0	40.0
	Sub-category	**Sample (n)**	**N (%)**
Gender*		**n = 240**	
	Female	112	46.7
	Male	127	52.9
	Transgender/Other	1	0.4
Region†		**n = 185**	
	Western	23	12.4
	Prairies	137	74.1
	Central	22	11.9
	Eastern	3	1.6
Education		**n = 237**	
	≤ High School	43	18.1
	Post-Secondary	54	22.8
	Bachelor's Degree	92	38.8
	≥ Graduate Degree	48	20.3
Nutrition Qualification		**n = 237**	
	Yes	19	8.0
	No	218	92.0
Level of Performance		**n = 237**	
	Recreational	144	60.8
	Competitive	93	39.2
Children		**n = 237**	
	Yes	112	47.3
	No	125	52.7
Employment		**n = 237**	
	Full Time	112	47.3
	Part Time	20	8.4
	Retired	59	24.9
	Student	36	15.2
	Other	10	4.2

SD = Standard Deviation, kg = kilogram, cm = centimeter, BMI = Body Mass Index, * due to small sample size, all evaluations using gender are based on male & female categories. †The Region question in the SNKQ was added after the data collection period had already started.

QOL Scores

The overall WHOQOL-BREF scores for each Domain are displayed in Table 12. The Social Relationships domain saw the lowest mean score at 70.2%, and the widest range with a minimum score of 8.3% and a maximum of 100%. The Environment and Physical Health domains have similar scores at 80.0% and 79.8%, respectively.

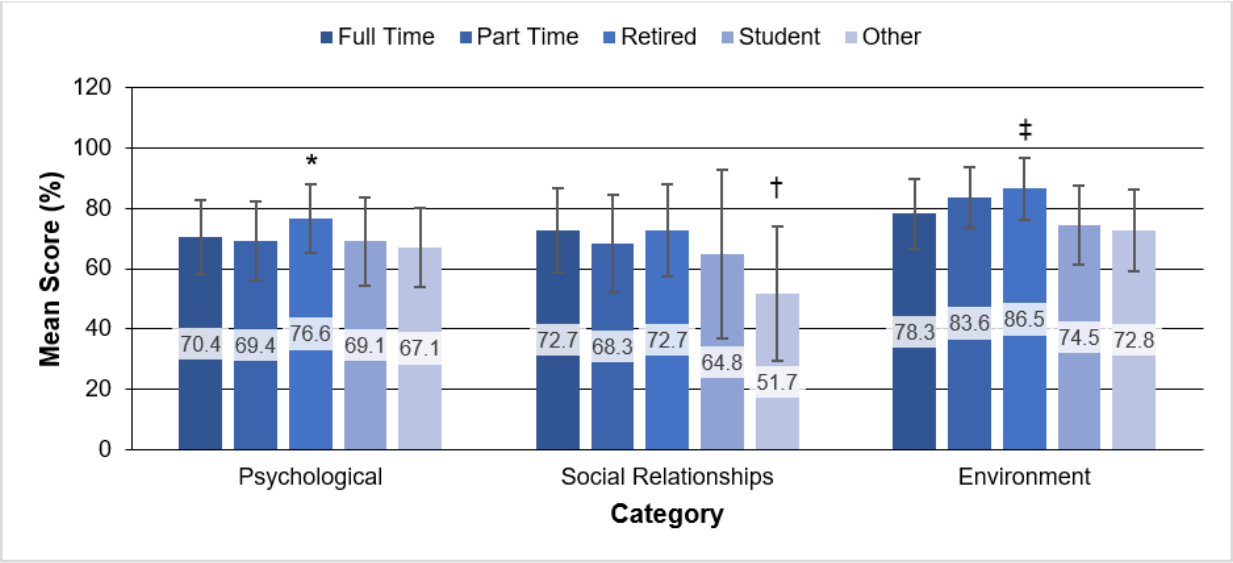
The QOL scores by category are also shown in Table 12. In the Psychological domain, males have a significantly higher mean score compared to females ($p=0.033$). Retired participants in the Environment Domain showed the highest score as a category at 86.5% while the lowest QOL score was the Eastern Region at 44.4% for the Social Relationships Domain. No significant differences in QOL scores were found for Level of Competition ($p>0.05$) while significant differences were found between groups for Region and Employment Categories ($p<0.05$). Lastly, pairwise comparisons revealed significant differences between Employment categories for 3 different Domains highlighted in Figure 14. Results from the pairwise comparison showed that the only category without a significant difference between Employment groups was Physical Health ($p>0.05$).

Table 12 – Overall and Categorical QOL Domain Scores of Curlers

Category (n)	Physical Health (SD)	Psychological (SD)	Social Relationships (SD)	Environment (SD)
Overall Mean	79.8 (11.9)	71.6 (12.7)	70.2 (18.0)	80.0 (12.2)
Minimum- Maximum	39.3-100.0	25.0-100.0	8.3-100.0	34.9-100.0
Gender n = 239				
Male (127)	80.2 (12.1)	73.2 (12.7) *	69.3 (17.6)	80.6 (11.6)
Female (112)	79.5 (12.0)	70.2 (12.9)	71.2 (18.8)	79.8 (12.7)
Region† n = 185				
Western (23)	81.2 (12.3)	73.6 (12.0)	75.4 (15.2)	83.6 (12.1)
Prairies (137)	80.0 (12.0)	72.6 (12.1)	72.7 (17.6)	80.8 (11.8)
Central (22)	76.9 (12.6)	68.8 (16.7)	62.9 (22.8)	72.2 (12.8)
Eastern (3)	82.1 (14.3)	62.5 (14.4)	44.4 (26.8)	78.1 (11.3)
Education n = 237				
≤ High School (43)	78.9 (11.2)	70.3 (12.0)	72.7 (18.2)	79.8 (10.3)
Post-Secondary (54)	77.6 (14.7)	71.0 (13.1)	71.7 (17.5)	79.3 (12.4)
Bachelor's Degree (92)	82.2 (10.4)	73.3 (13.2)	71.2 (18.1)	81.3 (13.1)
≥ Graduate Degree (48)	79.1 (12.0)	70.1 (12.9)	65.1 (19.3)	78.8 (12.0)
Level of Competition n = 237				
Recreational (144)	80.3 (12.3)	71.4 (12.5)	70.4 (17.0)	80.4 (11.9)
Competitive (93)	79.5 (11.2)	72.1 (13.4)	70.4 (20.2)	80.0 (12.4)
Children n = 237				
Yes (112)	79.6 (13.1)	72.6 (12.1)	70.7 (16.3)	81.6 (12.3)
No (125)	80.0 (11.1)	70.6 (13.6)	69.9 (20.0)	78.7 (12.0)
Employment ‡ n = 237				
Full Time (112)	80.0 (11.1)	70.4 (12.3)	72.7 (14.2)	78.3 (11.5)
Part Time (20)	80.5 (14.4)	69.4 (13.1)	68.3 (16.1)	83.6 (10.0)
Retired (59)	81.7 (12.4)	76.6 (11.5)	72.7 (15.4)	86.5 (10.2)
Student (36)	76.8 (10.4)	69.1 (14.6)	64.8 (27.9)	74.5 (13.1)
Other (10)	73.9 (17.7)	67.1 (13.0)	51.7 (22.2)	72.8 (13.5)

*Indicates a significant difference ($p=0.033$) with Mann-Whitney U tests between gender categories for Psychological scores. † Indicates a significant difference ($p<0.05$) with Kruskal-Wallis tests between categorical values in Regions for Environment scores. ‡ Indicates a significant difference ($p<0.05$) with Kruskal-Wallis tests between categorical values in Employment for Psychological, Social Relationships and Environment scores.

Figure 14 – Results for QOL Domain Scores by Employment Status of Curlers



QOL = Quality of Life, Kruskal-Wallis test showed significant differences between groups ($p<0.05$) in all three domains. A pairwise comparison with Bonferroni correction shows a significant difference in the Psychological domain between * Full Time and Retired participants ($p= 0.026$); in the Social Relationships domain between † Other and both Retired ($p=0.029$) and Full Time ($p=0.018$); and the Environment domain between ‡ Retired and Full Time ($p<0.001$), Other ($p=0.017$), and Student ($p<0.001$). Other = Homemaker, Unemployed, etc. N = 237.

Relationships between WHOQOL-BREF Domain Scores and other variables were also of interest as shown in Table 13. For example, both Social Relationships and Environment Domains scores had a significant, but small, positive relationships with Years Played ($p=0.018$ and $p=0.012$, respectively). Additionally, Age was positively and moderately correlated with Environment scores at a significant level ($p<0.001$).

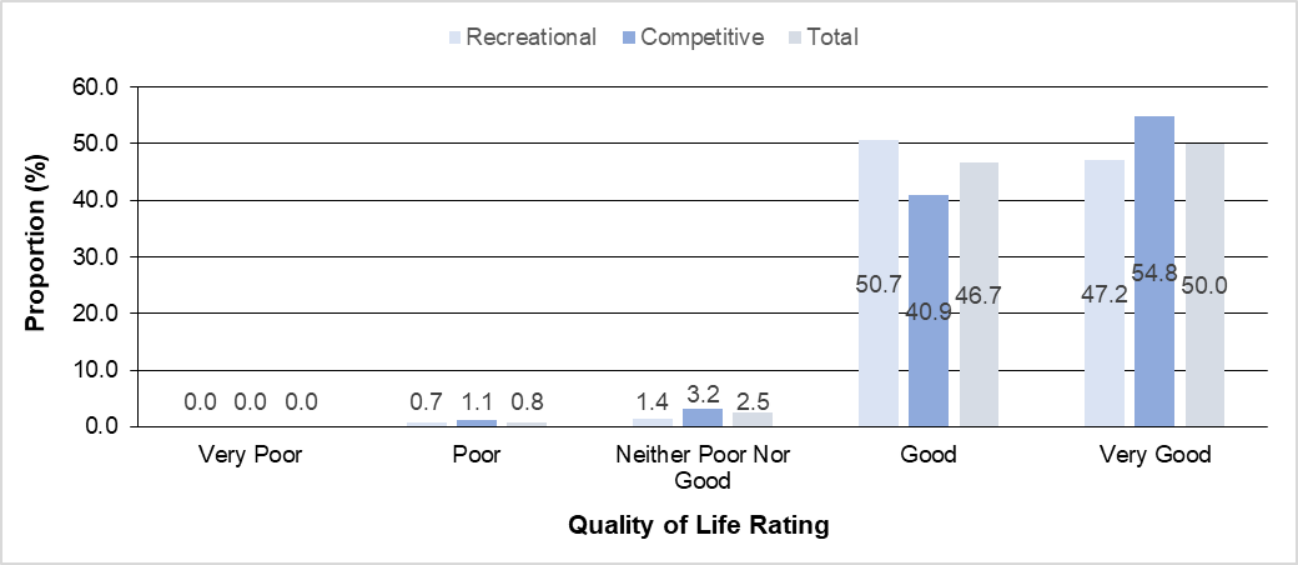
Table 13 – Participant Characteristics of Curlers Associated with QOL Domain Scores

Category	Physical Health	Psychological	Social Relationships	Environment
Age n = 237				
rho	0.115	0.165*	0.028	0.270†
p-value	0.078	0.011	0.667	<0.001
BMI n = 234				
rho	-0.033	-0.079	-0.039	0.060
p-value	0.614	0.229	0.551	0.362
Years Played n = 231				
rho	0.047	0.124	0.155*	0.166*
p-value	0.474	0.061	0.018	0.012
Training Hours n = 230				
rho	0.021	0.058	0.006	0.011
p-value	0.755	0.380	0.922	0.870

BMI = Body Mass Index, * Indicates a significant, but small positive correlation between two variables ($p<0.05$), † Indicates a significant, and moderate positive correlation between two variables ($p<0.05$).

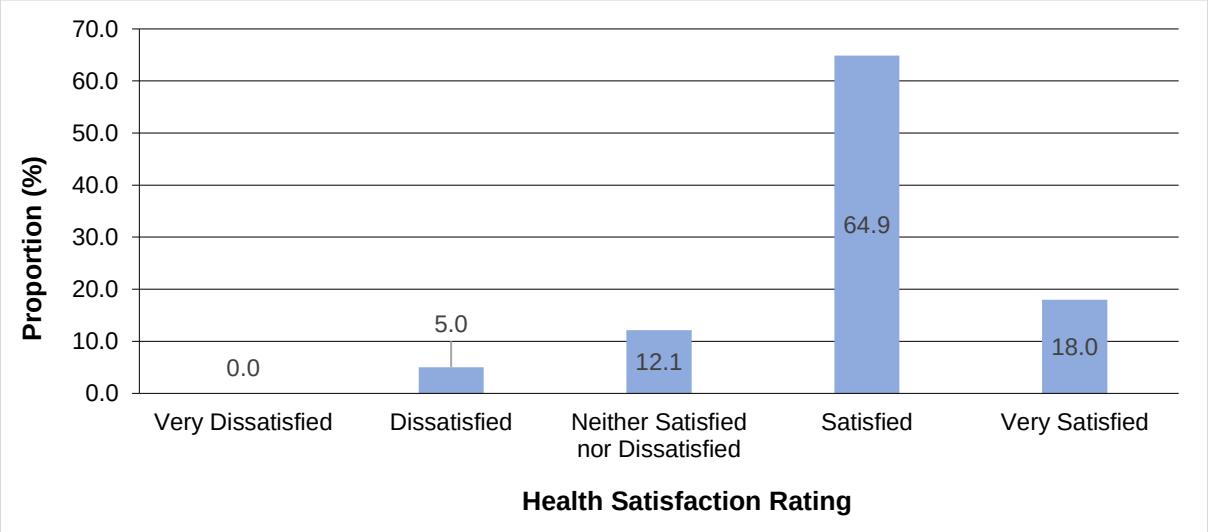
Question 1 of the WHOQOL-BREF revealed that participants felt they had either Very Good or Good overall QOL with 50.0% and 46.7% of participants respectively, for an average of 89.3% (Figure 15). Figure 15 also shows no significant differences between recreational and competitive athletes for Question 1 QOL scores ($p>0.05$). Question 2 on satisfaction with overall health, a large part of the participants was Satisfied with their health at 64.9% (see Figure 16).

Figure 15 – Results for QOL Rating Overall and by Level of Performance of Curlers



Overall, N = 240. Level of Performance, N = 237.

Figure 16 – Results for Overall Satisfaction with Health of Curlers

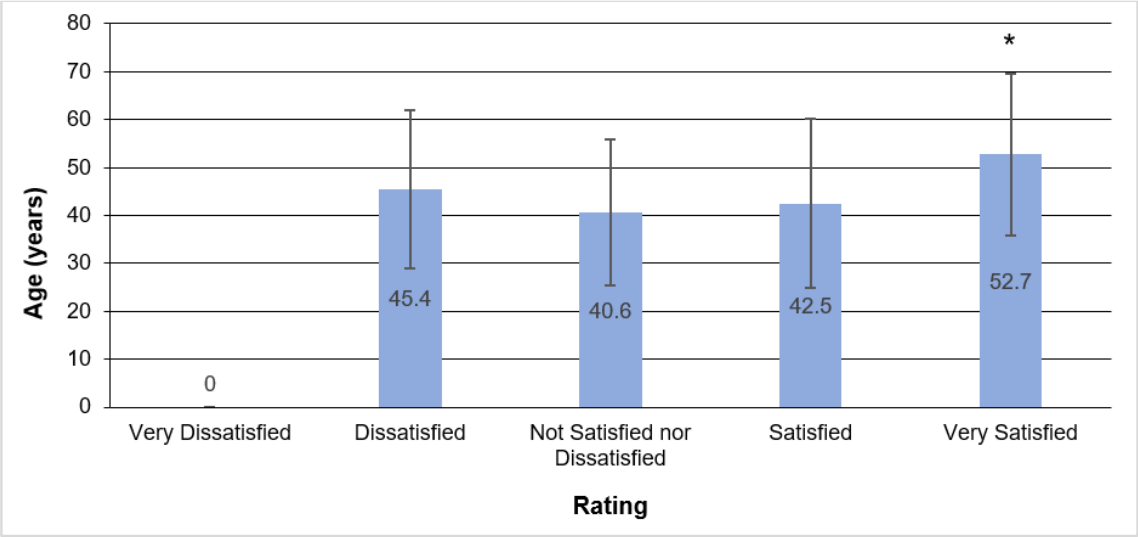


N = 239.

There were no significant relationships between Age, BMI, Years Played, and Training Hours to Rating Overall QOL. However, there were differences found between Age, BMI, and Training Hours with Satisfaction with Overall Health (Question 2), but not Years Played. For Training Hours, there were differences between Not Satisfied nor Dissatisfied and Satisfied. Those who were Satisfied with their Health trained significantly more hours per week than those who were Not Satisfied nor Dissatisfied about their Health at 7.8 hours and 4.8 hours each ($p=0.022$).

