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Availability of sports foods globally and in New Zealand supermarkets

A systematic review and analysis of availability data

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*A thesis submitted in partial fulfilment of the requirements for the degree of Master of Health
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Abstract

Background

Sports foods are specially formulated, usually with specific added ingredients or nutrients, to help people achieve specific nutritional or sporting performance goals. The increasing availability of such products has been hypothesised and may provide athletes with greater choice in aiding their recovery and performance. However, misinformed use of such products may lead to public health concerns, including through banned substances. Currently, no literature surrounding the availability of such foods in New Zealand has been published to confirm this and could be of use to multiple stakeholders.

Aims

- 1) To systematically review the published literature on the availability of sports foods globally and the marketing strategies used.
- 2) To assess the availability of sports foods within New Zealand supermarkets and availability trends over the past six years.

Method

A definition of sports foods was created from currently accepted definitions of similar products and used to identify relevant products. A systematic review was conducted across four scientific literature databases. Data were extracted onto a standardised form, and a narrative review was undertaken regarding availability, consumption, and marketing strategies.

Data between 2013 and 2018 were collected from the Nutritrack packaged food composition database that displays the appearance of unique food items on supermarket shelves, with photographs. These data were used to assess the availability of sports foods via descriptive and Chi-Square analysis, along with the front of package labelling techniques used to market such products.

Results

Data published on the availability of sports foods and marketing strategies used suggest that sports foods have been increasing in global availability (Figure 3). In New Zealand, between 2013 and 2018, the proportion of packaged foods classified as sports foods increased from 1.8% (n=247) to 2.1% (n=325). The systematic review found increased inclusion of recovery ingredients (Table 1), which was concordant with the increased nutrient-based claims found in the Nutritrack analysis (Table 8)

Conclusion

This research found an increased availability of sports foods globally and within New Zealand supermarkets. Marketing of these products now emphasises nutrient claims to entice consumers and quickly convey health status. This information can provide standing for public health professionals to educate the public around appropriate use of these products better, and for sporting bodies to make athletes aware of contamination risk. Further research should be conducted surrounding the sales of these products and their consumption.

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1 Chapter One. Introduction

1.1 Members of the research project

The candidate of this Masters' research project is Michael Lie, a second-year Nutrition and Dietetics student from The University of Auckland. Michael has long expressed interest in the field of sports nutrition and chose to undertake this research project not only for the completion of his Masters' degree but for personal aspirations and research. The three supervisors of this project were Dr Helen Eyles of The University of Auckland and the National Institute for Health Innovation (NIHI), Dr Andrea Braakhuis, the academic director for the University of Auckland's Nutrition and Dietetics program, as well as Ms Jeni Pearce (MNZM), a performance nutritionist, dietitian and technical lead of performance nutrition at High Performance Sport New Zealand (HPSNZ). Dr Helen Eyles has acted as the primary supervisor for this project, with Dr Andrea Braakhuis providing academic support and Ms Jeni Pearce acting as an industry contact and practical liaison.

1.2 Rationale

The conception of this research project took place in September of 2018 as a collaboration between The University of Auckland, NIHI, and HPSNZ. Each respective organisation understood the implications sports foods brought about within their fields, with potential concerns surrounding public health and athlete credibility and well-being being at the forefront. The candidate of the research project had hypothesised the increase in sports foods, which posed several implications for different populations. Through the concerns regarding the hypothesised rise in sports foods, members of the research project concluded that to assess the availability of such products, the utilisation of a packaged food database was required.

1.2.1 Sports foods, nutrition, and public health

Sports foods are food products consumed explicitly to enhance performance or recovery in the context of sport. FSANZ define "formulated supplementary sports foods" as "a product that is specifically formulated to assist sports people in achieving specific nutritional or performance goals" (1). Athletes and sportspeople, ranging from casual to elite, have different nutritional demands higher than the average person (2). Sports foods are a category of product designed to be convenient while facilitating performance and recovery (3). However, as they lack a complete array of nutrients, sports foods are not recommended as a sole source of nutrition but rather a supplement to an already varied diet (3).

Reports have suggested that a large proportion of non-athletes use these products without the increased nutrition demands of elite sportspeople (4). Of note, the demographic that is predominantly using sports foods and dietary supplements are now of a younger age (5).

Therefore, one unintended side effect of potential increased availability of these products is the usage of these specialised products in a non-sporting context, which can contribute to excess sugar and energy intakes and thus providing concern for public health.

The Sports Dietitians of Australia, a leading professional organisation and experts in sports nutrition have also laid out guidelines surrounding the nutrition and development of adolescents. For active adolescents, the current recommendation is to obtain most, if not all nutrients from whole foods as part of a varied diet, and the need for further supplementation is minimal (6). With such recommendations for young people and adolescent athletes going against current consumption patterns, it is of interest to public health practitioners, coaches and athletes informing themselves as to what is available.

1.2.2 Increase in the sports food sector in New Zealand

There are currently very little objective data surrounding the availability and sales of sports foods within New Zealand. A brief literature search before undertaking the formal research found that many articles originated from other countries or contained sensitive marketing information behind a paywall, and therefore could not be applied to guide this research. However, with sports foods and drinks becoming one of the fastest-growing packaged product categories amongst consumers in the United States of America (USA) and an increasing interest in health globally, it was hypothesised that this was also the case within New Zealand (7).

Some Australasian data has shown that between 1997 and 2006, there has been an increase in the sales of sugar-sweetened sports drinks, one of the constitutional groups of products that make up sports foods (8). Gosse (2010) also has responses from Australasian based consumers noting that there has been an increased presence of sports food and drink within supermarkets and online. However, there is currently no scientific literature surrounding this (8).

This sentiment is also reiterated by Food Standards Authority Australia New Zealand (FSANZ), with their 2013 findings reporting that there has been an “expansion in the range, availability and marketing of sports-related food products” especially within supermarkets, gyms, and the internet (9). However, both pieces focussed on qualitative responses from consumers and did not provide an objective look at what is directly available to consumers. Furthermore, consumer research has previously shown that health and nutrient claims can lead consumers to make conscious decisions on the health status of a food product (10, 11). With an expansion in the marketing of sport-related food products, this is directly relevant to this research. This thesis seeks to provide an objective analysis of the sports foods available in New Zealand supermarkets and how they are being marketed, as well as reviewing similar work done globally, in the interest of the health and safety of both the general public and athletes.