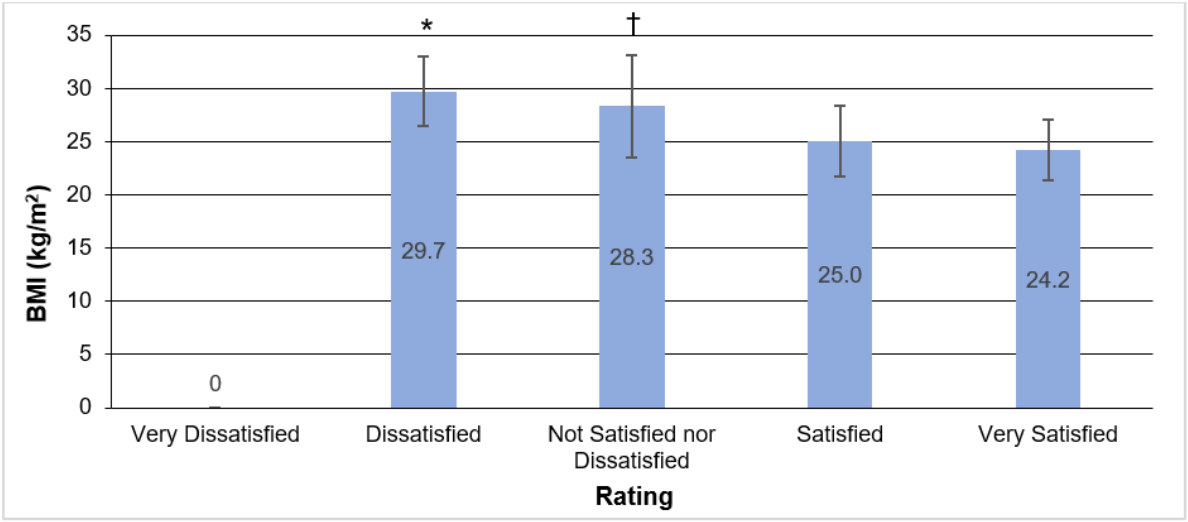
In respect to Age, those who were Very Satisfied with their Health were significantly older than those who were Not Satisfied nor Dissatisfied ($p=0.017$) or Satisfied ($p=0.007$, see Figure 17). And lastly, those who were Dissatisfied with their health had significantly higher BMIs on average than those who were Satisfied ($p<0.001$) and Very Satisfied ($p<0.001$); while those who were Not Satisfied nor Dissatisfied also had significantly higher BMIs on average compared to Satisfied ($p=0.008$) and Very Satisfied ($p=0.003$) participants (see Figure 18).

Figure 17 – Relationship Between Satisfaction with Health and Age of Curlers



*Indicates a significant relationship between Very Satisfied and both Satisfied and Not Satisfied nor Dissatisfied (p=0.017, p=0.007). N = 236.

Figure 18 – Relationship Between Satisfaction with Health and BMI of Curlers



BMI = Body Mass Index, *Indicates a significant difference between Satisfied and Very Satisfied and Dissatisfied (p<0.001, p<0.001), † significant difference between Satisfied and Very Satisfied and Not Satisfied nor Dissatisfied (p=0.008, p=0.003). N = 233.

Sport Specific QOL Scores

Results specific to Sport QOL questions are shown in Table 14. From this analysis, participants were the most satisfied with their relationships with their teammates and were the least satisfied with their level of physical condition.

Table 14 – Results for ALQS Sport Specific Questions

Question	Mean	SD	N
How satisfied are you with the amount of free time you have away from your sport?	4.0	0.7	239
How satisfied are you with your relationships with your coaches?	3.6	0.8	192*
How satisfied are you with your relationships with your teammates?	4.2	0.7	240
How satisfied are you with your level of physical condition?	3.5	0.9	240
How satisfied are you with your athletic performance?	3.6	0.8	240
How satisfied are you with your role on your team?	4.0	0.6	239

*This question was on a scale of 6 instead of 5 – the 6th was N/A as not all athletes surveyed would have a coach. All questions were on a Likert scale as follows: Very Dissatisfied, Dissatisfied, Neither Satisfied nor Dissatisfied, Satisfied and Very Satisfied.

Discussion

The present study revealed that curling athletes overall had relatively high NK with Education and prior Nutrition Qualifications having a significant impact on NK scores. Interestingly, results showed that competitive athletes did have higher SNK scores on average compared to recreational athletes, but differences were not statistically significant. Rather, the opposite was true where recreational athletes had significantly higher TNK and GNK than competitive athletes. NK categories were also assessed, and it was found that salt, calories and fat in the GNK section were poorly understood by the participants, while weight management, macronutrients and nutritional requirements were poorly understood in the SNK section. Lastly, it was revealed that curling athletes receive nutrition information primarily from friends, family and scientific articles.

The results for QOL in this population reveal that factors associated with QOL in this population are Employment Status, Age, Gender and Curling Years Played. Older and Retired

athletes had higher QOL scores compared to their younger and employed counterparts. As well, Curling Years Played had a small but positive relationship with the Social Relationships domain of QOL. To note, no differences were found between competitive and recreational players for overall QOL and the four Domains. The following sections will discuss these findings compared to the current literature.

Nutrition Knowledge Scores

Overall NK scores were TNK at 69.6%, SNK at 67.3%, and GNK at 71.4% within this study. The TNK scores in the current study are about 10% higher than the average scores reported from 30 sport nutrition studies reviewed in Table 1 (see Table 1 for References), at 59.5%, but within mid-range of 33.2% - 83.7%, which is based on the studies review by Trakman et al. (2016). According to Torres-McGehee et al. (2012), adequate nutrition knowledge score cut-offs are set at >75%, which would indicate that our curling population may have inadequate knowledge. However, this cut-off may be arbitrary as the number of questions used in the current study far outweighs theirs at 61 and 20 questions, respectively, which may alter results and the ability to use similar cut-off points. Similarly, the type of questions and categories covered in the current study are not equivalent to the SNKQ used by Torres-McGehee et al. (2012) who did not ask questions regarding alcohol intake, pre-nutrition and post-nutrition, which are all shown to impact sport performance and important to include in a SNKQ (Trakman et al., 2016). Although the results from the current study suggest that the Canadian curling population does have a relatively higher TNK than other athletic populations, this interpretation should be taken with caution as SNKQs are not created equally, rather they vary in the number of questions and categories assessed, and therefore comparisons are limited as there are no other evaluations on the Canadian curling population or curling as a whole.

Factors Affecting Nutrition Knowledge

Many factors may influence NK, and in our study gender, education, nutrition qualification, level of performance, and age were all found to have some significant, independent, influence on NK.

Gender. In our study female participants had significantly higher TNK, and GNK scores compared to males. Although there was no statistical difference in SNK scores between females and males, on average SNK scores were higher for females. For TNK, scores were 67.7% for males and 71.7% for female participants. A review by Trakman et al. (2016) revealed that 10 out of 15 studies found no difference between gender and NK in their studies. For example, Rash et al. (2008) found no significant difference between male and female collegiate track athletes at 58.7% and 57.8%, respectively. In contrast, Azizi & Rahmani-Nia (2010) found that female collegiate athletes had significantly higher NK scores than male collegiate athletes at 60.42% and 57.36%, respectively. Although our study population saw a significant difference in TNK, the literature is equivocal. There may be other confounding variables such as literacy and/or education that may impact our findings. However, other studies have suggested that females have a higher affinity for obtaining NK in regards to optimal health, which may help to clarify this difference (Hendrie et al., 2008). Further investigation is warranted to see if there are any other factors influencing the impact of NK for both genders in this population.

Education. In the current study, having a Bachelor's Degree or a Graduate Degree and higher was significantly related to having higher TNK than those with High School or lower levels of Education. Other studies have also shown that Education positively impacts NK (Wardle, Parmenter, & Waller, 2000). For example, Alaunyte et al. (2015) evaluated NK in a group of professional Rugby players that contained levels of education spanning from Secondary

to Degree, and attributing their higher overall NK score of 73% to their higher level of education compared to other studies in similar sports and collegiate-level only athletes (Spendlove et al., 2012). Similarly to the current study, Trakman, et al. (2018) found that education had a significant effect on TNK scores ($p=0.003$) for the entire population of elite and non-elite American football players, with those who had university degrees having significantly higher TNK scores than those with diplomas and high school level education ($p=0.037$ and $p=0.039$, respectively).

Additionally, studies that evaluate nutrition-specific education interventions also support the idea that education does have a positive impact on NK. For example, Valliant et al. (2012) found a significant ($p<0.001$) improvement in SNK from 44.9% to 57.3% in a group of collegiate female volleyball players after an individualized nutrition intervention with a Registered Dietitian. These results were similar to nutrition intervention studies seen in groups of Brazilian multi-sport athletes and American collegiate baseball players who saw a significant difference in pre- and post-intervention NK scores at 70.0% to 89.0% ($p<0.05$) and 56.7% to 70.0% ($p<0.001$), respectively (Nascimento et al., 2016; Rossi et al., 2017). The results from these studies suggest that education may be a viable target for improving NK. Therefore, the findings of our study suggest that the curling population is similar to other sporting groups reported in the literature where education has an impact on NK, and that nutrition-education interventions may be an important area on which to focus to improve NK of the curling population.

Nutrition Qualifications. The current study found that those who did have nutrition qualifications had significantly higher NK scores than those who did not, in all three categories (SNK, GNK, TNK). These results are similar to Barr (1987) who found dietetic interns had

higher TNK than both college students and varsity athletes at 76%, 34%, and 34%, respectively. Here, the dietetic interns were used to validate the survey, but also provide a sub-group that has nutrition qualifications. Likewise, Spendlove et al. (2012) also reported having dietetic interns and Accredited Practicing Dietitians to validate their survey and compare to both the community sample and elite athlete samples in their study. The NK scores for the dietetic intern and dietitian group was significantly higher than both community sample and elite athlete groups overall and for subsections of the questionnaire ($p<0.05$). As Registered Dietitians and dietetic interns are required to have higher levels of education such as a Bachelor's Degree or higher (Dietitians of Canada, 2020), and are studying specifically nutrition, it is logical that having a nutrition qualification such as these will contribute to higher NK scores.

Even so, other studies in the literature that evaluate solely nutrition courses or study, not specifying nutrition qualifications, have seen mixed results. For example, Zawila et al. (2003) indicated that female collegiate cross-country runners who had previously taken a nutrition course, 22% of their population, had higher NK thank those who did not. However, A. Andrews et al. (2016) found no significant difference between collegiate athletes that had a previous nutrition course (48% of their populations) than those who didn't at 55.6% and 58.1%, respectively. Similarly, Trakman et al. (2018) found no differences between those with previous nutrition study or not in a group of elite and non-elite male American football players at 51.0% and 47.9%, respectively. Together, the results from the current study and the evidence from the literature indicate that having a nutrition qualification has a more definite relationship with increased NK than a nutrition course alone. There are varying levels of nutrition study, courses, diplomas, and degrees which may be helpful to clarify in subsequent studies evaluating the effect of previous nutrition study and knowledge on TNK, GNK, and SNK.

Level of Performance. In the current study, I hypothesized that competitive athletes would have higher SNK scores than recreational athletes. This hypothesis is based on the intent behind the Level of Performance for competitive athletes that includes a desire to win and improve their skills (Higgs et al., 2019). Because nutrition can impact sport performance, it was hypothesized that these competitive athletes would have more SNK as it applies directly to their advancement in the sport. The current study revealed that indeed, competitive athletes did have higher SNK than recreational athletes, but it was not statistically significant. The difference is quite minimal with recreational athletes achieving 70% on SNK and competitive athletes at 71.2%. These scores are quite higher than those of Trakman et al. (2018b) who found their SNK score for elite Australian Football players at 47% and non-elite American football players at 46%, however, the difference between groups is quite similar. Barr (1987) found similar results with varsity athletes having slightly higher but not significant SNK scores compared to students at 20% and 17%, respectively. Trakman et al. (2018b) and Barr (1987) both used different questionnaires than the current study, as well as Trakman et al. (2018b) included a smaller number of questions regarding SNK (13 questions compared to 26 in this study). Furthermore, nutrition recommendations for athletic populations have evolved with increased research, which may also suggest an increased interest in this subject area over the past few decades. The increase in interest in SNK and recommendations may further add to the discrepancies between the low SNK scores found in Barr (1987) compared to the two recent reports, as the current athletic population may have more interest in NK and sport nutrition recommendations. This may account for some of the variability, as well as the difference in questionnaires used (Trakman et al., 2017). Overall, the results from the current study, which is also supported from other studies, suggest that there is still room for improvement for SNK for competitive athletes,

who may benefit more from the application of this NK on sport performance. This may be an indication for Registered Dietitians and other professionals working with competitive athletes to include SNK improvement education interventions.

Age. Lastly, the only continuous variable to show a small, positive but significant relationship to TNK was age. Similar to these findings, Spendlove et al. (2012) also found that age was a significant, independent, factor on NK scores ($p=0.036$). Conversely, Trakman et al. (2018) did not find any significant differences between 3 age categories for TNK at 48.8% for 17-25 years old, 49.0% for 26-35 years old and 40.9% for ≥36 years old. To note, this study did have a very small number of participants over the age of 36 with only 7 out of 99 participants being in this category (Trakman, et al., 2018). This may help to explain the differences between their findings and ours. Age may have an impact on NK as it has been shown to increase over the lifespan (Wardle et al., 2000). This may be an important consideration for master's level athletes and also the curling athletic population as a whole since curling has higher ages for athletes at high levels of participation as well as a long lifespan of curling participation well into their 70's and 80's as shown in our current study with a maximum age of 84 years old.

Sport Nutrition Knowledge Categories

Many studies in the literature on NK and athletic populations report SNK specific categories or questions to showcase the areas that are well or poorly understood by their participants. In our study, Hydration (92.6%) and Micronutrients (76.4%) were the two categories with the most correct answers, while Weight Management (63.9%), Macronutrients (56.2%), and Requirements (49.1%) were more misunderstood.

Macronutrients. In our current study, Macronutrient NK question scores were below our TNK average at 56.2%. Our scores are similar to those by Trakman, et al. (2018) who reported

that elite and non-elite male American football athletes had average scores for macronutrients questions at 57% and 59% each. Similarly, Devlin and Belski (2015) reported that carbohydrate and protein questions in their study involving elite male American football players had answers scored at 66.0% and 56.6%, respectively. Although there are studies showing similarity in macronutrient NK for some athletes, overall, as reviewed by Trakman et al. (2016), it was found that there were no specific trends for this category with some studies having high and low scores in the macronutrient section.

Regarding specific questions related to macronutrients, the results of the current study showed that 64.6% of curling athletes agreed that protein was the main source of energy for the muscle. This is a common misconception that Rosenbloom et al. (2002) also found in a group of collegiate athletes; 47% of male and 43% of female athletes agreed with this same statement. Zawila et al. (2003) also confirmed that the concept of protein as a major source of energy for the muscle is poorly understood with only 31.7% of female collegiate cross-country runners disagreeing with this statement. On the other hand, 74.0% of our participants correctly identified that a balanced diet provides all the protein requirements needed for athletes, which was also found by Devlin and Belski (2015) with 78% of elite male American football players correctly answering this question.

For questions related to carbohydrates, the results of the current study are similar to other studies that evaluated the statement “foods rich in carbohydrates are the main sources of energy for the body,” and found that it was well understood with 72.8% of curling athletes agreeing with this statement (Trakman et al., 2016). Similarly, Folasire et al. (2015) found that 69.1% of collegiate athletes also agreed that foods rich in carbohydrates are the main sources of energy for

the body, which was also the case in a study by Hamilton et al. (1994) where 98% of elite distance runners also agreed with this same statement.

Fat seems to be one category that is mostly misunderstood by athletes (Andrews & Itsiopoulos, 2016; Trakman et al., 2016). In our study, only 19.4% of curling athletes correctly disagreed with the statement "no more than 15% of calories in the diet should come from fat." This is similar to a study by Shifflett et al. (2002) where only 22% of collegiate athletes correctly identified the proportion of daily intake that should come from fat, and in a study by Zawila et al. (2003) which found similar results at only 18.3% of female collegiate cross-country runners correctly disagreeing with this same statement regarding fat intake.

Micronutrients. Our current study showed that the Micronutrient category average was above the TNK average score of 69.6% at 76.4%, which is similar to trends in the literature. Overall, sections related to micronutrients have been above the study average such as with Arazi & Hossein (2012) who reported the category "Vitamin" at 61% and "Calcium and Iron" at 56% for a cohort of collegiate and non-collegiate athletes compared to the average NK score of 54% and as described in a systematic review (Trakman et al., 2016). However, a more recent study by Trakman, et al. (2018) describes the micronutrient section as being poorly understood by elite athletes at 39% and the average for nonelite male American football athletes at 50%. Again, discrepancies may be due to the number of questions or style of questions asked as these studies did not use the same SNKQ. Additionally, there may be differences in NK for micronutrients according to location as Trakman, et al. (2018) describe there are no other studies in Australian athletic populations for comparison, while the systematic review was representative of a mostly American sample of studies.