1.2.3 Sports foods, doping, and contamination in sport

Sports foods are a convenient method to obtain specialised nutrition for recovery and performance (12). While many athletes safely consume sports foods and enhance their diet with sport-specific dietary supplements, consumption of such products carries an ever-present risk of doping (13).

Whether doping occurs as a result of explicit manufacturer malpractice or innocent cross-contamination of product, the onus is on the athlete to avoid banned substances. With both increased availability and variety in the range of sports foods, athletes and sporting bodies should find it imperative to know what is available. Sports foods have become increasingly popular amongst and within everyday foods (14). Haigh (2019) finds that while traditional sports foods such as gels, drinks and powders still exist, there has been an emergence of sports foods within food groups such as breakfast foods, cereals and bars (14).

This increased variety is a trend noted amongst sports dietitians in Australia, with recommendations to athletes to be wary of cereals with added protein powders due to the possible risk of contamination (15). Investigations in New Zealand of what is available to the public and athletes is therefore imperative to allow for safe and fair play amongst sporting competitors.

1.3 Thesis aims, objectives and structure

1.3.1 Aims

The primary aim of this thesis and research is to investigate the current availability of sports foods within New Zealand supermarkets over the past six years. An auxiliary aim for this thesis is to conduct systematic research on published literature surrounding the global sports food market to help contextualise the findings within New Zealand. This research seeks to inform consumers and sporting bodies to provide a basis to enact change for the benefit of public health and safety.

1.3.2 Objectives

- 1) To assess global trends of availability of sports foods and similar products by conducting a systematic review. The systematic review is to encompass findings from the last fifteen years to help identify global trends.
- 2) To use availability data from New Zealand supermarkets to assess the availability of sports foods, how the trends of which have changed in the last six years, and to see marketing using front of package labelling techniques

1.3.3 Structure

Chapter One: Introduction – Summary of the rationale, research, and format of the thesis

Chapter Two: Systematic Review – Provides the grounds for a Systematic Review, the method by which it was conducted, its findings, and discussion of implications

Chapter Three: Nutrtrack database research – Provides an overview of the “Nutrtrack” supermarket food composition database and how it was used to assess the availability and marketing of sports foods in New Zealand supermarkets, the findings, and a discussion of the implications

Chapter Four: Conclusion – Overall summary the main results of the thesis

2 Chapter Two. The global availability and consumption of sports foods: A systematic review

2.1 Introduction

Sports nutrition products have seen a recent boom in mainstream appeal. Despite having a niche function, and initially formulated to help the athletic elite and avid gym-goers, sales of such products have since expanded to the now more health-conscious general consumer (16). Due to this breakthrough to the mainstream consumer, a global shift in increased sports food availability and range has been hypothesised. However, to date, little objective data confirm these trends. As of the writing of this thesis, there are no current compilations of literature that explore the broader availability of sports foods, nor the consumption of such foods. Sports nutrition is a large and quickly growing consumer health category that promotes the achievement of optimum nutrient intake, which is having positive implications in health care costs and well-being. The flow-on effects of sports foods for general health have been increasing in recent years (17). The overall aim of this systematic literature review was to assess the literature on the availability, consumption and marketing strategies of food and drink products globally that fall under a new definition of sports foods, set out by High Performance Sport New Zealand (HPSNZ) within this research project.

While the primary aim of the review is to characterise the availability, consumption and marketing strategies of sports foods and products, to conduct the review properly, the definition of sports foods and products required clarity. It is imperative to sporting bodies, elite athletes, and sport-minded individuals to be able to identify whether such products fall under the formal definition of a sports food. Their availability will ultimately influence athlete and sporting performance and safety across a wide range of abilities, from recreational to elite sportspeople. Specific sports foods that are available should also be studied to discern them from other sports products that may not be recognised by varying sporting bodies.

New Zealand is renowned for its ability to raise world-class athletic talent relative to its population, and one such factor that has the potential to explain or even advance this occurrence is nutrition. Before delving into the local market of sports foods, this systematic review was conducted to guide the research within New Zealand. By assessing the availability and consumption of sports foods around the globe, from countries with a wide range of socio-economic development, the trends within New Zealand may become better understood and validated.

2.2 Aim

This systematic review aimed to explore the availability, consumption (intake and purchases), and marketing of sports foods and drinks as sold online and in physical stores globally.

2.2.1 Objectives

1. To explore the availability of sports foods and drink products globally
2. To examine recent trends in the availability and consumption of sports foods and drinks (past 14 years)
3. To review contemporary marketing techniques used to sell sports foods and drinks
4. To assess the consumption of sports foods and drinks amongst athletes and the general population

2.3 Methods

2.3.1 Data sources and search strategy

Studies were sought from four scientific databases, chosen for their relevancy:

- Medline (Biomedical focussed literature)
- SportDISCUS (Literature surrounding sport and sports medicine)
- Google Scholar (Generic literature database)
- FSTA (Food Science and Technology Abstracts)

The primary search strategy (below) was developed for SportDISCUS and subsequently modified for the remaining three databases (removal of Food* for Medline and FSTA). The following terms were entered into these databases

1. Sport*
2. Sport* adj3 food
3. Sport* adj3 drink
4. Sport* adj3 gel
5. Sport* adj3 aid
6. Food, fortified
7. Food, formulated
8. Dietary supplement*
9. Functional food*
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11. Food packaging
12. Food Industry
13. Commerce
14. Supermarket*
15. Retail*
16. Market*
17. 11 or 12 or 13 or 14 or 15 or 16
18. 10 and 17

To uncover grey literature, a systematic and targeted web search was conducted to identify potentially eligible unpublished studies that met the inclusion/exclusion criteria. A broad internet Google search was performed using these phrases:

- “sports food” AND “availability”
- “sports food” AND “supermarkets”
- “sports food” AND “trend”

The top 100 results of each Google search were screened for their content, and potentially eligible studies published in English and able to be downloaded as the full text was included for screening.

2.3.2 Inclusion criteria

For this systematic literature search, there were no limitations based on study design or country of origin. Studies were included if they included at least one of the following:

- The availability or intake of sports foods and drinks at one time point or several points over time
- The marketing techniques used for sports foods and drinks
- Published between 1 January 2005 to 13 March 2019 as to explain recent trends relevant to the current sports food market
- Set in an online or physical retail outlet that stocks sports foods including but not limited to; supermarkets, supplement stores (both website and store-based), and sporting goods stores.