For specific micronutrient misconceptions, the statement “vitamins are a good source of energy” was answered correctly in our study with 65.2% of curling athletes disagreeing with this statement. However, this has not been the case in the literature with most studies reporting this exact statement to be misunderstood (Heaney et al., 2011). For example, Folasire et al. (2015) found that their cohort of Nigerian collegiate athletes incorrectly agreed with this statement at 82.7% which is similar to Zawila et al. (2003) which reported only 31.6% of their female collegiate cross-country runners disagreed with this statement. This discrepancy may be due to the increased age of our population as NK is accumulated over the lifespan compared to the collegiate athletes examined in both aforementioned studies (Wardle et al., 2000).

Hydration. Hydration is another category that sees both above and below the average scores in the literature. In the current study, hydration questions were the most well understood at 92.6%, which is well above the average of TNK at 69.6% noted for the same population. Heikkilä, Valve, Lehtovirta, and Fogelholm (2018) also reported that Fluid Balance and Hydration had the highest scores as a category within NK, at 85.2% for Finnish multi-sport athletes. Conversely, Blennerhassett et al. (2018) reported that at a score of 76.3%, Fluids was the most poorly understood section in a NK questionnaire that was completed by a group of ultra-endurance athletes. An important distinction in the SNKQs used may help to clarify this discrepancy between the study by Blennerhassett et al. (2018) and other studies. The SNKQ used by Blennerhassett et al. (2018) contained hydration questions with a higher level of complexity and endurance-specific recommendations compared to the general hydration questions covered in the SNKQ used in the current study (Zinn et al., 2005). For example, our study assessed hydration NK by assessing statements like “dehydration decreases performance” and “an athlete should replace fluids before, during and after an event” whereas Blennerhassett et al. (2018)

asked more complex and specific endurance-related questions such as “in an ultra-endurance race, what is the recommended amount of sodium per litre of fluid?” This portrays one of the biggest limitations of comparing NK nutrition categories among studies as the SNKQs are not created equally. Therefore, it is possible that there are sport-specific differences in hydration NK or that there is a better understanding of basic hydration NK but not advanced in certain populations.

In general, our current study showed that curling athletes correctly identified that dehydration decreases performance with 97.2% of participants agreeing with this statement. This is very similar to both Rosenbloom et al. (2002) and Nikolaidis and Theodoropoulou (2014) who found that 94% and 92% of male and female collegiate athletes, respectively, and 87.6% of semi-professional soccer players correctly agreed that dehydration decreases performance. As well, the statement “an athlete should replace fluids before, during and after an event” was correctly agreed with by the majority of our curling athletes at 97.5%, which was almost identical to the responses by American collegiate athletes, with male athletes agreeing at 96%, and female athletes at 95% (Rosenbloom et al., 2002). It is possible that our population of curling athletes have a basic understanding of hydration practices and further research may be required to assess sport-specific or more advanced applications of hydration for sport performance.

Weight Management. Weight Management is also a category score that was below the TNK average of 69.6% at 63.9%. This category of SNK is frequently reported in the literature with many studies declaring that it is one of the most misunderstood topics of SNK (Abbey et al., 2017; Trakman et al., 2018; Valliant et al., 2012; Weeden et al., 2014) although understanding of common safety practices for weight loss are seen in many studies (Trakman et al., 2016). For example, Shifflett et al. (2002) reported that weight gain was one of the most commonly

misunderstood topics with asking questions like “when weight gain is desired, athletes should…” and having an incorrect answer 89% of the time, which was similar in our current study as only 29.5% of curling athletes correctly identified that athletes should increase calories by increasing intake from all food groups.

The current study also saw that 93.7% of curling athletes disagreed with the statement “what the athlete eats is only important if the athlete is trying to gain or lose weight”. Zawila et al. (2003) did not report a % of correct responses but this statement was not included in their table of statements that were answered correctly by <35% of participants indicating that there was a higher than average number of participants who understood this statement. Conversely, (Dunnigan, 2010) found that 55.4% and 44.5% of male and female collegiate athletes disagreed with a similar statement of “the only time it is important to be aware of caloric intake is when you are trying to gain or lose weight.” The differences may be due to the wording of the statement as calories and what you eat in general, may be understood differently with their impacts on weight.

Overall, the current study did see similar trends in NK compared to other athletic populations within SNK categories and with specific SNK questions. However, caution must be taken when interpreting these results due to the prevailing discrepancies in SNKQ used in the literature and the differences between athletic populations studied; such as age, gender and level of performance. This exploration of NK provides a vital starting point of information for educators, such as Registered Dietitians, Trainers, or Coaches, who work with the curling population as this may clarify the knowledge gaps necessary to address in nutrition education. Further assessment of the NK of curling populations will help to clarify these trends and nutrition knowledge gaps.

Sources of Nutrition Information. Asking about the sources of nutrition information for athletic populations is one of the most commonly asked questions in many SNKQs. In our current study, Family (41.3%), Friends (40.6%), and Scientific Articles (36.9%) were the most frequently selected sources of Nutrition Information. Comparatively, Barr (1987) found that varsity athletes used magazines (69%) and books (67%) as primary sources of information, and Blennerhassett et al. (2018) also found that magazines (72.5%) was one of the highest selected nutrition resources for ultra-endurance athletes in addition to other athletes (71.6%). Shifflett et al. (2002) reported that collegiate athletes selected parents (28%) and coaches (17%) most frequently as their primary source of nutrition information while Weeden et al. (2014) found that Healthcare Professionals (64.8%) and the Internet (59.3%) were the highest. There may be many factors influencing the sources of information sought out in these different populations, including age, technology availability, and sport culture. RDs are not as frequently used as sources of information although being the trained experts in nutrition. Therefore, improving accessibility to RDs for curling athletes to obtain or improve SNK may be a consideration for teams, sporting associations and any other settings that provide support for athletes.

Nutrition Beliefs

Beyond NK, Nutrition Beliefs are often assessed in athletic populations and may focus on nutrition in general or may be more sport-specific. For example, our study found that 49.8% and 42.3% of curling athletes agreed and disagreed, respectively, with the general nutrition belief statement “It is the coach’s responsibility to stress good nutritional practices.” To note, 69.4% of those who disagreed reported that it is the athlete’s responsibility to stress good nutritional practices. Hoogenboom et al. (2009) also found that only 36.5% of female collegiate swimmers disagreed with this statement. This belief may be practically useful for coaches, trainers, and

dietitians to be aware of as coaches may have a lack of NK without proper education and training as suggested by Torres-McGehee et al. (2012). Therefore, efforts to train or educate coaches may be a useful tactic to improve NK amongst athletic populations.

With regards to sport-specific beliefs, statements such as “skipping meals is justifiable if you need to lose weight quickly” may also indicate where NK education may be needed. For example, in our current population, 96.6% of the participants correctly disagreed with the statement which is similar to a group of American collegiate female swimmers who 100% disagreed with this statement (Hoogenboom et al., 2009). On the other hand, only 53.5% of female and 46.5% of male American collegiate multi-sport athletes correctly disagreed with this statement in a study by Dunnigan (2010) which is very similar to a study by Eskici and Ersoy (2016) with only 45.5% of Turkish female basketball players correctly disagreeing. Although Dunnigan (2010) did not provide the breakdown by sport and did include swimming athletes in her study, these beliefs may be popular in specific sports or part of a culture at a particular college or institute as both American collegiate studies offered very different results. This further implies that assessing beliefs about weight management in a specific population and location may be warranted to safeguard against unhealthy practices.

Nutrition Practices

The Nutrition Practices of athletes may help to showcase habits on top of their dietary intake. For example, many studies report asking, “do you skip meals prior to competition,” with our current population showing that 92.8% reporting No. This result is higher than those seen in other studies. For examples, Folasire et al. (2015) reported that only 50.1% of Nigerian collegiate athletes stated No, and 68.7% of Indian collegiate athletes in a study by Nazni and Vimala (2010) stated that they did not skip meals prior to competition. The higher proportion of curling

athletes not skipping meals prior to competition compared to other studies may be due to an older population as the two other studies are focused on collegiate athletes, our age range is 18-84 years old, and NK being previously shown to increase across the life-span (Wardle et al., 2000). Additionally, other factors may come into play with the differences of this nutrition practice such as the type of sport or the level of performance. Further investigation and clarification of how the curling population perceives skipping meals as a poor pre-competition strategy may be needed to elucidate if NK or other factors influence this difference compared to other sporting populations.

Similarly, our study reported that a small percentage of curling athletes changed their nutrition during the competitive season with 26.7% answering yes to the question “Does your dietary pattern change at the time of competition compared to the off-season”, which was different than the literature. The studies of Folasire et al. (2015) and Nazni and Vimala (2010) reported very different results regarding this nutrition practice. Folasire et al. (2015) reported 53.6% of Nigerian collegiate athletes said yes to changing their nutrition at the time of competition, and the proportion of athletes saying yes to this statement was even higher in the study by Nazni and Vimala (2010) with 63.3% of Indian collegiate athletes reporting that they also did change their nutritional practices during competitive seasons compared to the off-season. Again, potential differences in ages, type of sport, levels of performance, and location may be influencing these practices in different athletic populations.

Lastly, our study showed that alcohol intake did not change during the competitive season for these athletes nor were there any differences between competitive and recreational athletes for alcoholic drinks consumed in a sitting as well as frequency of drinking alcohol for one week. Alcohol intake of 73.2% during the competitive season is not surprising as drinking

alcohol has been anecdotally common within this sport and may be even considered part of curling (Brooks, Barnes, & Stevens, 2017). Even at the elite level, recent media reports have shown that alcohol intake is alive and well with elite teams with an example of a Canadian team being removed from competition due to intoxication (Bull, 2018).

Drinking culture is common in other sports as well, which is the basis for including questions and assessment on alcohol intake in NK studies according to the review by Trakman et al. (2016). For example, a study on substance use trends in the NCAA revealed that 54.3% of athletes consumed alcohol during both the competitive and off seasons with most athletes consuming 1-2 drinks per sitting (Bracken, 2012). In contrast, Hull et al. (2016) reported that only 18.2% of the collegiate multi-sport athlete participants drank alcohol during the competitive season with most athletes drinking 0 days per week and having 0 drinks during one sitting.

The contrast between our findings and those at the collegiate level may be due to age, as the legal drinking age of athletes in the United States is 21 compared to Canada which has a legal dinking age of 18 or 19 years old depending on the province. Additionally, differences between team and individual sports with alcohol intake is also a possibility as to why drinking may be so prevalent in the Canadian curling population as bonding through drinking may be a component of a team sport environment (Vella & Cameron-Smith, 2010). For example, male collegiate track athletes reported lower annual alcohol intake at 69.8% compared to ice hockey at 95.5% (Bracken, 2012). These findings are important, specifically for the competitive group, as alcohol intake can negatively impact sport performance, especially when in excess (Thomas et al., 2016). Those working within this population may want to address alcohol intake during the competitive season and emphasize safe drinking protocols.

In conclusion, further studies may help to confirm the nutrition practices and beliefs in the curling population and at varying levels of performance. Clarifying the nutrition practices and beliefs can help to identify common habits, knowledge gaps and potential topics for nutrition education by Registered Dietitians, Trainers and other supporting roles.

Quality of Life

QOL is a vast area of research with a multitude of factors that may influence an individual's QOL (Power & Kuyken, 1998). However, there is very little research available on athletic populations and QOL outside of the realm of injuries and health-related QOL. Overall, the literature has shown that participation in physical activity and sport improves QOL alongside health (Omorou et al., 2013), but it remains to be shown whether the level of performance (recreational or competitive) has an impact on QOL, especially in the sport of curling. This section will review our results regarding QOL overall and in the context of recreational and competitive curling athletes compared to the limited available research.

Overall QOL. In our study, overall QOL was assessed through the stand-alone question "how would you rate your Quality of Life?" with 46.7% of our curling athletes selecting "good" and 50.0% of the athletes selecting "very good" for an average of 4.46 on a 5-point Likert scale, or 89.3%. High QOL scores, using a similar instrument such as the WHOQOL-BREF, is common in athletic populations. Our findings were similar to a study by Boldt et al. (2018) who found overall QOL ratings to be an average of 4.33 (86.6%) and 4.48 (89.6%) in a group of adult European female and male endurance runners, respectively; and to a study evaluating QOL in a group of elderly Brazilian Kendo athletes with an average of 4.39 (87.8%) for the same individual question on rating overall QOL (Mendonça, Alonso, Greve, & Garcez-Leme, 2017). Overall, it seems our curling population follows patterns of overall QOL scores in other sport

populations. However, further research is required to evaluate if these high scores are solely related to sport participation as I did not include a control group in the assessment of QOL. The following sections will review the factors that influence the four Domains of QOL and how they may relate to the overall QOL of this population.

Gender. The Psychological Domain of the WHOQOL-BREF, which covers areas such as having a meaningful life, acceptance of bodily appearance, and frequency of negative feelings, was found to be significantly lower in female curlers compared to male curlers at 70.2% and 73.2%, respectively. These results are similar to findings by Boldt et al. (2018) who reported on a group of endurance athletes where the Psychological Domain score was significantly ($p<0.001$) lower for women at 74.7% compared to men's score of 80.2%.

Gender differences in the Psychological Domain have been elucidated in the literature for the general population as well as with elite athletes (Schaal et al., 2011). For example, Schaal et al. (2011) found that elite female athletes are more likely to be diagnosed with psychological disorders such as eating disorders or anxiety disorders, due to biological and psychosocial factors. As well, although body image dissatisfaction exists for men, this component of the Psychological Domain, which is associated with eating disorders, is prevalent for women and almost a normal part of their everyday life (Marshall, Lengyel, & Utioh, 2012). Further research is needed to assess if body dissatisfaction and mental health disorders are prevalent in the curling population and if that explains any gender differences in the Psychological Domain.

Employment and Age. In our study, there were significant relationships found with Employment in three of the four QOL Domains: Psychological, Social Relationships and Environment. In summary, those who identified as Retired participants had higher QOL scores compared to Full Time, Student and Other (unemployed, homemaker, etc.) for the Environment

Domain. The Environment Domain evaluates access to transport and health services, having enough money to meet needs, and the opportunity for leisure activity, is higher in the Retired population and increases with Age, both of which are related as retirement typically comes at a later stage in life. Transitioning to retirement has been shown in the literature to either improve or decrease QOL depending on individual differences such as adjustment to retirement or variable incomes (Kim & Moen, 2001). Curling is an organized sport and there is a fee involved in participation in curling leagues, tournaments and national competition. As such, it could be assumed that individuals who participate in curling would have more financial freedom to do so. This may be also true when considering that those in the retirement category having scores that are higher than Students and Other, which includes those who are unemployed, as categories that are known to have financial limitations. As this study did not inquire about income, further research is required to assess if this is a possible influence on the increased Environment Domain scores for the curling population.

Similar to the Environment Domain, the Psychological Domain saw higher scores in the Retired participants compared to Full-Time participants and had a small but positive relationship with Age which logically accompanies this life-stage of retirement. A potential influence on the difference between Retired and Full-Time participants for the Psychological Domain could be the absence of work and thus potentially less stress. In a review on Psychological Research on Retirement by Wang & Shi (2014), the authors described that there is a psychological commitment to working that gets left behind in retirement alongside reduced stress and responsibilities. This lowered stress and psychological work may directly impact how participants answer questions, such as “how much do you enjoy your life” and “how well are you able to concentrate” as less stress may increase the enjoyment of life and mental capacity.

Interestingly, retirement is not typically associated with increased physical activity and rather decreased physical activity (Wang & Shi, 2014). As physical activity is related to improved mood and stress, it is possible that participation in curling may also contribute to the increased score in this Domain for the Retired Participants. Further research in this population with a control group of other retirees may help to showcase if PA, as participation in curling, improves Psychological QOL.

Lastly, Retired and Full-Time participants had higher scores than Other (unemployed, homemakers, etc.) in the Social Relationships Domain. This Domain assesses satisfaction with personal relationships, sex life and support from friends. Homemakers, who are typically women, are reported to be happier than their full-time counterparts but said to have a reduced social network compared to those in the workplace (Treas & Van Der Lippe, 2011). This reduced social network may mean less social support or the ability to create social relationships. As this is similar to those unemployed, small social networks may be a viable reason for the differences in this Domain.

Overall, our study results indicate that older and retired curlers tend to have higher QOL in three of the four Domains. As curling is a sport that fosters participation until a later age in life, further research on whether retired or elderly individuals have similar QOL scores in these domains outside of curling would be helpful to elucidate the degree to which employment status affects QOL compared to participation in curling exclusively.

Weekly Training Hours. Our study results showed that there were no significant effects of Training Hours per week on any of the QOL Domains. Crane, Rissel, Standen, & Greaves (2014) found similar results with no differences in WHOQOL-BREF Domains between cyclists who cycled weekly and those who cycled less than weekly. Although these results are similar to

our findings, it was not indicated if the athletes were competing at a higher level of performance or not, regarding competition, and thus should be taken with caution.

Additionally, Boldt et al. (2018) reported no differences in both male and female athletes who competed in either a 10km, half-marathon or marathon/ultra-marathon in Physical, Social Relationships and Psychological Domains, while there was a minor effect of the race distance on scores for female runners in the Environment Domain. Although the study by Boldt et al. (2018) did not address training hours specifically, it is widely accepted that individuals training for an ultramarathon would spend much more time running every week compared to an athlete training for a 10k race or even a marathon (Knechtle, 2012). Therefore, it seems as though these results are similar to the current study.

Lastly, a study by Omorou et al. (2013) provided insight into training time by assessing the level of physical activity (low, moderate and high), sport participation and their combinations' impact on QOL. Here, the results showed that participation in sport increased QOL compared to physical activity alone. Overall, the effects seen on QOL Domains for athletes were dependent on the level of physical activity. For example, increased physical activity mirrors increased QOL scores in Psychological and Social Relationship Domains. These studies show that the amount of time involved in sport participation does not seem to influence QOL scores, however identifying the level of physical activity outside of sport alongside curling may further help clarify this relationship and support the findings by Omorou et al. (2013).

Curling Years Played. Our current results did show a small but positive association between Curling Years Played and the Social Relationships and Environment Domains. The Social Relationships domain may be influenced by the fact that curling is a team sport. Team sports offer an opportunity to expand social networks and offers consistent opportunity for social

interaction and relationship development (Wikman, Elsborg, & Ryom, 2017). A study by Leipert et al. (2011) on the health implications of curling in Canadian women supports this idea by reporting that participation in curling did facilitate social connections for rural participants. These women described close relationships with their teammates and called them their "curling family" and "second home" (Leipert et al., 2011). Unfortunately, there is very little research on the general QOL differences between team and individual sports, outside the realm of injuries.

Additionally, curling is a sport that sees longevity in participation. For example, curling is a sport that can be played in elderly ages as there are modifications available to facilitate playing with lowered physical ability as well as having Senior Curling Championships (Curling Canada, 2018b). Therefore, it could be that the Social Relationships Domain is influenced by not only the availability of social interactions but also the lifelong nature of this sport. Further research on team versus individual sport QOL and longevity in sport may help to clarify this relationship in curlers and the Social Relationships domain.

In the Environment Domain, the question "do have you enough money to meet your needs" may be one factor that can explain this relationship to Years Played. As previously mentioned, there is a financial investment involved to participate in the organized sport of curling. Continued participation in curling over the lifespan may indicate that participants have enough money for their needs as they can invest in league or competition play. As well, this Domain also includes the opportunity for leisure activity, which may also be one of the factors influencing this relationship for Years Played. It is possible that those who do not have enough opportunity for leisure activity do not sign up to curl as often as others who do. However, without knowing the income, level of PA, or leisure activities outside of curling in this

population makes this estimation difficult. More information is needed to assess why longevity in the sport of curling may be associated with increased QOL in the Environment Domain.

Competitive vs. Recreational QOL. In our study, the results did not support our hypothesis that competitive athletes would have lower QOL scores compared to recreational athletes as there were no significant differences in all four of the QOL Domains as well as the overall QOL question.

The literature on competitive versus recreational athletes for general QOL is sparse. In comparison to our results, Kotarska, Nowak, Szark-Eckardt, and Nowak (2019) also did not find significant differences between their 3 groups of athletes, those who practice combat sports and martial arts recreationally, athletes who compete in other sports but practice combat sports and martial arts, and those who are competitive in combat sports and martial arts, on the stand-alone QOL question ($p>0.05$). However, Kotarska et al. (2019) did find significant differences between groups in all four of the individual domains ($p<0.05$). Many factors may explain this difference including that curling is a team sport compared to martial arts and combat sports which are individual sports, which could impact Social Relationship scores as previously described. Additionally, the physical strain from the type of sport in question may influence scores in this area. For example, combat sports and martial arts are contact sports whereas curling is not, which may impact the Physical Domain in relation to potential injuries. More research on the physical nature of curling as a sport and in other team sports in relation to QOL is warranted.

With no differences in QOL between curlers' Level of Performance and very little evidence in other sports, there are many questions left unanswered. Evaluation of Level of Performance in the current study may also have impacted our results shown in this category. Elite athletes, defined as those competing at the highest level, were part of the competitive group

and there may be differences between elite athletes and the rest of the competitive athletes. For example, elite athletes can be vulnerable to problems related to mental health such as anxiety and substance abuse, and injuries which may all impact different QOL Domains (Rice et al., 2016). Therefore, assessing QOL in a larger pool of elite curling athletes compared to recreational athletes can help to shed light on whether QOL changes due to Level of Performance with more specificity. In the end, more research is needed in sporting populations to further assess if participation at varying levels of Performance impact QOL and whether the type of sport and physical natures of the sport impact these findings.

Overall, this novel exploration of QOL in the curling population points towards high QOL with Gender, Employment, Age and Curling Years Played playing a role in the QOL of this population. Further research on competitive vs. recreational sports and QOL is required to explain differences between sports and between levels of physicality or intensity, and whether or not the participation in curling maybe improve QOL in Canadians independent of other factors.

Part 1 Conclusions on NK and QOL

The exploration of NK and QOL in Canadian Curlers has revealed many interesting results including that Canadian curlers have relatively high SNK compared to other athletic populations, but that areas such as weight management, macronutrients and requirements may require additional educational focus. Similar trends were found in Nutrition Beliefs regarding weight management, and continued evaluation of Nutrition Practices is suggested as a way to observe if NK is translated into behaviour.

Regarding QOL, this is the first exploration of QOL in this cohort of Canadian curlers and high QOL scores were found overall. No differences were observed between the competitive and recreational groups; however, more research is needed to clarify why competitive curlers

may not differ in QOL compared to recreational curlers or if participation in curling alone increases QOL compared to those not participating in this sport.

Chapter IV: Part 2: Evaluation of Dietary Intake of a Small Group of Competitive Canadian Curlers.

Methods

Participants

The participants for Part 2, included athletes at the "elite" level, which was defined by using the Sport For Life Model as "Podium Pathway" athletes, who are competing at the international or Olympic level and who train for improvement and achievement (Higgs et al., 2019). Podium Pathway athletes were recruited directly from the NTP, which provides support for the highest ranking curlers in Canada and those who display potential to represent Canada at the World Championships and Olympic Games (Curling Canada, 2019).

The elite athletes were asked to complete a 3-day food record in the off-season (July-September 2018). This data collection was done separately from this study as a mandatory part of the NTP Intake assessment by the Registered Dietitian on staff with Curling Canada. Thus, for this study, Jorie Janzen, the Registered Dietitian on staff sent an email confirmation after receiving food records and at that time asked these athletes to participate in Part 2 of this study. NTP athletes that agreed to participate signed, by hand or virtually, an informed consent form to allow the use of their completed 3-day food records for this study (see Appendix D). Ethics approval was obtained from the University of Manitoba Joint-Faculty Research Ethics Board.

The elite level curlers were invited to participate in Part 2 of the study via email and communication from Curling Canada. In general, the sample size needed for this study is n = 385; however, with a finite population in Part 2 (NTP), we will adjust to reflect this small population (Rodríguez del Águila & González-Ramírez, 2016). The size of the sample, N, will be the NTP population. Using a 95% Confidence level (z = 1.96), a margin of error of 5% (0.05),

and SD of 0.5 to ensure the sample size is large enough (Kotrlik & Higgins, 2001), the expected number of participants needed for part 2 of the study is 45 participants (see below for the calculation). As the participation level was very low (n=4), Part 2 is described as a small study to show trends and individual differences, instead of a representation of the population.

$$n = \frac{(\text{Z-score})^2 \times SD^*(1\text{-}SD) \times N}{(N\text{-}1)(\text{margin of error})^2 + (\text{Z-score})^2 \times SD^*(1\text{-}SD)}$$

n = 44.33 or 45 participants.

Study Design

Dietary intake information was collected from NTP level participants in Part 2 to determine all food and drink intake habits of these athletes. These athletes were instructed to complete the 3-day food record either electronically through the Food Processor Nutrition Analysis Software online portal (ESHA, 2019, Version 11.3), MyFitnessPal app (Under Armour Inc., 2004), or via a hard copy using a general template (See Appendix B). Athletes were asked to record all foods, beverages, and supplements taken for that period.

Dietary intake values were compared to recommendations and requirements, such as recommended macronutrient intakes for athletes based on body weight (Rodriguez et al., 2009; Thomas et al., 2016), Basal Metabolic Rate (BMR) based on the Harris-Benedict equation (Harris & Benedict, 1919), and Estimated Energy Expenditure, based on BMR and an additional PAL to account for the additional energy expenditure associated with physical activity (Black, 2000). Additionally, individual micronutrient intakes were compared to the RDA. According to Health Canada (2010) an RDA is:

> "the average daily dietary intake level sufficient to meet the nutrient requirements of nearly all (97–98 percent) healthy individuals in a group… If sufficient scientific

evidence is not available to establish an EAR, and thus calculate an RDA, an Adequate Intake is usually developed". (p. 1)

The Adequate Intake for other life stage and gender groups is believed to cover the needs of all healthy individuals in the groups, but lack of data or uncertainty in the data prevent being able to specify with confidence the percentage of individuals covered by this intake (Health Canada, 2010). As well, micronutrients are compared to Tolerable Upper Intake Level (UL) which describes the highest amount of a nutrient that an individual can have, daily, without any adverse health effect risk (Health Canada, 2010).

Statistical Analysis

Each item listed on the 3-day food records was entered in The Food Processor Nutrition Analysis Software (ESHA, 2019, Version 11.3) to calculate the dietary intake of each athlete (daily and 3-day averages). Suggested dietary intakes for gender and activity level are also calculated based on Rodriguez et al. (2009) and Thomas et al. (2016) recommendations to compare the adequacy of their diets, for macronutrients, regarding sport recommendations. Fibre intake will be compared to DRIs and micronutrients will be compared to RDA values for those available or Adequate Intake for those that do not currently have RDA values as previously described (Health Canada, 2010).

Dietary intake values are reported in energy intake, macronutrient and micronutrient ranges with mean and SD. No statistical analysis will be conducted as there is a very small sample size (n=4). However, Goldberg cut-offs will be used to determine if each participant was misreporting their intake (Black, 2000). The Goldberg cut-off equation includes a factor for the level of physical activity based on their reported physical activity, PAL are set at 1.55, 1.7 and 2.0 for low, medium, and high levels of physical activity.

Results

Participant Characteristics

From the NTP program, four female athletes participated in this part of the study. Table 15 describes the participant characteristics with the average age of 30 years, BMI of 22.9 kg/m^2 and overall intake per day at 1541 kilocalories. Three of the four participants had higher Reported Energy Intakes (EI_{rep}) than their BMR, with P3 being below BMR, and all participants had lower energy intakes compared to their estimated requirements.

Dietary Intake and Misreporting

Assessment of misreporting according to the Goldberg cut-offs revealed that P1 and P2 were adequate reporters and P4 was an under-reporter at the Moderate physical activity level (PAL = 1.7). Their EI_{rep}/BMR (see Table 15 below) scores were equal to 1.24, 1.32 and 1.08, respectively (EI_{rep}/BMR 95% Confidence Interval = 1.10 - 2.62). As P3 did not provide detailed physical activity with her 3-day food record, her physical activity level was set at Low (PAL = 1.55) and was found to be an under-reporter (EI_{rep}/BMR 95% Confidence Interval = 1.00 – 2.40) with an EI_{rep}/BMR of 0.97.

Macronutrient Intake

As seen in Table 15, the four participants had an accumulated average intake lower than the recommendations for carbohydrate intake as well as fibre intake, with only one participant (P1) reaching over 25g of dietary fibre daily. They did meet protein recommendations at 1.5g/kg/day with only one participant (P3) having less than the recommended amount at 0.8g/kg/day. Lastly, overall, the participants had an average intake higher than recommendations for fat as % of total daily calories with only two of the participants achieving a fat intake between 20-35% total daily calories.

Table 15 – Participant Characteristics and Dietary Intake Results of Elite Curlers

	P1	P2	P3	P4	Average	Recs
Age (years)	27	26	30	37	30	
Weight (kg)	53.6	51.4	54.6	70.5	57.5	
Height (cm)	157.5	155.0	157.5	162.6	158.1	
BMI (kg/m^2)	21.6	21.4	22.0	26.7	22.9	
BMR (kcal/day) *	1315	1290	1310	1442	1339	
BMR x PA (kcal/day) †	2038-2236	1999-2193	2030-2227	2236-2451	2075-2276	
Energy Intake (kcal/day)	1632	1703	1267	1562	1541	
Carbohydrates (g/day)	175.4	152.7	162.0	168.2	164.6	
Carbohydrates (g/kg/day)	3.3	3.0	3.0	2.4	2.9	**5-7**
Protein (g/day)	101.8	108.9	69.7	59.2	84.9	
Protein (g/kg/day)	1.9	2.1	1.3	0.8	1.5	**1.2-2.0**
Fat (g/day)	61.8	75.7	41.0	70.1	62.2	
Fat (%total kcal)	34.1	40.0	29.1	40.0	35.8	**20-35**
Fibre (g/day)	29.7	21.8	22.0	12.6	21.5	25

BMI = Body Mass Index, BMR = Basal Metabolic Rate, KCAL = kilocalorie, PA = Physical Activity Factor, P = Participant, Recs = Recommendations, ___ = lower, ___ = higher, and ___ = achieved recommendations.
*Calculated using the Harris-Benedict Equation. †PA for moderate activity was used (low to medium, 1.55-1.7).
Bolded recommendations are from the Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the ACSM (Thomas et al., 2016) while regular type recommendations are from DRIs (Government of Canada, 2006).

Micronutrient Intake

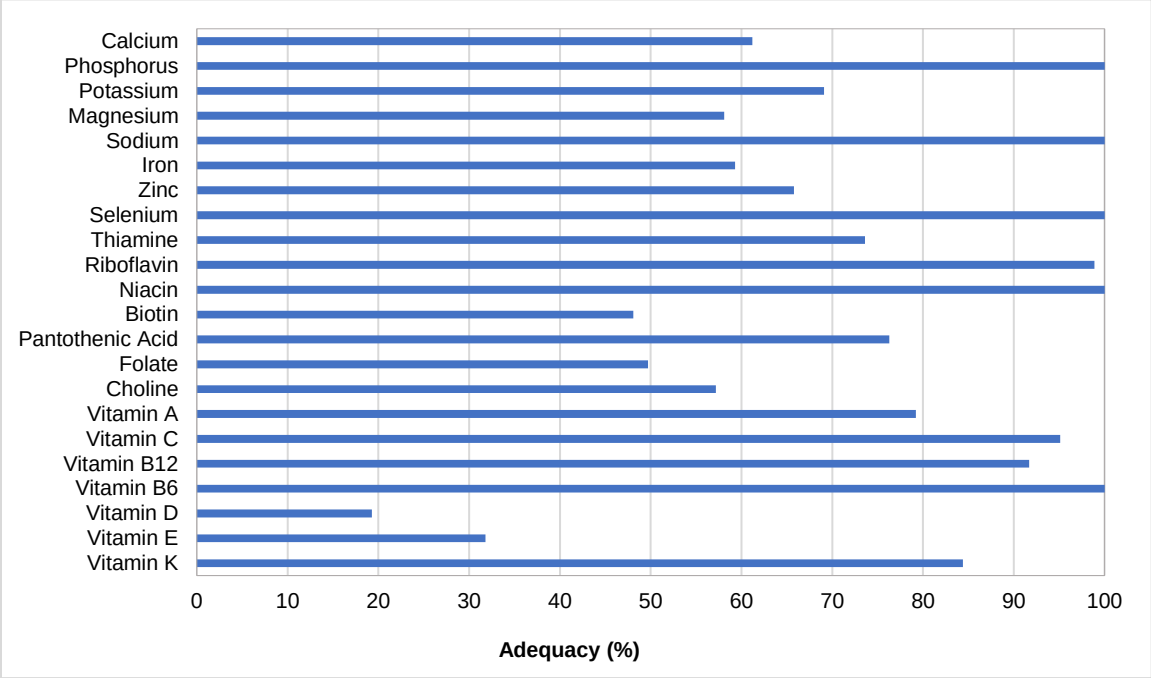
Micronutrients intake values are presented in Table 16 and averages of the participants are shown in Figure 19 as % achieved. On average, the participants met or surpassed their requirements for phosphorus, sodium, selenium, niacin and Vitamin B6 while being below recommendations for all other vitamins and minerals. Vitamin D intake from food was the lowest compared to requirements at 19.3% while Vitamin E was also low at 31.8%.