2.3.3 Exclusion criteria

Studies were excluded if they:

- Were not published in the English language or did not have a legible English translation
- Focussed on sports foods that contained the following ergogenic aids: caffeine, creatine, beta-alanine, nitrates, sodium bicarbonate as these do not fall under the HPSNZ definition of sports foods. These ingredients are supplementary to sports foods and focus on ergogenic benefits rather than nutritive benefits and are therefore excluded from the definition.
- Did not have a full text available

2.3.4 Key definitions

Sports foods and drinks were as defined by HPSNZ as: "Sports Foods are goods produced, imported, and offered for sale under the Food Act 2014, and any applicable standards, including but not limited to the Australia New Zealand Food Standards Code and the New Zealand Food (Supplemented Food) Standard 2016 and include sports drinks, sports bars, sports gels (not containing anything other than recognised flavouring), cherry juice, blackcurrant powders and tablets, meal replacements and electrolytes. Sports Foods exclude ergogenic aids" (1, 18).

2.3.5 Outcomes of interest

The first objective of this review was to explore the availability of sports food and drink products found around the world. This objective was achieved through the collation of different measures to assess the overall availability of these products including but not limited to market share, dollar sales, product variety, product development, and places of purchase.

The review's secondary objective was to see the trend of the availability of sports foods and its change over the past 14 years. Changes in the types of products available, the inclusion and exclusion of certain ingredients, and market growth were used to examine this.

The third objective of this review was to examine the marketing techniques and trends that companies have used to drive the sales of sports foods and drinks. To assess the range of sports food marketing, the development of new products, multiple marketing campaigns and health food claims were identified and evaluated.

The fourth objective of this review was to assess the usage patterns of sports food and drinks amongst both athletes and the general population. The prevalence of usage, types of products used, and reasons for use and purchase were considered when performing this review.

2.3.6 Data screening, extraction, and synthesis

Studies identified from database and grey literature searches were uploaded into an Endnote library, separated into their respective databases in Endnote and duplicates were removed. The study titles and abstracts of all records were screened to exclude ineligible studies and those that were not available in English. The abstract and full-text screening was then performed to identify the final list of studies that met the inclusion criteria for the final literature review. Full-text versions of all included studies were saved as .pdf files and uploaded as attachments within the ultimate Endnote X8 database. The data extraction process and form were adapted from an EPOC Cochrane systematic review resource (19). The final extraction form template is found in Appendix 1, and the resulting data extraction is displayed in Table 1. The following data were extracted for each study; Outcomes, results, and applicability.

2.4 Results

2.4.1 Description of included studies and extraction table

Of a total of 7397 papers found through the above search strategy, 74 were removed as duplicates, 7191 were excluded after title screening, 67 were removed after screening the abstracts, 44 were removed for not having the full-text available for viewing, and thus 21 met the criteria for inclusion (Figure 1). Of these twenty-one papers, five were of a cross-sectional design, two consumer research reports, and the remaining fourteen papers were insights such as market valuation, and sales data, into market research. Global representation was included in this review with nine studies originating from the USA, four from the wider Australasia and Asia-Pacific region, two from the UK, one each from China, Germany and Uganda, and the rest (n=4) were otherwise unspecified.

Two of the final 21 papers were identified through grey literature searching and the remaining nineteen through the four electronic databases mentioned in the search strategy.

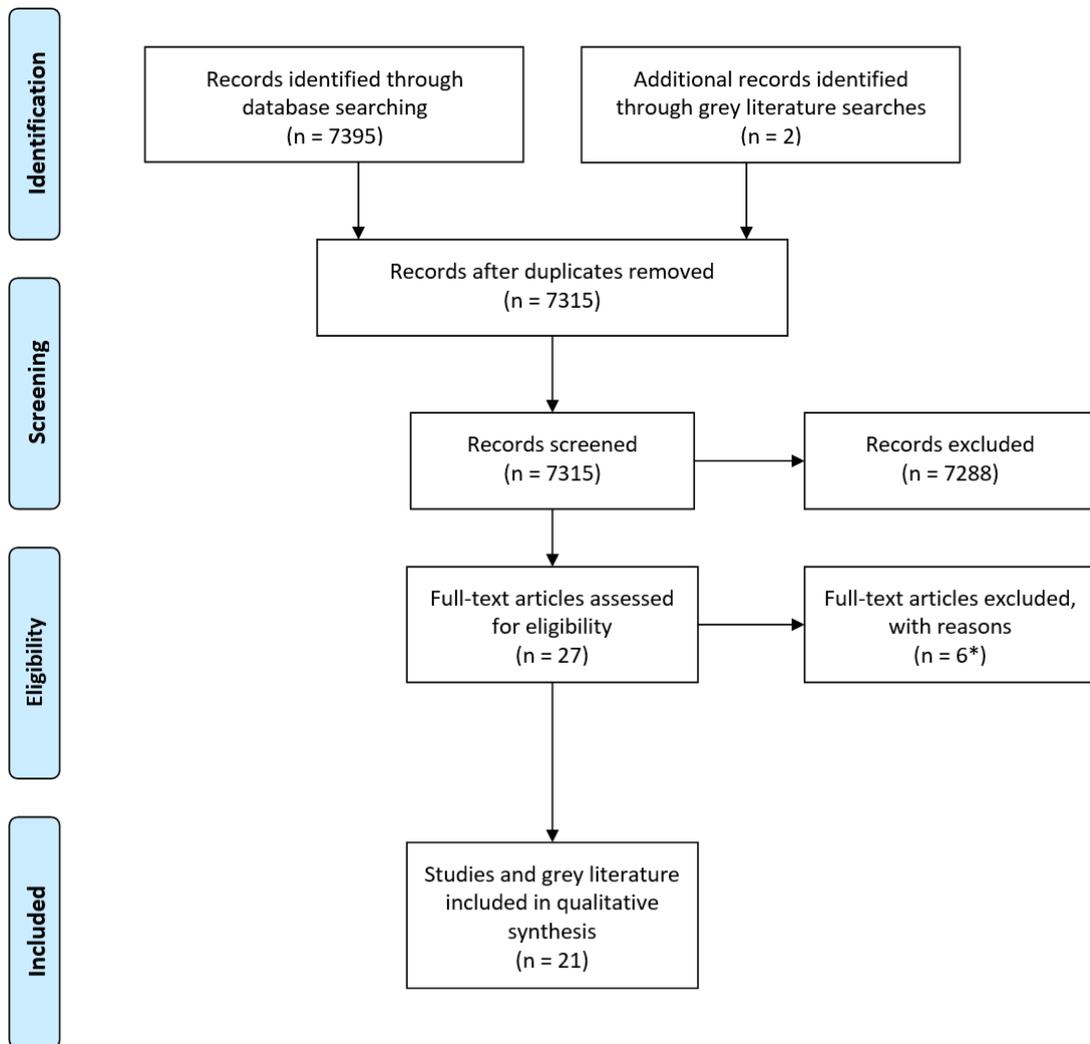


Figure 1. Inclusion process of the final 21 studies for this review in PRISMA format.