Table 16 – Micronutrient Intake Results of Elite Curlers

	P1	P2	P3	P4	Average	Recs
Calcium (mg)	1103.3	354.2	301.5	687.7	611.7	1000
Phosphorus (mg)	617.0	1387.1	560.5	445.4	752.5	700
Potassium (mg)	1920.2	2356.1	1607.1	1298.3	1795.4	2,600*
Magnesium (mg)	220.5	279.9	114.6	128.5	185.9	320
Sodium (mg)	2071.5	2446.9	1876.9	1973.2	2092.1	1,500*
Iron (mg)	15.6	13.5	6.6	7.0	10.7	18
Zinc (mg)	4.3	10.3	3.1	3.3	5.3	8
Selenium (µg)	36.3	158.1	45.5	54.1	73.5	55
Thiamine (mg)	0.8	1.0	0.7	0.8	0.8	1.1
Riboflavin (mg)	0.9	1.5	1.0	0.9	1.1	1.1
Niacin (mg)	9.8	36.6	11.6	16.0	18.5	14
Biotin (µg)	6.7	39.0	7.7	4.4	14.4	30*
Pantothenic Acid (mg)	3.5	5.8	2.6	3.4	3.8	5*
Folate (µg)	162.3	326.2	106.7	200.5	198.9	400
Choline (mg)	102.1	547.6	143.6	178.9	243.0	425*
Vitamin A (µg)	464.1	738.1	663.0	353.6	554.7	700
Vitamin C (mg)	53.3	97.6	89.3	45.0	71.3	75
Vitamin B12 (µg)	2.4	2.6	2.9	1.0	2.2	2.4
Vitamin B6 (mg)	1.2	2.3	1.2	1.2	1.5	1.3
Vitamin D (µg)	1.8	2.6	6.5	0.7	2.9	15
Vitamin E (mg)	2.9	9.1	3.2	3.9	4.8	15
Vitamin K (µg)	41.7	151.9	33.0	77.0	75.9	90*

Recs: Recommendations. *Recommended Dietary Allowances (RDAs) are shown without an asterisk (*) and Adequate Intakes (AIs) are followed by an asterisk (*) (Health Canada, 2010).

Figure 19 – Micronutrient Intake Recommendation Achievement Results of Female Elite Curlers



Dietary Intake, SNKQ and QOL

Two of the Part 2 participants also completed Part 1 of this study (P1 & P3). As seen in Table 17, both participants had higher SNK compared to the average of participants in Part 1, but they did differ with TNK and GNK. P3 had overall higher TNK, GNK and SNK compared to the average while P1 had lower TNK and GNK compared to the average. Additionally, both participants showed higher QOL scores in all 4 domains compared the average and competitive group.

Table 17 – Dietary Intake, NK and QOL Results of Female Elite Curlers

	P1	**P3**	**Average**	**Competitive**
TNK	80.3	68.9	69.7	69.0
GNK	75.0	63.9	69.5	67.5
SNK	88.0	76.0	70.1	71.2
QOL1	82.1	92.9	79.8	79.5
QOL2	75.0	83.3	71.6	72.1
QOL3	83.3	83.3	70.2	70.4
QOL4	90.6	87.5	80.0	80.0
			Recs	
Carbohydrates (g/kg/day)	3.3	3.0	5.0-7.0	
Protein (g/kg/day)	1.9	1.3	1.2-2.0	
Fat (% total kcal)	34.1	29.1	20-35	
Fibre (g/day)	29.7	22.0	25	

TNK = Total Nutrition Knowledge, GNK = General Nutrition Knowledge, SNK = Sport Nutrition Knowledge, QOL = Quality of Life, g = grams, kg = kilograms, kcal = kilocalories, P = Participant, Recs = Recommendations, ___ = lower, and ___ = achieved recommendations.

Discussion

The results from the small study revealed that female elite curling athletes had similar trends in intake compared to other sport populations. Energy, carbohydrate, and fibre intake were found to be below recommendations, while protein was within and fat was above recommendations. This section of the discussion will review these results compared to the literature of other sport populations and sport nutrition recommendations.

Energy Intake

In this study, all four of the female elite level curlers had below the recommendations for their total energy intake. I used a BMR calculation called the Harris-Benedict Equation and a PAL of low to medium (1.55-1.7) with all athletes within the calculation for low PAL. These findings are very similar to other sporting populations in the literature (as seen in Table 3), including a study by Hoogenboom et al. (2009) where a group of female collegiate swimmers showed low energy intakes, and a study by Papadopoulou and Papadopoulou (2010) with multi-sport elite female athletes. More recent studies have also identified that female elite athletes may not be taking in enough energy. For example, a study by Mielgo-Ayuso et al. (2017) showed low intake in a group of female elite volleyball players and a group of elite female football players evaluated by (Condo et al., 2019). Very few of the studies evaluating dietary intake in sport populations (see Table 3) show an adequate energy intake result with only two studies in male collegiate soccer players and national-class male fencing athletes intaking more energy than required (Ghloum & Hajji, 2011; Noda et al., 2009).

Although our results align with most of the literature in athlete dietary intake, not all studies utilize the same dietary intake instrument (3-day food record, 7-day food record or 24HR recall) and calculation for energy requirements (Kreider et al., 2010; Rosenbloom et al., 2002) which all have a certain margin of error and that makes direct comparisons between studies difficult. However, the trend still occurs with different instruments and some studies using sport-specific energy requirements and wearable technology such as armbands, which has been suggested to be more accurate in calculating energy expenditure.

Lastly, in our study two of the four athletes were found to be under-reporters, meaning it was likely that they did not report all food items or accurate portions in their 3-day food record.

More research would be needed to corroborate our findings in the elite curling group as low energy intake is a very important factor that can affect athletic performance. Specifically, low energy intake may affect energy availability and lead to relative-energy deficiency syndrome where female athletes may experience amenorrhea and low bone density.

Macronutrients

Carbohydrates. In this study, all four female elite level curlers did not meet carbohydrate requirements for moderate physical activity by being below 5-7g/kg/day at 2.9g/kg/day, which is also below recommendations for light physical activity of 3-5g/kg/day (Thomas et al., 2016). This average may be slightly higher as we found two of the four athletes to be under-reporters (P3 &P4); however, even with adequate reporting, this intake is well below the moderate activity level recommendations.

Low carbohydrate intake is consistent in the literature across many sports and levels of performance (see Table 3). Studies conducted with athletes competing in swimming, volleyball, softball, baseball, and other collegiate sports have found low carbohydrate intake in female athletes (Anderson, 2010; Hoogenboom et al., 2009; Nepocatych et al., 2017; Noda et al., 2009). Additionally, elite and professional female athletes have also shown low carbohydrate intake in sports such as football, volleyball, rugby, and soccer (Condo et al., 2019; Dos Santos et al., 2016; Marsh et al., 2017; Mielgo-Ayuso et al., 2017). Similar to energy intake, there are various ways to assess carbohydrate intake and many studies utilize different recommendations, such as by body size (g/kg) or by percent of daily intake (AMDR) with many reporting both, which may make direct comparisons difficult. Further studies assessing the dietary intake of elite curlers are required to see if this trend is consistent between genders and with a larger participant pool. Regardless, low carbohydrate intake is a concern for elite athletes as carbohydrate is one of the

most important nutrients for athletic performance, as it not only provides skeletal muscles with energy its adaptation to training, but also provides energy for brains and central nervous systems (Thomas et al., 2016).

Protein. Protein intake in this group of athletes was not consistent, with two athletes being within the ACSM recommendations of 1.2-2.0 g/kg of protein per day, one being below at 0.8g/kg/day and one slightly above at 2.1g/kg/day (Thomas et al., 2016). To note, the athlete that was below the recommendations was also an under-reporter, therefore it is possible that she could have had closer to recommendations of protein intake. In any case, the 0.8g/kg/day average is the recommended protein intake for the general population (Government of Canada, 2006), therefore she would be meeting her minimum requirements, but potentially not enough for her sport activity. The other under-reporter was within range for protein intake at 1.3g/kg/day, but at the lower end, which would still leave a lot of room for this athlete to be within recommendations with more accurate reporting.

Results for protein intake in this study are similar to those reported in the literature. Most of the literature shows within or above recommendations for protein intake with very little showing low protein intake (see Table 3). For example, results in a group of female football players found their average protein intake was 1.5g/kg/day compared to the same 1.2-2.0g/kg/day ACSM recommendations in a study by Condo et al. (2019), and another study in female elite volleyball players found their daily protein intake to be 2.1g/kg/day compared to a range of 1.6-1.8g/kg/day in a study by Mielgo-Ayuso et al. (2017), although compared to the ACSM range, they would still be considered above recommendations.

This is important to note as variable ranges of adequate protein intake can be seen within the literature. For example, Bogdanis et al. (2013) reported that their group of female high jump

athletes fell within recommendations of 1.2-1.7g/kg/day at an average of 1.3g/kg/day while Gábor et al. (2010) reported female multi-sport athletes having adequate protein intake at 14.8% of total energy intake using the general population recommendations of the European Union. As with other macronutrients, the level of activity and type of sport may impact recommendations used as markers for adequacy in dietary intake studies in other sports. However, it seems to be that protein intake is above or within general recommendations and future research may confirm dietary intakes of curling athletes, both male and female, according to their individual needs while participating in curling.

Fat. For fat intake, in this study, we saw two athletes overconsuming fat intake when compared to the AMDR of 20-35% of total energy intake, with the other two within recommendations. Interestingly, one of the athletes who fell within the AMDR range was also found to be an under-reporter (P3) and although P1 fell within the recommendations and was an accurate reporter, she was at the high end of the range at 34.1% of her daily intake. These findings align with trends in athletic populations in the literature that indicate that most athletes are above, or within recommendations, with very few indicating being below RDAs (see Table 3). Over 50% of the studies evaluated in Table 3 indicated overconsumption of fat, such as in a study by Gábor et al. (2010) where female multi-sport athletes reported dietary fat intakes of 35.2% of daily intake. Another example is a study by Anderson (2010) in a group of collegiate female volleyball players. However, Anderson (2010) reports a range of 30.2%-32.6% daily fat intake during their season and 30.8%-34.9% during the postseason as being over the recommendations of 25% as indicated by Hawley, Dennis, Lindsay, & Noakes (1995). Using the AMDR range, it would have been assumed that these athletes were within their

recommendations, which showcases that although many studies show high fat intakes such information needs to be taken with caution.

With two athletes being over recommendations and one being very close to the high range, it would be important to confirm whether high fat intake is consistent among this population and female curling athletes specifically. High fat intake is a concern as it may be taking up space in the diet rather than other nutrients of interest, such as carbohydrates, that may be beneficial for sport performance. Further research is required to confirm this trend.

Nutrition Knowledge and Dietary Intake

Nutrition Knowledge was assessed in Part 1 of our study and two elite athletes completed both Part 1 and Part 2 (P3 and P1). Both athletes had higher SNK scores compared to the average of our study as well as compared to the average of all competitive players. Otherwise, TNK and GNK scores differed between the two participants with P1 having higher TNK and GNK compared to P3 and the averages.

Comparing the relationship between dietary intake and NK was not possible because of the small sample size. However, P1 did have higher NK scores than P3 while meeting her recommendations slightly more often than P3. P1 met protein, fat, and fibre recommendations, and had an overall energy intake that was larger than her BMR, but below her estimated total energy intake requirements. P3, on the other hand, was an under-reporter and showed that her daily intake was below her BMR, and well below total energy intake requirements, was low on fiber and carbohydrate intakes, while being adequate in protein and fat intakes. It would be interesting to know if this difference in NK scores played a role in P1 being closer to recommendations or not as the research has shown that NK and dietary intake have a significantly small but positive relationship in reviews on the topic in athletic populations

(Heaney et al., 2011; Trakman et al., 2016). More research would be needed to assess if this higher NK in elite-level curlers, outside of other variables, is related to reaching more nutrition recommendations, and whether this is consistent with the literature.

Part 2 Conclusions

Low participation in this part of the study did not allow for statistical analyses of the results. However, the female elite curlers did show similar trends in their dietary intake compared to other sport populations, such as having on average low energy and carbohydrate intakes. Protein and fat intakes for athletes see some variability in the literature, which was mimicked in our study. On average, protein intake was found to be within recommendations, and fat intake was above recommendations. Additional research on the dietary intake of elite level curlers, of both genders, is warranted to corroborate these findings and to further explore the relationship between NK and Dietary Intake in this population.

CHAPTER VI: STUDY IMPLICATIONS, LIMITATIONS AND FUTURE DIRECTIONS

Study Implications

One of the primary objectives of this study was to explore the NK of Canadian curlers, with the results showing that NK scores from Canada's curling population tend to be relatively high compared to athletes from other sports. However, given that NK does have a relationship with dietary intake, which can directly impact health and sport performance, continued improvement in NK in this population is warranted. The NK categories that are highlighted in this study to be poorly or greatly understood can impact the work of those tasked with improving NK in curling athlete populations. For example, Registered Dietitians can utilize the results of this study to directly address knowledge gaps in this population and to help direct their efforts in nutritional counselling at the individual level. As an illustration, Registered Dietitians may spend more time on areas poorly understood such as focusing education on fat, such as which foods contain which types of fat, and may not spend as much time on hydration basics, as this is well understood in this population. Additionally, the prevalence of alcohol intake during the competitive season may also be an area of concern for this population, therefore education on the negative effects on sport performance due to alcohol may be warranted.

Studies on other sports have shown that nutrition education interventions in athletic populations can increase NK scores (Nascimento et al., 2016; Rossi et al., 2017; Valliant et al., 2012); thus this strategy may be a viable option for professionals working with athletes to address the poorly understood NK categories. At the competitive level, professionals working with athletes, such as coaches and athletic trainers may also consider additional training in nutrition in order to further support this transfer of knowledge to curling athletes if access to a Registered Dietitian is not available.

Findings from part one of our study indicated that curling athletes tend to seek out nutrition information primarily from friends and family. This study did not explore the reasons why certain nutrition information sources were popular among curlers, thus exploring and addressing this information source within this population may be important for nutrition professionals at large. Improving the visibility and use of Registered Dietitians in the population is thus a potential implication from this study.

A second objective of this research was to assess general QOL in curling athletes. Overall, participants had high QOL scores, and these values were similar to other athletic populations, such as endurance runners and Kendo athletes (Boldt et al., 2018; Mendonça et al., 2017). The QOL results from the curling participants in this study can provide a starting benchmark for QOL values for recreational and competitive level curlers. The original intent when embarking on this study was to evaluate QOL in-season and out of season for elite level curler as an assessment of the impact of competition on QOL for elite athletes as well as compared to the rest of the curling population. Participation in a second round of QOL assessment for elite curlers was not possible due to difficulties with recruitment. Nevertheless, the QOL data collected from the current study may still be of interest to Curling Canada and other curling associations who may want to know the impact of QOL on the athletes, and it may useful to help with formulating strategies to help athletes during stressful competition seasons. Additionally, these high QOL scores, in combination with further research, may help with the promotion of curling as a positive form of physical activity for improved QOL, especially in later stages of life; as the results of this study noted that participants who identified as retired had the highest overall QOL scores. These results showing high QOL scores in curlers may help improve interest and participation in curling across the country in areas such as retirement homes or

communities, and support funding initiatives for curling rinks, tournaments and associations to continue their work from grassroots to international levels.

Using a small study, I sought to explore the dietary intake of elite athletes and assess their nutritional adequacy. The results from athletes in this study mirrored similar dietary intake patterns noted in other sporting populations, identifying areas for improvement. The individualized dietary assessment outcomes may be valuable information for the elite athletes themselves as they may be interested in optimizing their nutrition in order to increase sport performance at the national and international level. Dietary intake analyses can help these athletes identify where they can improve and further support their health and performance should this information be reviewed and returned to the participants. Additionally, dietary assessment information from curlers may serve as crucial information for Registered Dietitians and other sport nutritionists that are working with elite curling athletes as curling is a high-performance sport and nutrition plays an important role on sport performance. Awareness of dietary intake/dietary pattern trends and areas of common dietary inadequacies can greatly help these professionals to better understand what to expect when working with elite curling athletes, but also in identifying area where they may want to focus nutritional counselling and education in working with curling athletes. Lastly, this small study pointed towards dietary intake potentially not being optimized in this population. Should further research using a larger representative sample size corroborate these findings, such results would provide some evidence for curling sport organizations, such as Curling Canada, to further support the use of Registered Dietitians within their sport performance programs. Because nutrition has an impact on sport performance, dietary intake adequacy should remain a vital area of research to further examine potential areas of improvement for athlete success with the support of nutrition experts.

Strengths

To my knowledge, this study represents the first study to exclusively assess NK, QOL, and dietary intake of curling athletes. As there is no prior research on these topics for curlers, the results from this study contribute to addressing a gap in the literature toward an understanding of some nutrition and lifestyle factors affecting athletes engaged in the sport of curling. The questions selected for inclusion in the NK questionnaire utilized in this study addressed all SNK categories identified as essential by a recent review by Trakman et al. (2016), and draw on the inclusion of questions from a validated instrument to assess GNK (Parmenter & Wardle, 1999). Additionally, this questionnaire was reviewed by local Sport Nutrition Registered Dietitians for literacy and knowledge adequacy.

Both the NK and QOL questionnaires were administered primarily online, which helped to reach a larger number of participants in a cost-effective manner. This study was able to recruit at least 320 participants for the SNKQ, which is moderately below the estimated 385 participants required as per the *a priori* sample size calculation conducted for the study. Our pool of 320 exclusively curling participants for the SNKQ was still a recruitment success since the total number of participants in this study is significantly higher than most of the SNK survey research on other sport populations, which averaged at about 100 participants per study (see Table 1).

The study participants included curlers from across the country, which was feasible due to the online format for the study questionnaires wherein web links to the questionnaires were sent to curling clubs and associations across Canada. Additionally, in partnership with Curling Canada, it was possible to recruit competitive level curlers, thereby allowing for assessments of NK and QOL in both competitive and recreational athletes, which adds to the extensiveness of this study. Lastly, this study used a previously validated QOL questionnaire, the WHOQOL-

BREF, which has been widely used in many populations around the world. In addition to the WHOQOL-BREF, this study included previously studied sport-specific QOL questions to better understand the QOL of athletes.

Limitations

The first limitation of this study is the use of an author-derived SNK portion of the NK questionnaire. Although I followed the trend in this area of research to use questions from multiple previously validated questionnaires, the combination of questions into a new SNKQ was not validated. This could bring into question the reliability of NK scoring. One way to analyze reliability is by assessing the internal consistency of the SNKQ. Here, using Cronbach's alpha analysis is a commonplace approach to see if the items in the SNKQ are measuring the same outcome. The Cronbach's alpha coefficient analysis for the SNK portion of the questionnaire revealed an alpha of 0.65, which is very close to the acceptable internal consistency Cronbach's alpha coefficient of 0.7 (Pallant, 2010). As previously discussed, the variability in instruments used to assess NK in athletic populations is a concern not only in our study but also in many other studies as shown in the literature. As sport nutrition research evolves, so do the questionnaires, thus comparisons between studies may be very difficult due to wide variabilities in the questionnaires used. Having consistent use of similar questionnaires and validation of such questionnaires can greatly help this issue in this area of research.

To ensure statistical power to identify changes in the NK and QOL, a SD of 0.5 was used to ensure the sample size was large enough (Kotrlik & Higgins, 2001) to represent the entire curling Canadian population. While the study did come close to achieving an adequate sample size of 385 with 320 participants recruited, the distribution of study participants across provinces is not representative of the entire country. For example, the highest number of participants was

from Manitoba as I sought out participation in person. Overall, no conclusions can be drawn from the study results regarding the assessment of location of residency as a factor affecting NK or QOL. Although each provincial curling association was contacted and individual curling rinks were also emailed, it is possible that there was less interest in participating in research in other provinces or without knowing the investigators or university. As well, the demographic question regarding province of residency was only added as an amendment to the study after data collection had already started. Further assessment of a larger curling population pool in other provinces across Canada would be helpful to create a more representative illustration of NK, QOL and Dietary Intake for the entire Canadian curling population.

Another limitation to this study was the low participation rate from the elite level curlers in Part 2 of the study. Originally, the study intended to assess dietary intake at both pre- and in-season periods. Multiple attempts to collect diet information happened throughout the data collection period. Even with the NTP athletes being required by their staff Registered Dietitian to provide a 3-day food record, there was resistance to allowing that data to be used in scientific research. One possible explanation would be that the data collection period during this study also coincided with an Olympic year. Considering that these athletes were likely focused on training and competition, it could be that the athletes did not have the time nor the energy to complete the 3-day food record during this time.

As well, the number of members of the curling NTP program are very small. This may further create resistance to allowing data to be used as athletes may be concerned that they may be identified due to location or other demographic information. Lastly, the type of instrument used may also contribute to the low participation levels as food records are known to have higher participant burden compared to other shorter forms of dietary intake assessment tools.

Ultimately, only pre-season dietary intakes were used for this part of the study. Further research for dietary intake in elite curling athletes may want to probe the reasons for resistance to participation in studies collecting dietary intake information, with the results from such research use as a guide to provide a safe and familiar environment in which to provide dietary intake information for research purposes.

There were a few limitations associated with QOL. First, because the intent was that all participants would complete both the SNK and QOL questionnaires, to reduce the burden on participants, it was decided that all demographic information would be captured on the SNKQ, and data between both questionnaires would be matched through the use of a unique identifier. However, the demographic questions that were included in the SNKQ were aimed at describing important characteristics associated with NK, but not QOL. For example, QOL can be impacted by income level, physical health, and injuries, however, our study demographics did not capture this information. Therefore, determining the relationships between QOL and certain factors that influence QOL is incomplete.

Lastly, separating the NK and QOL questionnaires could have negatively impacted the number of participants who completed the QOL portion of the survey. Firstly, online recruitment utilized separate web links to each questionnaire which may have caused some participants to only select one of the questionnaires. Also, as the SNKQ was presented first, the length of this questionnaire, comprising of about 84 questions, may have deterred participants from completing the QOL questionnaire. This is evident as there were 320 participants reported in the NK section of the study and only 240 participants in of the QOL section of the study. Secondly, having separate links caused some participants to fill out the QOL questionnaire only. For example, 16 participants completed the QOL but not the SNKQ in this study. Here, data collected for QOL-

only participants could not be used for statistical purposes as demographic information was solely collected on the SNKQ.

Future Directions

This current study began the assessment of NK, QOL and Dietary Intake in the Canadian curling population, and identified several areas that warrant further research. Firstly, for more consistent and comparable results between studies and athletic populations the use of a single, updated, and validated general SNKQ would better help to elucidate differences between sporting populations and factors that influence NK. Using updated sport nutrition recommendations and more general, not sport-specific, type questions could help to assess a more basic understanding of SNK across sport populations. This survey could be validated by testing it in both athletic populations as well as those with high nutrition knowledge (registered dietitians, dietetic interns, nutrition students, etc.) to evaluate reliability and consistency with the instrument.

Secondly, the relationship between dietary intake and NK within this population has not been elucidated. Therefore, assessment of NK in combination with Dietary Intake is warranted. Researchers should consider the resistance of this population to reporting dietary intake and create a safe environment and appropriate timing for data collection in their study design. The selection of a different dietary intake evaluation tool may also be taken into consideration as the 3-day food record may have been a deterrent in this population to participate in the study as it can be time consuming. Either the selection of another tool or additional support to complete the 3-day food record may be important to include to increase participation. Only female participants agreed to complete the dietary intake section of our study, thus future research

should work at ensuring equal participation for both genders to better elucidate potential influences on the NK and dietary intake relationship.

Third, the evaluation of HrQOL may also be an area of interest in this population as injuries and physical health directly impact QOL but have not been evaluated in this population. Including additional demographic characteristics that may influence HrQOL such as income, health conditions and injuries is necessary. As with other sports, evaluating HrQOL may provide further research opportunities in learning more about what injuries are common in curling athletes and potential implications for professionals such as trainers and doctors working with this population.

Lastly, given that participation in physical activity has been shown to increase QOL, additional research on QOL of curling athletes compared to a control group is warranted. Assessing physical activity levels outside of curling, as well as participation in other sports, may help to clarify whether or not a participation in curling alone has any positive influences on QOL compared to physical activity, other sports, or non-physical activity.

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APPENDIX A – SPORT NUTRITION KNOWLEDGE QUESTIONNAIRE

This is a survey, not a test. Your answers will help identify which dietary advice people find confusing. It is important that you complete it by yourself. Your answers will remain anonymous. <u>If you don't know the answer, mark "not sure" rather than guess</u>. You may skip any question you are not comfortable with. All participants completing the survey, regardless of skipped questions, will have the chance to enter the gift card draw. This should take approximately 25-35 minutes to complete.

Thank you for your time.

Section 1: Nutrition experts classify foods into groups. We are interested to see whether people are aware of food groups and the nutrients they contain.

1. Do you think these foods and drinks are typically high or low in added sugar? (select one box per food)

	High in added sugar	Low in added sugar	Not sure
Diet cola drinks	☐	☐	☐
Plain yogurt	☐	☐	☐
Ice cream	☐	☐	☐
Tomato Ketchup	☐	☐	☐
Melon	☐	☐	☐

2. Do you think these foods are typically high or low in salt? (select one box per food)

	High in salt	Low in salt	Not sure
Breakfast cereals	☐	☐	☐
Frozen vegetables	☐	☐	☐
Bread	☐	☐	☐
Baked beans	☐	☐	☐
Red meat	☐	☐	☐
Canned Soup	☐	☐	☐

3. Do you think these foods are typically high or low in fibre? (select one box per food)

	High in fibre	Low in fibre	Not sure
Oats	☐	☐	☐
Bananas	☐	☐	☐
White rice	☐	☐	☐
Eggs	☐	☐	☐
Potatoes with skin	☐	☐	☐
Pasta	☐	☐	☐

4. Do you think these foods are a good source of protein? (select one box per food)

	Good source of protein	Not a good source of protein	Not sure
Poultry	☐	☐	☐
Cheese	☐	☐	☐
Fruit	☐	☐	☐
Baked beans	☐	☐	☐
Butter	☐	☐	☐
Nuts	☐	☐	☐

5. Which is the main type of fat present in each of these foods? (select one box per food)

	Polyunsaturated fat	Monounsaturated fat	Saturated fat	Cholesterol	Not sure
Olive oil	☐	☐	☐	☐	☐
Butter	☐	☐	☐	☐	☐
Canola oil	☐	☐	☐	☐	☐
Eggs	☐	☐	☐	☐	☐
Coconut oil	☐	☐	☐	☐	☐

6. Which one of the following nutrients has the most calories for the same weight of food? (select one)

Sugar	☐
Protein	☐
Carbohydrates	☐
Fibre	☐
Fat	☐
Not sure	☐

Section 2: The next few items are about choosing foods.

7. If a person wanted to buy a yogurt at the supermarket, which would have the least sugar/sweetener? (select one)

0% fat cherry yogurt	☐
Plain yogurt	☐
Creamy fruit yogurt	☐
Not sure	☐

8. If a person wanted soup in a restaurant or café, which one would be the lowest fat option? (select one)

Mushroom risotto soup (field mushrooms, porcini mushrooms, arborio rice, butter, cream, parsley and cracked black pepper)	☐
Carrot butternut and spice soup (carrot, butternut squash, sweet potato, cumin, red chillies, coriander seeds and lemon)	☐
Cream of chicken soup (chicken, onions, carrots, celery, potatoes, garlic, sage, wheat flour, double cream)	☐
Not sure	☐

9. Which would be the healthiest and most balanced choice for a main meal in a restaurant? (select one)

Roast turkey, mashed potatoes and vegetables	☐
Lasagna, garlic toast and Caesar salad	☐
Fish and chips served with coleslaw and tartar sauce	☐
Not sure	☐

10. Which would be the healthiest and most balanced sandwich lunch? (select one)

Ham sandwich, fruit, blueberry muffin and fruit juice	☐
Tuna salad sandwich, fruit, low fat yogurt and water	☐
Egg salad sandwich, chips, low fat yogurt and water	☐
Not sure	☐

11. Which of these foods would be the healthiest choice for a dessert? (select one)

Berry Sorbet ☐
Apple and blackberry pie ☐
Carrot cake with cream cheese topping ☐
Lemon cheesecake ☐
Not sure ☐

12. Which of these combinations of vegetables in a salad would give the greatest variety of vitamins and antioxidants? (select one)

Lettuce, green peppers and cabbage ☐
Broccoli, carrot and tomatoes ☐
Red peppers, tomatoes and lettuce ☐
Not sure ☐

Section 3: This section involves questions and statements on nutrition knowledge. Please select one answer or "not sure" if you do not know the answer.

13. Protein is the main energy source for the muscle
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

14. Foods rich in carbohydrates are the main sources of energy in the body
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

15. To meet nutritional needs, athletes should consume approximately:
    a. 2,000 calories a day ☐
    b. 3500 calories a day ☐
    c. 1500 calories a day ☐
    d. Depends on gender, sport and training program ☐
    e. None of the above ☐
    f. Not sure ☐

16. The Body can synthesize Vitamin D upon exposure to the sun
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

17. No more than 15% of calories in the diet should be provided by fat
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

18. Exercise increases protein requirements
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

19. An athlete's protein needs are determined by:
    a. The intake of nutrients ☐
    b. Nothing specific, it is best to consume as much as possible ☐
    c. The type of sport and training done ☐
    d. A and c ☐
    e. Not sure ☐

20. With respect to protein intake among athletes:
    a. A powder protein supplement is best ☐
    b. Foods high in protein should be avoided since they are also high in fat ☐
    c. Supplements are important since not enough protein can be ingested through a regular diet ☐
    d. A balanced diet provides all the protein that is needed ☐
    e. Not sure ☐

21. The majority of an athlete's carbohydrates should be:
    a. Complex sugars ☐
    b. Simple sugars ☐
    c. Fiber ☐
    d. Saturated sugars ☐
    e. Not sure ☐

22. Lack of iron in the diet can result in fatigue, injury and illness
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

23. The vitamin and mineral needs of athletes are best met by:
    a. Using high potency multi-vitamin & mineral supplements ☐
    b. Adhering to a balanced diet ☐
    c. Eating plenty of foods high in fiber ☐
    d. Adhering to a diet primarily comprised of dairy, vegetables and fruit ☐
    e. Not sure ☐

24. Adequate calcium intake is necessary for athletes because it is important for:
    a. Healthy bones ☐
    b. Muscle contraction ☐
    c. Nerve conduction ☐
    d. All of the above ☐
    e. Not sure ☐

25. An athlete should replace fluids before, during and after an event
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

26. Dehydration decreases performance
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

27. Athletes should drink water during activity in order to:
    a. Avoid 'dry mouth' and the sensation of thirst ☐
    b. Balance carbohydrate levels ☐
    c. Maintain hydration levels ☐
    d. Help reduce the formation of free radicals in the muscles at work ☐
    e. Not sure ☐

28. Caffeine can increase the risk of dehydration
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

29. An athlete should consume a high fat meal 2-3 hours before an event
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

30. Protein supplements are necessary
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

31. Vitamins are a good source of energy
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

32. Excess vitamin supplementation may harm the physically active person
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

33. Alcohol consumption can negatively affect the absorption and utilization of nutrients
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

34. When weight gain is desired, athletes should:
    a. Increase calories by increasing intake from all food groups ☐
    b. Weight train and increase protein in diet ☐
    c. Increase calories by increasing fat intake ☐
    d. There are no specific principles; it is highly individualistic ☐
    e. Not sure ☐

35. When weight loss is desired, athletes should:
    a. Lose at most 1-2 lbs of body fat per week ☐
    b. Increase protein intake ☐
    c. Decrease fat intake ☐
    d. Limit water intake ☐
    e. A and c ☐
    f. Not sure ☐

36. An athlete involved in endurance events (eg, distance running) should follow a considerably different diet than one participating in events of short duration (eg, sprinting)
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐
37. What the athlete eats is only important if the athlete is trying to gain or lose weight
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐
38. The nutritional needs of athletes differ from normal populations
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

Section 4: This section involves statements about nutrition beliefs. Please select one answer or "not sure" if you do not know the answer.

39. Eating Carbohydrates makes you fat
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐
40. Skipping meals is justifiable if you need to lose weight quickly
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐
41. If trying to lose weight, carbohydrates should come only from fruits and vegetables rather than from breads and pastas
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

42. Vitamin supplementation is recommended for physically active people/athletes
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

43. The last meal before a competition should be consumed at least 3 hours before a competition
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

44. Salt is an essential part of an athlete's diet (increased intake versus normal population)
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

45. Natural and organic foods are more nutritious than foods grown under conventional methods
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

46. Sports drinks are the best way to replace body fluids lost during exercise
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

47. Athletes should rely on thirst to ensure fluid replacement
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

48. High amount of water consumption will increase the body weight
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

49. Dark yellow urine is a sign of proper hydration of the body
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

50. During exercise, mass ingestion of fluid is preferred over frequent ingestion of small amounts
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

51. As an athlete, my food intake should increase compared to the normal population
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

52. Dietary patterns should change depending on the season and climate
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

53. It is the coach's responsibility to stress good nutritional practices
    a. Yes ☐
    b. No ☐
        i. **If no**, whose responsibility, is it? Click here to enter text.
    c. Not Sure ☐

54. Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

55. Nutritional counseling would be important to the athlete who is trying to change their weight
    a. Agree ☐
    b. Disagree ☐
    c. Not Sure ☐

Section 5: This section involves your nutritional practices. Please select one answer and where applicable please describe your selection. For answers in this section: Always means every single time; often means most of the time but not 100% of the time; sometimes is 50% of the time; and never is 0%.