Adapted from: Moher, D., Liberati, A., Tetzlaff, J., Altman, DG., The PRISMA Group. (2009) (20).

*1 excluded for focussing on energy drinks and therefore, caffeine.

One excluded for focussing on and selling three specific protein bars.

One excluded for merely looking at dietary supplements, not sports foods.

One excluded for insufficient information on inclusion criteria

Two excluded for reporting on sports nutrition guidelines, not availability.

Table 1. Summary of the extraction of the final 21 studies.

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Braun, 2009, Germany (21)	Cross-sectional survey	German elite athlete training camp	228 elite young (<25 years of age) German athletes.	To assess the prevalence of Dietary Supplements (DS)	1. Availability of sports foods	"The supplements were purchased mainly in pharmacies (56%), supermarkets (17%), and health food stores (15%)."	No direct measure of availability
			77 male, 87 female final respondents.	Identify the most frequently used DS by sporting code	4. Use of sports food by athletes and the general population	"Minerals (87%), vitamins (76%), sport beverages (69%), and carbohydrate preparations (64%) were most frequently taken by DS users, whereas the use of protein/amino acid products (30%), ergogenic aids (24%), fatty-acid preparations (6%), and other supplements (27%) was less widespread."	Several sports drinks may have included caffeine.
			They are subdivided by sport; endurance, racquet, ball, combat, other.	Assess motives of use and source of information/purchase		63% of users stated that they did so for health-related reasons ("maintenance of health," 44%; "improvement of immune functions," 34%; "prevention," 27%). Performance-related reasons were cited by only 43% of users ("regeneration," 35%; "improving performance," 27%). 21% of users used it because they were recommended by others.	64 participants (28%) were excluded for unsatisfactory form completion
						Athletes who had cited performance reasons for use consumed more protein and carbohydrate products, those who cited health reasons used vitamins more frequently.	

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Buss, 2006, USA (22)	Market research insights	Market research of the US sports drinks industry	Gatorade as a majority shareholder of the US sports drink market	To outline the market share, growth and product development of Gatorade as part of the US sports drink market	1. Availability of sports foods	Gatorade sports drink sales have increased by 70% from 2001 to 2006, with an estimated total sales of \$3,000,000,000 (USD) in the USA. This also reflects Gatorade holding an estimated 85% share of the sports drink market.	Despite Gatorade holding the clear majority of the sports drink market in the US, this article only focuses on one brand. Thus its marketing and success cannot be transferrable to all sports drinks. Sales data did not include the Walmart chain of supermarkets or individual convenience stores which would have misrepresented the real value of Gatorade's annual sales.
				To outline the market share, growth and product development of Gatorade as part of the US sports drink market	3. Marketing techniques used to sell sports food/drink	<p>Sub-branding of Gatorade has led to an increase in sales and have involved the development and marketing of new flavours, sweetness profiles and energy profiles of their drinks.</p> <p>“What PepsiCo has done is maintained Gatorade's marketing focus on actual and self-perceived athletes, even though a huge and untold part of its actual consumer base may be athletic wannabes or just people who like the drink.”</p> <p>Furthermore, the recruitment of top athletic talent in the form of household names such as Dwyane Wade has also been utilised to push product;</p> <p>“In July, for example, Gatorade made a major new push into China by putting the picture of Dwayne Wade, a star guard with the NBA champion Miami Heat, on 20 million bottles in China. Wade, who with other American players faced-off against the Chinese national team in Guangzhou over the summer, also appeared in TV commercials for Gatorade. In what Gatorade insisted wasn't an intentional concession to the nationalism of Chinese consumers, Wade's right arm blocks the words “USA” printed on his red jersey in the labels on the new bottles.”</p>	

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Chepulis, 2018, NZ/Australia/Canada/UK (23)	Cross-sectional analysis	Major supermarket chains across New Zealand, Australia, Canada and the UK	Sugar-sweetened beverages that were available across all four countries for comparison	To compare the nutritional content, serving size and taxation potential of supermarket beverages from four different Western countries	1. Availability of sports foods/drinks	Between the four countries, a total of 4157 products were scanned that met the inclusion criteria and 371 of these were classified as sports/energy drinks. Of the four countries, Australia had the broadest range of sports/energy drinks with 122 scanned but this only made up 7% of all products. In contrast, New Zealand, Canada and the UK had sports/energy drinks make up approximately 10% each of their sugar-sweetened beverage line-up.	Several drinks contained caffeine, i.e. energy drinks Did not include zero-sugar drinks which may be classified as a sports food
Clarke, 2016, UK (24)	Market research insights	Market research into the global and local (UK) sports supplement industry	Sports supplements that were produced and sold from 2012 to 2016	To outline the growth and current market for sports supplements in the UK	2. The trend of availability of sports foods/drinks in the past 14 years	<p>“In the UK in 2014 the sports supplement industry had a recorded value of £301 million and is forecast to grow to £471 million by 2018.”</p> <p>“However, when most people initially hear the word ‘supplements’ their initial impression is of protein supplements. They are still very popular in the supplement market and are continuing to grow with estimations of £8 billion worth globally by 2017.”</p>	Ergogenic aids were included in this study. The article author was heavily invested in the supplement industry.
					4. Use of sports food by athletes and the general population	“Supplements are no longer simply used by professional athletes – in fact, in 2012, athletes only made up 5% of sales for supplement products.”	