56. Does your dietary pattern change at the time of competition compared to the off-season?
    a. No ☐
    b. Yes ☐
    c. Sometimes ☐
        i. **If yes/sometimes**, How? Click here to enter text.

57. Do you skip meals prior to competition?
    a. No ☐
    b. Yes ☐
    c. Sometimes ☐
        i. **If yes/sometimes**, Why? Click here to enter text.

58. Do you consume sports drinks every day before practicing/or when you feel dehydrated?
    a. No ☐
    b. Yes ☐
    c. Sometimes ☐
        i. **If yes/sometimes**, Why? Click here to enter text.
59. Do you use supplements (ex: multivitamins or protein powder) as an athlete?
    a. No ☐
    b. Yes ☐
    c. Sometimes ☐
        i. If so (yes/sometimes), which ones and how much (dosage)? Click here to enter text.

60. I eat just before an event
    a. No ☐
    b. Yes ☐
    c. Sometimes ☐
        i. **If yes/sometimes**, how long before an event? (hour/minute) Click here to enter text.

61. I eat during an event
    a. No ☐
    b. Yes ☐
    c. Sometimes ☐

62. I eat just after an event
    a. No ☐
    b. Yes ☐
    c. Sometimes ☐
        i. If **yes/sometimes**, how long after an event? (hour/minutes) Click here to enter text.

63. I eat breakfast
    a. Always ☐
    b. Often ☐
    c. Sometimes ☐
    d. Never ☐

64. I consume water during and after training/competition
    a. Always ☐
    b. Often ☐
    c. Sometimes ☐
    d. Never ☐

65. I always eat at least one hour before competition
    a. No ☐
    b. Yes ☐
    c. Sometimes ☐

66. I consume milk and alternatives
    a. Yes ☐
    b. Sometimes ☐
    c. No ☐
        i. **If no**, why not? Click here to enter text.

67. I consume caffeinated beverages to increase mental alertness during competition
    a. Yes ☐
    b. No ☐
    c. Sometimes ☐
        i. If so, which products/beverages and how much? Click here to enter text.

68. Throughout a 7-day week about how many days do you drink alcohol?
    a. 0 ☐
    b. 1-2 ☐
    c. 3-4 ☐
    d. >5 ☐

69. How many alcoholic beverages do you usually consume in one sitting?
    a. 0 ☐
    b. 1-2 ☐
    c. 3-4 ☐
    d. >5 ☐

70. Do you drink alcohol during your competitive season?
    a. Yes ☐
    b. No ☐

Section 6: We would like to ask you a few questions about yourself.

71. What is your gender?
    a. Male ☐
    b. Female ☐
    c. Transgendered/Other ☐

72. What is your age?

Click here to enter text.

73. What is your current height, approximately? Please provide this in feet and inches or centimeters.

Feet	Click here to enter text.
Inches	Click here to enter text.
Or Centimeters	Click here to enter text.

74. What is your current weight? Please provide this in pounds or kilograms.

Pounds	Click here to enter text.
Or Kilograms	Click here to enter text.

75. What is the Province or Territory that you reside in?
    a. Alberta
    b. British Columbia
    c. Manitoba
    d. New Brunswick
    e. Newfoundland and Labrador
    f. Northwest Territories
    g. Nova Scotia
    h. Nunavut
    i. Ontario
    j. Prince Edward Island
    k. Quebec
    l. Saskatchewan
    m. Yukon

76. How long have you been participating in curling?

Click here to enter text.

77. In season, how many hours per week do you participate in curling?

Click here to enter text.

78. Are you currently registered in the Canadian Team Ranking System (CTRS) by Curling Canada?
    a. No ☐
    b. Yes ☐
        i. **If yes**, how many years have you registered in CTRS? Click here to enter text.

79. Which level of curling do you participate in? (select all that apply)
    a. Local Participation (neighbourhood, city, or surrounding area)
    b. Regional Participation
    c. Provincial Competition
    d. National Competition (previous or current)
    e. National Team Program Athlete (current)

80. What is the highest level of education you have completed?
    a. Elementary School ☐
    b. Some High School, No Diploma ☐
    c. High School Diploma or Equivalent (GED) ☐
    d. Technical or Trade Certificate ☐
    e. Diploma ☐
    f. Bachelor's Degree ☐
    g. Graduate Degree ☐
    h. Post-graduate degree ☐
    i. Other: Click here to enter text. ☐

81. Are you currently:
    a. Employed full-time ☐
    b. Employed part-time ☐
    c. Unemployed ☐
    d. Homemaker ☐
    e. Retired ☐
    f. Student ☐
    g. Other: Click here to enter text. ☐
82. Do you have any children?
    a. No ☐
    b. 1 ☐
    c. 2 ☐
    d. 3 ☐
    e. 4 or more ☐

83. Do you have any nutrition related qualifications (or are you studying to get a nutrition qualification)?
    a. No ☐
    b. Yes ☐
        ii. **If yes**, please specify: Click here to enter text.

84. Which sources of information do you rely on regarding nutrition (select all that apply):
    Athletic Trainer ☐
    Coach ☐
    Dietitian/Nutritionist ☐
    Scientific Articles ☐
    Magazines ☐
    Friends ☐
    Family ☐
    School ☐
    Media: Facebook/Instagram/Twitter ☐
    Other: Click here to enter text. ☐

APPENDIX B – FOOD RECORD EXAMPLE

Self-Generated Code: FA19A Day Number: ONE Day MONDAY Date: 10/21/17

Record ALL food and drink consumed during the date including sweets, snacks, nibbles, sauces and dressings, water and supplements (vitamins, etc.). Please also record ALL training or activities throughout these 3 days.

Please remember to record:

METHOD OF COOKING (eg. boiled pasta)

TYPE OF FOOD (eg. wholemeal bread)

AMOUNT OF FOOD (eg. 6 heaped tsp white sugar or weight (g))

BRAND NAMES (eg Nestle diet lite) if possible

Time of Day	AMOUNT EATEN	DETAILS OF FOOD & DRINK
6:00 am	250ml	Apple Juice Fruitbox (Minutemaid)
	1	Multivitamin tablet
8:00 am	1 ½ cups	Bran Flakes
	½ cup	Lucerne Skim milk (fat free) (for Bran Flakes)
	2 tsp	White Sugar (for Bran Flakes)
	1 large glass (~400ml)	Tropicana orange juice with pulp
	1 toast slice	Safeway Multigrain toast
	1 tablespoon	IXL Apricot Jam
10:30 am	1 Large Cup (450ml)	Cappuccino from café
	31g	Quaker chocolate chip granola bar
	250ml	Water
	1 large	Apple – Granny Smith

1:00 pm	2 slices	Dempster's 12 grain bread
	1 tablespoon	Butter (enough to cover surface of 1 slice of bread)
	2 slices (20g)	Tomato
	1 leaf (5g)	Lettuce
	2 slices (40g)	Kraft Process Cheese – regular fat
	1 cup	Fries from cafeteria
	300ml	Water

Self-Generated Code: FA19A Day Number: ONE Day MONDAY Date: 10/21/17

FOOD CONSUMED	QUANTITY EATEN	DETAILS OF FOOD & DRINK
DURING AFTERNOON	1 small handful	Mixed Salted Nuts
EVENING MEAL	261g (2)	small lamb chops, fat cut off, grilled
	1 (med size)	Baked potato
	1tbs	Butter
	1cup	Mixed frozen Heinz vegetables (including corn, carrot, beans) – boiled
	200g (1 tub)	Strawberry yogurt 99% fat free (Danone)
	2 glasses (200ml)	Red wine
DURING EVENING / SUPPER	1 cup (250ml)	Whole fat plain milk
	5	Home made chocolate chip cookies ~5cm diameter
	200ml	Water
TRAINING/ OTHER ACTIVITIES	TIME & DURATION	TYPE OF ACTIVITY
	5:00 – 7:00 pm	Curling Game

DAY ONE

Self-Generated Code:_____ Date: _____ Day of the week: _____

Record ALL food and drink consumed during the date including sweets, snacks, nibbles, sauces and dressings, water and supplements (vitamins).

Please remember to record:

METHOD OF COOKING (eg. boiled pasta)

TYPE OF FOOD (eg. wholemeal bread)

QUANTITY OF FOOD (eg. 6 heaped tsp white sugar or weight (g))

BRAND NAMES (eg Nestle diet lite) if possible

FOOD CONSUMED	QUANTITY EATEN	DETAILS OF FOOD & DRINK
EARLY MORNING		
BREAKFAST		
DURING MORNING		
MIDDAY		

DAY ONE CONTINUED

Self-Generated Code:_____ Date: _____ Day of the week: _____

FOOD CONSUMED	QUANTITY EATEN	DETAILS OF FOOD & DRINK
DURING AFTERNOON		
EVENING MEAL		
DURING EVENING / SUPPER		

TRAINING/ OTHER ACTIVITIES	TIME & DURATION	TYPE OF ACTIVITY

DAY TWO

Self-Generated Code:_____ Date: _____ Day of the week: _____

Record ALL food and drink consumed during the date including sweets, snacks, nibbles, sauces and dressings, water and supplements (vitamins).

Please remember to record:

METHOD OF COOKING (eg. boiled pasta)

TYPE OF FOOD (eg. wholemeal bread)

QUANTITY OF FOOD (eg. 6 heaped tsp white sugar or weight (g))

BRAND NAMES (eg Nestle diet lite) if possible

FOOD CONSUMED	QUANTITY EATEN	DETAILS OF FOOD & DRINK
EARLY MORNING		
BREAKFAST		
DURING MORNING		
MIDDAY		

DAY TWO CONTINUED

Self-Generated Code:_____ Date: _____ Day of the week: _____

FOOD CONSUMED	QUANTITY EATEN	DETAILS OF FOOD & DRINK
DURING AFTERNOON		
EVENING MEAL		
DURING EVENING / SUPPER		
TRAINING/ OTHER ACTIVITIES	TIME & DURATION	TYPE OF ACTIVITY

DAY THREE

Self-Generated Code:_____ Date: _____ Day of the week: _____

Record ALL food and drink consumed during the date including sweets, snacks, nibbles, sauces and dressings, water and supplements (vitamins).

Please remember to record:

METHOD OF COOKING (eg. boiled pasta)

TYPE OF FOOD (eg. wholemeal bread)

QUANTITY OF FOOD (eg. 6 heaped tsp white sugar or weight (g))

BRAND NAMES (eg Nestle diet lite) if possible

FOOD CONSUMED	QUANTITY EATEN	DETAILS OF FOOD & DRINK
EARLY MORNING		
BREAKFAST		
DURING MORNING		
MIDDAY		

DAY THREE CONTINUED

Self-Generated Code:_____ Date: _____ Day of the week: _____

FOOD CONSUMED	QUANTITY EATEN	DETAILS OF FOOD & DRINK
DURING AFTERNOON		
EVENING MEAL		
DURING EVENING / SUPPER		
TRAINING/ OTHER ACTIVITIES	TIME & DURATION	TYPE OF ACTIVITY

ADDITIONAL INFORMATION

If you have made any major changes to your eating habits during the past few months, please describe them here:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

On completion of this record, please return it to Jorie Janzen at jorie@cscm.ca.

THANK YOU FOR YOUR CO-OPERATION IN COMPLETING SUCH A DETAILED FORM. WE ARE VERY GRATEFUL FOR YOUR TIME AND EFFORT.

If you have any comments or suggestions, please write them below.

_____

_____

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APPENDIX C – QUALITY OF LIFE QUESTIONNAIRE

This questionnaire is based on the World Health Organization QOL-BREF (2) to evaluate Quality of Life in the general population and the Athlete Life Quality Scale (3) in athletic populations.

Instructions:

This questionnaire asks how you feel about your quality of life, health, or other areas of your life. Please answer all the questions. If you are unsure about which response to give to a question, please choose the one that appears most appropriate. This can often be your first response.

Your answers will remain anonymous. You may skip any question you are not comfortable with. All participants completing the survey, regardless of skipped questions, will have the chance to enter the gift card draw. This survey should take no more than 5-10 minutes to complete.

Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life in the last two weeks. For example, thinking about the last two weeks, a question might ask:

Do you get the kind of support from others that you need?

Not at all	Not much	Moderately	A great deal	Completely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

You should check the number that best fits how much support you got from others over the last two weeks. So you would check the number 4 if you got a great deal of support from others as follows.

Do you get the kind of support from others that you need?

Not at all	Not much	Moderately	A great deal	Completely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

You would check number 1 if you did not get any of the support that you needed from others in the last two weeks.

Section 1. **Please read each question, assess your feelings, and check the number on the scale that gives the best answer for you for each question**.

1. How would you rate your quality of life?

Very Poor	Poor	Neither Poor nor Good	Good	Very Good
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

2. How satisfied are you with your health?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Section 2. The following questions ask about **how much** you have experienced certain things in the last two weeks.

3. To what extent do you feel physical pain prevents you from doing what you need to do?

Not at all	A little	A moderate amount	Very much	An extreme amount
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

4. How much do you need any medical treatment to function in your daily life?

Not at all	A little	A moderate amount	Very much	An extreme amount
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

5. How much do you enjoy life?

Not at all	A little	A moderate amount	Very much	An extreme amount
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

6. To what extent do you feel your life to be meaningful?

Not at all	A little	A moderate amount	Very much	An extreme amount
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

7. How well are you able to concentrate?

Not at all	Slightly	A moderate amount	Very much	Extremely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

8. How safe do you feel in your daily life?

Not at all	Slightly	A moderate amount	Very much	Extremely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

9. How healthy is your physical environment?

Not at all	Slightly	A moderate amount	Very much	Extremely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Section 3. The following questions ask about **how completely** you experience or were able to do certain things in the last two weeks.

10. Do you have enough energy for daily life?

Not at all	A little	Moderately	Mostly	Completely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

11. Are you able to accept your bodily appearance?

Not at all	A little	Moderately	Mostly	Completely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

12. Have you enough money to meet your needs?

Not at all	A little	Moderately	Mostly	Completely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

13. How available to you is the information that you need in your day-to-day life?

Not at all	A little	Moderately	Mostly	Completely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

14. To what extent do you have opportunity for leisure activities?

Not at all	A little	Moderately	Mostly	Completely
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

15. How well are you able to get around?

Very Poor	Poor	Neither Poor nor Good	Good	Very Good
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Section 4. The following questions ask you to say how **good** or **satisfied** you have felt about various aspects of your life over the last two weeks.

16. How satisfied are you with your sleep?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

17. How satisfied are you with your ability to perform you daily living activities?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

18. How satisfied are you with your capacity to work?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

19. How satisfied are you with yourself?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

20. How satisfied are you with your personal relationships?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

21. How satisfied are you with your sex life?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

22. How satisfied are you with the support you get from your friends?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

23. How satisfied are you with the condition of your living place?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

24. How satisfied are you with your access to health services?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

25. How satisfied are you with your mode of transportation?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Section 5. The follow question refers to **how often** you have felt or experienced certain things in the last two weeks.

26. How often do you have negative feelings, such as blue mood, despair, anxiety, depression?

Never	Seldom	Quite Often	Very Often	Always
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Section 6. The following questions refer to how **satisfied** you have felt about various aspects related to sport.

27. How satisfied are you with the amount of free time you have away from your sport?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

28. How satisfied are you with your relationships with your coaches?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied	N/A
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐

29. How satisfied are you with your relationships with your teammates?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

30. How satisfied are you with you level of physical condition?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

31. How satisfied are you with your athletic performance?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

32. How satisfied are you with your role on your team?

Very Dissatisfied	Dissatisfied	Neither Satisfied nor Dissatisfied	Satisfied	Very Satisfied
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

APPENDIX D – CONSENT FORMS

UNIVERSITY OF MANITOBA

Faculty of Agricultural and Food Sciences
Human Nutritional Sciences

Consent Form

Title: Survey of Sport Nutrition Knowledge in Canadian Curlers

Principal Investigator: ----------
Research Supervisor: ----------

This consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Research:
You are asked to participate because we would like to evaluate current nutrition knowledge, beliefs and practices of curling athletes across Canada. Nutrition knowledge has been shown to affect dietary intake and thus overall health and athletic performance. For this reason, many studies have evaluated sport specific nutrition knowledge in various sports, but none have done so in the sport of curling. Since curling is a high-performance sport, assessing the current knowledge, practices and beliefs around sport nutrition is crucial to prescribe a better nutrition program for optimal performance. The results of this study will help to do this by identifying potential gaps in nutrition knowledge and current nutritional trends within this population.