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Feder, 2018, USA (25)	Market research insights	Market research into protein products; both supplement s and foods	Protein products that were produced and sold from 2013 to 2017	To outline the trend and current state of protein products being sold in the US	1. Availability of sports foods/drinks	<p>Pea protein has continued to make a name for itself, mostly due to technological advances that have enhanced its texture profile in products; “According to a recent report by Allied Market Research, the global pea protein market is expected to shoot up from \$32 million in 2017 to more than \$175 million by 2025.”</p> <p>“The report further noted that “in 2017, the pea protein isolate segment accounted for more than half the share of the global pea protein market in terms of value.”</p>	This study does not discern the use of pea protein as a protein supplement (sports food) or in the form of meat substitutes.
FSANZ, 2013, Australia/NZ (9)	Research report	Cross-sectional analysis	777 respondents from a pool of 10,003 possible participants	To collect data to be able to inform a review on the Formulated Supplementary Sports Food (FSSF) Standard	1. Availability of sports foods/drinks	<p>The places that respondents most frequently last purchased a supplementary food was a general retailer, e.g. supermarket, gas station, dairy, followed by health food shops, pharmacy/chemists, gym/sports shop, internet and once again followed by sponsors, coaches, teammates and health professionals, e.g. doctor/dietitian.</p>	<p>Electrolyte drinks, which make up a large part of the available sports foods in today’s market, were excluded for analysis in this report.</p> <p>As the report was conducted from the results of a telephone survey, the answers are highly subject to multiple respondent biases, including social desirability bias.</p>
					4. Use of sports food by athletes and the general population	<p>Prevalence of supplementary foods use was 10.2% (9.8-10.7) in Australia for those 15 years old and over, and 9.3% (8.4-10.3) in New Zealand.</p> <p>Prevalence for consumer-identified sports foods was 11.6% (11.2-12.1) in Australia for those 15 years old and over, and 10.9% (9.9-12.0) in New Zealand, implying those who use supplementary foods make up most of the population that consume consumer-identified sports foods.</p> <p>“Of the types of supplementary foods used, approximately 79% of respondents used protein-based supplements, followed by 15% for energy type products, miscellaneous, pre-workout, rehydration and finally meal replacement products.”</p>	

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Garrison, 2017, USA (26)	Market research insights	Market research into sports and performance drinks in the USA	Nutritional and performance drinks that were sold and consumed between 2010 to 2015	To assess the current state of nutritional and performance drink within the USA drinks market and its growth over the 2010-2015 period	<p>2. The trend of availability of sports foods/drinks in the past 14 years</p> <p>4. Use of sports food by athletes and the general population</p>	<p>“From 2010-2015, performance drinks experienced 86% sales growth, while nutritional drinks saw a 67% growth. The overall market grew 38%, reaching \$13 billion in 2015. While sports drink sales grew 22% from 2010-2015, weight loss drinks experienced stunted growth (5%) caused by shifts in consumer dieting habits.”</p> <p>“Mintel research suggests that 39% of consumers use nutritional and performance drinks as a replacement for breakfast. What’s more, three in five consumers currently use nutritional and performance drinks as a meal replacement, and 48% consume them as part of a meal, up from just 20% who used nutritional drinks as a meal supplement in 2012.”</p> <p>“In addition to seven in 10 (69%) consumers agreeing that nutritional and performance drinks are a more effective source of nutrients, the majority of consumers agree that they are more convenient (79%) than whole foods (e.g. fruits, nuts, grains).”</p> <p>“Overall, when purchasing nutritional and performance drinks, the most important factors for US consumers are favorite flavor (41%), amount of protein (40%) and high fiber (33%).”</p> <p>“With consumers viewing their efficacy favorably, it’s no wonder that 40% are consuming nutritional and performance drinks before, during or after exercising. These drinks are also carving out their share of the snacking category as 80% of consumers apart from other drink categories at a time when consumers are looking for products that contribute to a healthy lifestyle,” says Beth Bloom, senior food and drink analyst at Mintel.”</p>	<p>The reporting of performance drinks also includes energy drinks; which are products that contain caffeine.</p> <p>Some other drinks categorised as nutritional/performance drinks, e.g. weight loss drinks, may also contain extracts and other ergogenic aids that may not be explicitly outlined in the exclusion criteria but still affects performance.</p>

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Gosse, 2010, Australia/NZ (8)	Research report	Ten focus group interviews in Adelaide, Sydney, Brisbane, Wellington, and Auckland	Total of 80 participants across ten focus groups with variable sports product consumption, socioeconomic status, gender, age, and geographical location	To inform regulation on FSSFs by consumers': "1. knowledge and awareness of sports foods and drinks 2. perceptions and attitudes towards sports foods and drinks 3. purchase behaviours of sports foods and drinks 4. consumption behaviours relating to sports foods and drinks."	1. Availability of sports foods/drinks	<p>"Across both countries, this was thought to be due to the emerging presence of sports foods. Outlets where respondents had seen sports foods (e.g. protein powders, shakes and bars in particular) sold included: • Supermarkets, • Gyms, • Workout stores, (e.g. GNC, Planet Max, Workout World), • Health food stores, • Pharmacies, and • Internet online stores (Australian, New Zealand, US sites)."</p> <p>For active respondents in NZ, supermarkets were the most common source of purchase of sports foods as they often had the most significant discounts. New Zealand supermarkets also had a wider variety of brands, products and flavours than Australia (although Australians also reported a higher purchase rate at supermarkets). Australians, however, seemed to also buy sports foods more from gyms, specialty sports stores and pharmacies.</p> <p>More sedentary respondents reported purchasing online from local websites as well as from the United States.</p> <p>"In Australia, sports drinks are very prominent in many venues and outlets. Respondents reported seeing sports drinks sold at supermarkets (both aisle and point of sale), corner stores, sporting events, sports clubhouses, petrol stations, railway stations vending machines, food courts, sandwich shops and so on. There was a feeling that these products are now ubiquitous in the marketplace and stand out next to other products due to the brightly coloured liquids and packaging."</p> <p>Active respondents reported purchasing drinks from sporting venues, supermarkets and corner stores. More sedentary respondents reported purchasing these products at supermarkets, tuck shops and food courts.</p>	<p>Focus groups lack generalisability to a broader population.</p> <p>Lack of distinction between "formulated supplementary sports food" and "formulated supplementary food" by respondents</p> <p>However, the majority of products in this category are meal replacements which were easily identified by participants and excluded when being asked about sports food consumption.</p>

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Gosse, 2010, Australia/NZ (continued)	Research report	Ten focus group interviews in Adelaide, Sydney, Brisbane, Wellington, and Auckland	Total of 80 participants across ten focus groups with variable sports product consumption, socioeconomic status, gender, age, and geographical location	To inform regulation on FSSFs by collecting consumers': "1. knowledge and awareness of sports foods and drinks 2. perceptions and attitudes towards sports foods and drinks 3. purchase behaviours of sports foods and drinks 4. consumption behaviours relating to sports foods and drinks."	3. Marketing techniques used to sell sports food/drink 4. Use of sports food by athletes and the general population	<p>Marketing for sports foods seemed to be more specific when compared with sports drinks. Similarly, sports foods and drinks were advertised using sponsorship at sporting events, but foods had less television advertising than sports drinks. Australians recalled sports foods advertised on magazines, T-shirts, TV, and the internet</p> <p>Marketing of sports drinks heavily utilises athletic endorsements to appeal to more athletic audiences. "Respondents agreed that athletic endorsement could be seen to create credibility and a belief around the efficacy of the drink."</p> <p>In decreasing order, active respondents consumed sports foods for the following reasons; performance enhancement (especially gels, electrolyte drinks) – found more so in athletes who were involved in stamina/endurance-based activities, e.g. triathlons, recovery from exercise – found more so in athletes who were engaged in intense workouts e.g. sprints, for weight loss/weight maintenance and for weight/muscle gain (both the latter reasons were more common in gym-goers and involved protein foods such as whey powder or protein bars). Sedentary respondents cited only the latter two reasons.</p> <p>Active respondents consumed sports drinks primarily for hydration, stamina and cramp relief during/after physical activity and agree that they should largely be consumed within an exercise related context. For more sedentary respondents, they perceived sports drinks as a way to rehydrate and delivery energy but not necessarily within a sports context e.g. "on the run", on a hot day or when having a hangover.</p>	

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Gottschalk, 2006, USA (27)	Market research insights	Market research into the availability and growth of nutrition bars and whey added beverages in the USA	Nutrition bars sold and consumed in the USA from 1999-2004 and projections of whey supplemented beverages projected from 2005-2009	To assess the current usage of whey supplemented foods and drinks within the USA	1. Availability of sports foods/drinks	<p>“The market for nutrition/energy bars is red-hot, with sales growth of 169% from 1999 to 2004. according to Mintel.”</p> <p>“Manufacturers across all product segments are using whey proteins as they create products to meet consumer demand for healthy foods and beverages. Last year. 1.763 products in the U.S. and 6.435 worldwide were introduced with whey ingredients, according to Mintel International's Global New Products Database (GNPD).”</p>	<p>The author is the director of manufacturing and ingredient marketing at Dairy Management Inc; an affiliate with the dairy industry</p> <p>Reports in this study are only limited to whey-based beverages and bars</p>
					3. Marketing techniques used to sell sports food/drink	<p>“BMC (Beverage Marketing Corporation) projects a 10% increase through 2009 in this non-traditional area for dairy. "Dairy ingredients' best play is in the emerging high-growth functional/wellness overlap," said Kadison. In the ready-to-drink sports nutrition area alone, where a label claim about muscle building and maintenance could help drive sales, the projected growth is 16%.”</p>	
Graham-Paulson, 2015, UK (28)	Cross-sectional survey	Training camps for 28 different sports across Great Britain, Canada, America, Switzerland and Germany	399 physically impaired athletes who competed across 28 different sports	Finding supplement usage amongst impaired athletes, reasons for use, source of information and usage trends across sport/level/age/sex	1. Availability of sports foods/drinks	<p>“The three most common outlets where athletes obtained NS were the supermarket (23%, n = 71), internet (22%, n = 67) and health food/sports shop (21%, n = 65); others included pharmacy, sports nutritionist/dietitian and team sponsor.”</p>	<p>Physically impaired athletes have different nutritional needs to non-physically impaired athletes</p> <p>The study design was subject to multiple biases due to its survey and relied heavily on the honesty and accuracy of the athletes answering.</p>
					4. Use of sports food by athletes and the general population	<p>“Sports drinks Isotonic and hypotonic drinks/powders 20%, Carbohydrate Energy drinks, carbohydrate gels and energy bars 13% (48/339), Protein bars, powders and ready-to-drink shakes 26%, Recovery Products containing carbohydrate and protein to aid recovery 6% (25/339), Combination Products containing carbohydrate and/or protein, and other ingredients, e.g., vitamins 3% (13/339)”</p> <p>Most cited reasons for using nutritional supplements were for exercise recovery, energy and an increase in strength/power. Athletes who were more endurance-based had a higher consumption of sports drinks, carbohydrate supplements, protein and NS in general than those who were focussed on speed/power.</p>	

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Gude, 2018, N/A (29)	Market research insights	Market research into the global market of sports drinks	Sports beverages that were sold and consumed in 2017 several years prior	To outline the current demand for sports beverages, its areas for expansion and projections on its growth trajectory	1. Availability of sports foods/drinks	<p>“The sports & energy drinks market accounted for around USD 65 billion in 2017, and it is projected to grow at CAGR (Compound Annual Growth Rate) of 8.5% till 2022.”</p> <p>“The market is anticipated to continue to penetrate the untapped markets such as India, China, Brazil, Argentina, Chile, and South-East Asian Countries.”</p>	<p>Caffeine-containing energy drinks were part of the market share outlined in this report</p> <p>This report generalises the global sports beverage market but does not account for regional differences in marketing or sales; perceived Western bias</p>
					3. Marketing techniques used to sell sports food/drink	New areas for growth in this domain include vitamin fortification, natural flavours and colours, low-calorie options and higher protein beverages. Plant protein-based drinks are also seeing a rise. RTD beverages are still the dominant form of sports drinks due to their convenience and fit the need of their target demographic.	
Hartman, 2015, USA (30)	Market research insights	Market research into the sports nutrition bars and beverages sold in the USA	Sports nutrition bars and beverages sold in the USA in 2014	To assess the current market for sports nutrition bars and beverages within the USA	1. Availability of sports foods/drinks	This report states that protein as a supplement and additive has appeared in various foods including granola bars, cereals, snacks and other snacks, thus widening the availability of what can be classified as a sports food.	<p>While the current trend of availability, marketing and consumption is outlined in this report, it does not have sufficient year-specific figures to back it up</p>
					3. Marketing techniques used to sell sports food/drink	<p>Food companies are boosting protein content with complete spectrum proteins, egg and whey being the two most popular additions.</p> <p>Several newer nutrition bars are made with savoury flavours and more “whole food” ingredients.</p> <p>“Energy drinks are winning the race over sports drinks and are starting to appear everywhere, from pro wrestling locker rooms to office cubicles and youth soccer matches. This is prompting existing sports drink brand owners to reformulate their drinks to portray a healthier image, reduce sugar content and/or replace artificial ingredients.”</p>	