Study Procedures:
As a participant, you will be asked to complete a self-administered survey. This survey should take approximately 25 to 35 minutes of your time to complete.

Risks and Benefits:
There are no known risks to you associated with completing the survey. You may not directly benefit from participation in this research; however, the study results may provide a better understanding of athletes' nutrition knowledge for Registered Dietitians, Coaches and Athletic Trainers, which may lead to future educational opportunities for athletes.

Confidentiality:
Information gathered in this study will be published as part of a master's thesis, scientific journals and may be presented in public forums. However, your name and other identifying information will not be used or revealed. Personal information such as your name, address, telephone number and/or any other identifying information will be protected. No information

revealing any personal information such as your name, address, telephone number will be made publicly available. Your participation in the study is confidential.

Personal data of participants will be deleted within 12 months of the end of the study. The anonymous data will kept longer, but not beyond 5 years. Access to information on the questionnaire will be limited strictly to the researchers named above. All data will be deleted after the time has expired.

Data will be collected electronically via password protected Qualtrics and stored on a secure computer. This online survey company is located in Canada and as such is subject to Canadian laws. The web-survey company servers record incoming IP addresses of the computer that you use to access the survey but no connection is made between your data and your computer's IP address. If you choose to participate in the survey, you understand that your responses to the survey questions will be stored and accessed in Canada. The security and privacy policy for the web-survey company can be found at: https://www.qualtrics.com/privacy-statement/

This project is partly funded by Curling Canada. Curling Canada will not have any access to individual data of participants and will only receive aggregate results at the end of the study. Participation in this study is voluntary and will not influence ongoing interactions with Curling Canada should you decide not to participate.

Remuneration and Feedback:

By participating in this study, you will receive one entry into the draw for a $100 Visa Gift Card. The entire survey must be complete prior to entering the draw. Contact information will be requested upon completion of each survey to enter the draw. This personal information will not be linked to survey data and will be deleted after the draw has been made. The draw for the prize will be done on March 31, 2019 when the study is finished. Feedback regarding the research results will be provided to participants as an electronic document as requested (see below).

Withdrawal:

Participants can withdraw at any time when completing the online survey without submitting answers. Participants may also withdraw at any time prior to when the study ends, March 31, 2019, by notifying the researchers by e-mail or telephone and providing them with your self-generated code (see below). Should this occur all data gathered will be deleted immediately.

Your decision to complete and return this survey will be interpreted as an indication of your agreement to participate. In no way does this waive your legal rights nor release the investigators, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. Any questions may be directed to the Principal Investigator at the contact information above.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Joint-Faculty Research Ethics Board. If you have any concerns or complaints about this project, you may contact any of the above-named persons, ----------.

See attached PDF version of this consent form. Please print off a copy for your records.

Consent:
I am 18 years of age or older:
Yes ☐
No ☐

I understand the nature of this project and agree to participate:
Yes ☐
No ☐

To help with maintaining **confidentiality of information**, Personal Information collected on this page will be stored in a separate file from the rest of data collected in study. The personal information file will be kept in a secured location, and only accessed by the PI (----------). However, we want to link all your data so you will be assigned a **Study Code** (see instructions below).

Instructions for Creating Assigned Code:
1. What are the first two initials of your high school's name? _____
2. What day of the month were you born? _____
3. What is the last letter of your first name? _____
4. Combine your responses from 1 to 3 in order here (e.g., FA19A): _____ (**This is your Study Code**)
5. **Print your Study Code on all questionnaires you fill out for this study.**

Study Feedback Request (optional):
Name: _____
E-mail: _____
Or Address: _____

[After the survey has been completed, the following question will appear to enter the draw]

Would you like to enter the draw for the $100 Visa gift card?
Yes ☐
No ☐

Name:
Phone Number:
Email:
[Either phone number or email will be required]

UNIVERSITY OF MANITOBA

Faculty of Agricultural and Food Sciences
Human Nutritional Sciences

Consent Form

Title: Quality of Life Survey of Canadian Curlers

Principal Investigator: ----------
Research Supervisor: ----------

This consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Research:
You are asked to participate because we would like to evaluate the current Quality of Life status of all curling athletes across Canada. Quality of Life refers to the perception of one's well-being and standards relating to their physical, environmental and psychological health as well as their social relationships. Quality of Life has been shown to be higher in individuals that participated in recreational sports compared to those that do not. However, it is not known whether participating in curling would produce this same benefit. Evaluating Quality of Life status of curlers across Canada would help clarify this potential relationship.

Study Procedures:
As a participant, you will be asked to complete a self-administered survey. This survey should take approximately 5 to 10 minutes of your time to complete.

Risks and Benefits:
There are no known risks to you associated with completing the survey. You may not directly benefit from participation in this research; however, the study results may provide a better understanding of athletes' current Quality of Life status and perceptions.

Confidentiality:
Information gathered in this study will be published as part of a master's thesis, scientific journals and may be presented in public forums. However, your name and other identifying information will not be used or revealed. Personal information such as your name, address, telephone number and/or any other identifying information will be protected. No information revealing any personal information such as your name, address, telephone number will be made publicly available. Your participation in the study is confidential.

Personal data of participants will be deleted within 12 months of the end of the study. The anonymous data will kept longer, but not beyond 5 years. Access to information on the questionnaire will be limited strictly to the researchers named above. All data will be deleted after the time has expired.

Data will be collected electronically via password protected Qualtrics and stored on a secure computer. This online survey company is located in Canada and as such is subject to Canadian laws. The web-survey company servers record incoming IP addresses of the computer that you use to access the survey but no connection is made between your data and your computer's IP address. If you choose to participate in the survey, you understand that your responses to the survey questions will be stored and accessed in Canada. The security and privacy policy for the web-survey company can be found at: https://www.qualtrics.com/privacy-statement/

This project is partly funded by Curling Canada. Curling Canada will not have any access to individual data of participants and will only receive aggregate results at the end of the study. Participation in this study is voluntary and will not influence ongoing interactions with Curling Canada should you decide not to participate.

Remuneration and Feedback:

By participating in this study, you will receive one entry into the draw for a $100 Visa Gift Card. The entire survey must be complete prior to entering the draw. Contact information will be requested upon completion of each survey to enter the draw. This personal information will not be linked to survey data and will be deleted after the draw has been made. The draw for the prize will be done on March 31, 2019 when the study is finished. Feedback regarding the research results will be provided to participants as an electronic document as requested (see below).

Withdrawal:

Participants can withdraw at any time when completing the online survey without submitting answers. Participants may also withdraw at any time prior to the time when the study ends, March 31, 2019, by notifying the researchers by e-mail or telephone. Should this occur all data gathered will be deleted immediately.

Your decision to complete and return this survey will be interpreted as an indication of your agreement to participate. In no way does this waive your legal rights nor release the investigators, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Joint-Faculty Research Ethics Board. If you have any concerns or complaints about this project, you may contact any of the above-named persons, -----

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---.

See attached PDF version of this consent form. Please print off a copy for your records.

Consent:
I am 18 years of age or older:
Yes ☐
No ☐

I understand the nature of this project and agree to participate:
Yes ☐
No ☐

To help with maintaining **confidentiality of information**, Personal Information collected on this page will be stored in a separate file from the rest of data collected in study. The personal information file will be kept in a secured location, and only accessed by the PI (----------). However, we want to link all your data so you will be assigned a **Study Code** (see instructions below).

Instructions for Creating Assigned Code:
1. What are the first two initials of your high school's name? _____
2. What day of the month were you born? _____
3. What is the last letter of your first name? _____
4. Combine your responses from 1 to 3 in order here (e.g., FA19A): _____ (**This is your Study Code**)
5. **Print your Study Code on all questionnaires you fill out for this study.**

Study Feedback Request (optional):
Name: _____
E-mail: _____
Or Address: _____

[Next Page]

[After the survey has been completed, the following question will appear to enter the draw]

Would you like to enter the draw for the $100 Visa gift card?
Yes ☐
No ☐

Name:
Phone Number:
Email:

[Either phone number or email will be required]

UNIVERSITY OF MANITOBA

Faculty of Agricultural and Food Sciences
Human Nutritional Sciences

Consent Form

Title: Dietary Intake Assessment of Elite Canadian Curlers (general)

Principal Investigator: ----------
Research Supervisor: ----------
Researcher: ----------

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Research:
You are asked to participate because we would like to assess the current dietary intake patterns of elite and sub-elite curling athletes across Canada. It is well known that dietary intake is a vital component to improved overall health as well as athletic performance. Nutrition can affect areas related to performance such as an athlete's body composition, mental focus, perceived fatigue, and recovery. Thus, evaluating all foods, beverages and supplements that an athlete consumes may provide insight into diet quality and potential gaps in their nutrition plan that may further affect sport performance.

Study Procedures:
As a participant, you will be asked to complete a 3-day food record on two occasions. This food record will take approximately 30 to 40 minutes of your time. We ask that you provide the timing and quantity of all foods, beverages and supplements ingested for 3 consecutive days. In addition to all food, beverages and supplements consumed on the 3 days we ask that you provide training information. This is the time and duration of curling, training/exercise or other activities performed during your selected 3 days. An example of a 3-day food record will be provided as a Word Document for your viewing.

Risks and Benefits:
There are no known risks to you associated with completing the food record. You may not directly benefit from participation in this research; however, the study results may provide a better understanding of athletes' dietary intake and may lead to future educational opportunities for Registered Dietitians. Upon request, a personal dietary analysis may be completed which will give participants information on their dietary intake compared to current recommendations.

Confidentiality:
Information gathered in this study will be published as part of a master's thesis, scientific journals and may be presented in public forums. However, your name and other identifying information will not be used or revealed. Personal information such as your name, address, telephone number and/or any other identifying information will be protected. No information revealing any personal information such as your name, address, telephone number will be made publicly available. Your participation in the study is confidential.

Personal data of participants will be deleted within 12 months of the end of the study. The anonymous data will kept longer, but not beyond 5 years. Access to information on the questionnaire will be limited strictly to the researchers named above. All data will be deleted after the time has expired.

This project is partly funded by Curling Canada. Curling Canada will not have any access to individual data of participants and will only receive aggregate results at the end of the study. Participation in this study is voluntary and will not influence ongoing interactions with Curling Canada should you decide not to participate.

Remuneration and Feedback:
By participating in this study, you will receive one entry into the draw for a $100 Visa Gift Card. The entire 3-day food record must be completed prior to entering the draw. Contact information will be requested upon completion of each 3-day food record to enter the draw. Therefore, completing both 3-day food records will provide you with 2 entries into the draw. This personal information will not be linked to survey data and will be deleted after the draw has been made. The draw for the prize will be done on March 31, 2019 when the study is finished. Feedback regarding study results will be provided to participants as an electronic document as requested (see below). Additionally, individual dietary analysis information will be available at the end of the study for participants requesting it. Requests for dietary intake analysis can be sent to the Principal Investigator, ----------.

Withdrawal:
Participants can withdraw at any time when completing the food record without submitting it to the Registered Dietitian. Participants continuing with dietary intake and QOL assessment may also withdraw at any time prior to the time when the study ends, March 31st 2019, by notifying the researchers by the e-mail or telephone numbers listed above. Should this occur all data gathered will be destroyed immediately.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask the researchers for clarification or new information throughout your participation.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Joint-Faculty Research Ethics Board. If you have any concerns or complaints about this project, you may contact any of the above-named persons, ----------.

_____

Participant's Signature Date

_____

Researcher and/or Delegate's Signature Date

Self-Generated Code:
To help with maintaining **confidentiality of information**, Personal Information collected on this page will be stored in a separate file from the rest of data collected in study (ie. 3-day food record). The personal information file will be kept in a secured location, and only accessed by the PI (--------). However, we want to link all your data so you will be assigned a **Study Code** (see instructions below).

Instructions for Creating Assigned Code:
1. What are the first two initials of your high school's name? _____
2. What day of the month were you born? _____
3. What is the last letter of your first name? _____
4. Combine your responses from 1 to 3 in order here (e.g., FA19A): _____ (**This is your Study Code**)
5. **Print your Study Code on all questionnaires you fill out for this study.**

Study Feedback Request (optional):
Name: _____
E-mail: _____
Or Address: _____

UNIVERSITY OF MANITOBA

Faculty of Agricultural and Food Sciences
Human Nutritional Sciences

Consent Form

Title: Dietary Intake Assessment of Elite Canadian Curlers (NTP)

Principal Investigator: ----------
Research Supervisor: ----------
Researcher: ----------

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of the Research:
You are asked to participate because we would like to assess the current dietary intake patterns of elite and sub-elite curling athletes across Canada. It is well known that dietary intake is a vital component to improved overall health as well as athletic performance. Nutrition can affect areas related to performance such as an athlete's body composition, mental focus, perceived fatigue, and recovery. Thus, evaluating all foods, beverages and supplements that an athlete consumes may provide insight into diet quality and potential gaps in their nutrition plan that may further affect sport performance.

Study Procedures:
As a participant, you will be asked to allow Curling Canada and ---------- to release your previously completed food records to the principal investigator for the purpose of this study. As well, as a second food record is mandatory in your National Training Program Athlete Contract, the second food record will also be provided to the principal investigator. A complete 3-day food record will take approximately 30 to 40 minutes of your time. We ask that you provide the timing and quantity of all foods, beverages and supplements ingested for 3 consecutive days. In addition to all food, beverages and supplements consumed on the 3 days we ask that you provide training information. This is the time and duration of curling, training/exercise or other activities performed during your selected 3 days.

Risks and Benefits:
There are no known risks to you associated with completing the food record. You may not directly benefit from participation in this research; however, the study results may provide a better understanding of athletes' dietary intake and may lead to future educational opportunities

for Registered Dietitians. Upon request, a personal dietary analysis may be completed which will give participants information on their dietary intake compared to current recommendations.

Confidentiality:

Information gathered in this study will be published as part of a master's thesis, scientific journals and may be presented in public forums. However, your name and other identifying information will not be used or revealed. Personal information such as your name, address, telephone number and/or any other identifying information will be protected. No information revealing any personal information such as your name, address, telephone number will be made publicly available. Your participation in the study is confidential.

Personal data of participants will be deleted within 12 months of the end of the study. The anonymous data will kept longer, but not beyond 5 years. Access to information on the questionnaire will be limited strictly to the researchers named above. All data will be deleted after the time has expired.

This project is partly funded by Curling Canada. Curling Canada will not have any access to individual data of participants and will only receive aggregate results at the end of the study. Participation in this study is voluntary and will not influence ongoing interactions with Curling Canada should you decide not to participate.

Remuneration and Feedback:

By participating in this study, you will receive one entry into the draw for a $100 Visa Gift Card. The entire 3-day food record must be completed prior to entering the draw. Contact information will be requested upon completion of each 3-day food record to enter the draw. Therefore, completing both 3-day food records will provide you with 2 entries into the draw. This personal information will not be linked to survey data and will be deleted after the draw has been made. The draw for the prize will be done on March 31, 2019 when the study is finished. Feedback regarding study results will be provided to participants as an electronic document as requested (see below). Additionally, individual dietary analysis information will be available at the end of the study for participants requesting it. Requests for dietary intake analysis can be sent to the Principal Investigator, ----------.

Withdrawal:

Participants can withdraw at any time when completing the food record without submitting it to the Registered Dietitian. Participants continuing with dietary intake and QOL assessment may also withdraw at any time prior to the time when the study ends, March 31st, 2019, by notifying the researchers by the e-mail or telephone numbers listed above. Should this occur all data gathered will be destroyed immediately.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial

consent, so you should feel free to ask the researchers for clarification or new information throughout your participation.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Joint-Faculty Research Ethics Board. If you have any concerns or complaints about this project, you may contact any of the above-named persons, ----------.

_____

Participant's Signature Date

_____

Researcher and/or Delegate's Signature Date

Self-Generated Code:
To help with maintaining **confidentiality of information**, Personal Information collected on this page will be stored in a separate file from the rest of data collected in study (ie. 3-day food record). The personal information file will be kept in a secured location, and only accessed by the PI (-------). However, we want to link all your data so you will be assigned a **Study Code** (see instructions below).

Instructions for Creating Assigned Code:
1. What are the first two initials of your high school's name? _____
2. What day of the month were you born? _____
3. What is the last letter of your first name? _____
4. Combine your responses from 1 to 3 in order here (e.g., FA19A): _____ (**This is your Study Code**)
5. **Print your Study Code on all questionnaires you fill out for this study.**

Study Feedback Request (optional):
Name: _____
E-mail: _____
Or Address: _____