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Hartman, 2015, USA (continued)	Market research insights	Market research into the sports nutrition bars and beverages sold in the USA	Sports nutrition bars and beverages sold in the USA in 2014	To assess the current market for sports nutrition bars and beverages within the USA	4. Use of sports food by athletes and the general population	<p>“Nutritional bars are perceived as healthier than snack and cereal bars, Mintel says.”</p> <p>“Consumers just aren't drinking as many sports drinks as they once did, and sales have been somewhat deflated by teas and smoothies. The number of consumers who drink eight or more sports drinks a month is lower, offset by more casual sports drink users joining the consumer ranks, according to Packaged Facts' February 2015 report “Functional Foods: Key Trends by Product Categories and Benefits.”</p>	
Muwonge, 2017, Uganda (31)	Cross-sectional survey	Uganda, not otherwise stated	359 Ugandan athletes; 268 male, 91 female. They are further subdivided by occupation, education level, as well as sports code.	“Motivations to use, perceptions of and prevalence of dietary supplement use among professional Ugandan athletes. The results from this study are intended to help generate recommendations regarding dietary supplement use among athletes living in resource-limited and multicultural environments.”	4. Use of sports food by athletes and the general population	<p>13.9% of the athletes surveyed used nutritional supplements, which was further analysed to find variable usage rates depending on the type of sport played. The majority of respondents who had used dietary supplements were basketball and rugby players, followed by volleyball, athletics, and cycling.</p> <p>Of the types of nutritional supplements used, the most common were carbohydrate supplements, energy drinks, vitamins/minerals, fish oils and protein supplements.</p> <p>Of this sample of athletes, the most common source of receiving nutritional supplements were from their nutritionist, followed by a retail store or pharmacy.</p>	<p>Findings are specific to Ugandan athletes who are over 35.</p> <p>There are three times the male participants as there are female. and may not reflect the actual state of nutritional supplement use in Uganda</p> <p>Sub-classifications of sports foods do not exist within this paper, and thus the prevalence of use must be extrapolated with data that includes other nutritional supplements</p>

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Neville, 2009, Asia-Pacific (32)	Market research insights	Market research into sports drinks being developed in the Asia-Pacific region	Sports drinks being sold and consumed in the Asia-Pacific region in 2009	To assess the Asia-Pacific region's sports drink market	1. Availability of sports foods/drinks	"Among the fastest-growing markets for sports nutrition products are Japan and Asia, with product convenience and taste playing a strong role in driving this growth.	The Asia-Pacific region is a developing market regarding sports drinks when compared to traditional Western markets thus may not be truly representative of the current global perspective regarding these beverages
					3. Marketing techniques used to sell sports food/drink	"Asian food and drink processors can now capitalise on the functional benefits of whey protein as an essential ingredient for the sports nutrition market through the increasing range of application formats available to them. These offer a convenience and taste advantage for sports professionals and those wanting to enjoy nutrient-dense 'food on the go' as part of an active lifestyle."	
Shaw, 2016, Australia (33)	Cross-sectional survey	Swimmers were recruited during a training camp for the 2009 FINA World Aquatic Champions -hips	Thirty-nine elite swimmers taken from the Australian National swimming team. 19 male and 20 female swimmers made the gender breakdown.	Investigate the influence of the AIS sports supplement program on the supplement practices of the Australian National swim team	4. Use of sports food by athletes and the general population	The participants in this survey consumed, on average, 3.3 different sports foods. These were sports drinks (92% consumption), sports bars (64%), gym recovery bars (15%), liquid meal replacements (64%), protein powders (46%), electrolyte replacements (23%), and sports gels (33%) In general, participants seemed not to be very worried about the risk of taking Australian sourced supplements but were significantly more averse to taking those sourced overseas. Of these participants, the vast majority of them sourced their supplements from their respective swim programs, followed by a supermarket, sponsorship, from a health store, direct from supplement companies and then from the internet and chemists.	Their high level of performance limits this sample of athletes, and the fact they have had a pre-existing supplement program in place. This is therefore not reflective at all of the general population's supplement habits and may not be fully representative of other athletes

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Unknown, 2012, USA (34)	Market research insights	Market research into the product development of nutritional bars in the USA	Nutritional bars being produced within the USA in 2012	To assess the current and future trends of product development in the nutritional bars market	<p>1. Availability of sports foods/drinks</p> <p>3. Marketing techniques used to sell sports food/drink</p>	<p>“Other trends dominating and boosting the bar market are healthy snacking, sports and performance as well as naturalness and organic provenance, with all categories influencing each other, building cross-over concepts and challenging product developers by blurring the traditional category boundaries.”</p> <p>Consumer motivations are dictating product development, this paper summarises their requirements to be functionality, convenience, indulgence, snacking, and a natural and premium image.</p> <p>A new weight-conscious population has caused an increase in slimming and meal replacement bars development and sales, with markets enjoying “double digit growth rates”. This is driven by the convenience of a bar, and the fact that consumers constantly want bars with “less” i.e. calories, sugar, etc.</p> <p>“Other trends dominating and boosting the bar market are healthy snacking, sports and performance as well as naturalness and organic provenance, with all categories influencing each other, building cross-over concepts and challenging product developers by blurring the traditional category boundaries.”</p> <p>Furthermore, the main new ingredient inclusions within the development of new nutritional bars can be grouped into two major categories; slimming ingredients (satiety agents, fibres, etc.) and sports ingredients (proteins, carbohydrates to increase performance).</p>	<p>This report, unfortunately, does not report its findings with any quantifiable data and as such its role in assessing the availability of sports food is limited</p> <p>Marketing techniques used in this paper is limited to only the development of new products, rather than explicit marketing techniques used to increase sales</p>

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Unknown, 2015, USA (35)	Market research insights	Market research into the prevalence of sports food and drink consumption within the USA in 2015	Nutrition bars and sports beverages being sold and consumed in the USA in 2015	To find the current consumption and market for nutrition bars and sports drinks in the USA	2. The trend of availability of sports foods/drinks in the past 14 years	“Meanwhile, dollar sales in the nutrition bar segment grew an impressive 8% in 2014 to reach \$2 billion.”	This article does not state whether or not products containing the ergogenic aids outlined in the exclusion criteria are included in its reports of sports drinks/foods The marketing and product development trends are not backed up by figures in this report
					3. Marketing techniques used to sell sports food/drink	Newer products being developed have leaned toward a more natural formulation (fewer artificial ingredients, pesticides used, etc.), that also includes less sugar (and otherwise sweetened with agave, stevia, zero-calorie sweeteners). Consumer demands also increase the production of nutrition bars and sports foods that have a savoury flavour compared to sweet. Label references that include vegan, fair-trade and sustainable are also increasing in the realm of sports drinks. Packaged Facts expects the focus on sugar to also continue moving forward.	
					4. Use of sports food by athletes and the general population	“Without a doubt, this is why some of most popular functional foods are sports drinks and nutrition bars. According to market research publisher Packaged Facts, 36% of all U.S. adults consume sports drinks.”	
Volmer, 2018, N/A (36)	Market research insights	Market research into the claims and product development of sports foods globally	Sports foods being produced globally in 2018	To address the current trends of production and marketing in the sports food market	3. Marketing techniques used to sell sports food/drink	An increase of 29% in food and drink launches carrying a sports claim during the last 2 years. Also, four traditionally mass-market categories have shown particularly large increases in either protein claims or sports and recovery claims, including ready meals (+25%), dairy (+24%), cereals (+16%) and snacks (+10%). This report also summarises that consumers are driven for “sportified” foods, which has a “functional benefit” i.e. high protein or contains probiotics.	The definition of “sportified” foods in this report may not exactly fall in line with the sports food definition set out in the introduction of this review

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Wei, 2006, China (37)	Market research insights	Market research into functional drinks in China	The volume of Mizone sold in China in 2003	To outline and explain the success Mizone has had on the sports drink market in China	1. Availability of sports foods/drinks	“In 2003, Danone announced that sales of Mizone in China were already, within a year of launch, twice its sales in Australia. In 2004, 270 million litres of Mizone were sold in China, giving retail sales of approximately RMB700 million (\$88 million/€69 million).” – however, most consumers at this stage still preferred water and juice over Mizone when it came to general drinks	This case study was completed over 16 years ago and within a developing market Marketing techniques used in China may not have the same effect on Western audiences as the internet infrastructure and demographic is highly restricted in China when compared to most Western countries
					3. Marketing techniques used to sell sports food/drink	TV advertising was heavily utilised in Mizone’s Chinese campaign, with the recruitment of martial arts and movie superstar Jet Li as a brand ambassador. The utilisation of technology also heavily influenced Mizone’s marketing, with partnerships with multiple online gaming providers being established and quickly being rewarded. Mizone has partnered with SMS providers and online game creators to create an interactive campaign where the purchase of Mizone rewarded customers with specific codes to elevate their in-game status. One individual reported buying 800 bottles of Mizone to this end.	
Williams, 2018, USA (38)	Market research insights	Retails outlets in the USA including supermarkets, health outlet stores, health clubs, gyms, etc.	Sport nutrition products being developed and sold in the USA in 2018	To assess the trends in sales and development of sport nutrition products	2. The trend of availability of sports foods/drinks in the past 14 years	“There are six main subcategories within sports nutrition. Innova Market Insights finds that— despite rising levels of interest in ready-to-use products for more convenient, on-the-go solutions—traditional sports powders continue to dominate new product development, accounting for 50% of the global total of new sports-related items tracked in 2017. This is ahead of bars (15%), “other sports products” (12%), supplements (11%), RTD sports drinks (7%) and protein drinks (5%)”	Products reported in the sports nutrition category may also include products that contain ergogenic aids

Author(s), Year, Country	Design	Setting	Participants/ Products	Primary study objectives	Review objectives met	Main findings	Limitations
Williams, 2016, USA (39)	Market research insights	Retail outlets in the USA including supermarkets, health outlet stores, health clubs, gyms, etc.	Sport nutrition products being developed and sold in the USA in 2016	To assess the trends in sales and development of sport nutrition products	3. Marketing techniques used to sell sports food/drink	<p>“Innova Market Insights found that during 2017, more than 42% of US new sports product introductions referred to either added protein, high protein content and/or source of protein.”</p> <p>“While 7% of all food and drinks launches recorded by Innova Market Insights in 2017 used a vegan positioning, this rose to 11% in sports nutrition.”</p>	<p>Very large range of figures being used to estimate the global sports nutrition market value</p> <p>Products reported in the sports nutrition category may also include products that contain ergogenic aids</p>
					2. The trend of availability of sports foods/drinks in the past 14 years	<p>“Sports bars accounted for 12% of US sports nutrition launches recorded by Innova Market Insights in 2015, up from just over 7% in 2010.”</p>	
					3. Marketing techniques used to sell sports food/drink	<p>“Key health claims used for launches, as in drinks, reflected the rising interest in protein, with more than 90% of introductions featuring added-protein, high-in-protein or source-of-protein claims, up from just under 80% in 2014.”</p> <p>“In addition to protein content, other health claims featuring strongly in sports bar launches are similar to those for mainstream cereal and energy bars. Claims such as natural/no additives/preservatives were used on 39% of sports bar introductions in 2015; while and no added sugar/low sugar and/or sugar-free claims were used on 28% of new products.”</p> <p>“Meanwhile, coconut water is increasingly marketed as the natural isotonic of choice and a new option to traditional sports drinks.”</p> <p>Coconut featured in 14% of RTD sports drinks launches in 2015 with most launches being coconut water.</p>	

*This extraction review table was created to summarise the main findings of each study that were relevant to the review aims.

2.4.2 Objective 1: To explore the availability of sports food and drink products found globally

Fourteen studies were identified that address objective 1; to explore the availability of sports food and drink products found around the world (Table 1). Of these 14 studies, six reported market share and dollar value of the sports nutrition market, four reported the prevalence of sports nutrition products available across outlets, one included the availability of sports drinks as a proportion of sugar-sweetened beverages, and the remaining three reported on the rise of sports foods within other food subcategories.

The six studies that included information on market share and \$ value of the sports nutrition market, while differing in the valuation of the sports food market, all reported increasing availability of products (22, 25, 27, 29, 37, 39). Two of the studies cited that the most significant contributor to the global sports food and drink market was the United States (US), with market research analysts claiming the US is responsible for anywhere between half to two-thirds of total global sales (38, 39). These studies also claimed that the global sports nutrition market is worth between five to twenty billion \$USD in sales per year. However, reports within Gude (2018) appraise the value of the sports nutrition market to be higher, claiming that sports and energy drink sales alone accounted for approximately sixty-five billion \$USD in sales globally, with estimates of growth projecting at an 8.5% compound annual growth rate (29). Internationally, the sports food and drink market are not yet as developed as in the US (32).

The growth of the sports nutrition market in the States has led to the increasing demand of products elsewhere. International markets such as Latin America, Southeast Asia, Japan and China are only several beneficiaries of the availability increase that has occurred in the US (29, 32). This has led not only to the rise in exports of sports nutrition products from the States, but also the development and increasing availability of homegrown products in these countries. For example, Mizone's (Fruco-Danone sports drink) incorporation into the Chinese functional water market, grossed over eighty-eight million \$USD in its first year, causing local competitors to push their products more aggressively (37). Difficulty in assessing each country's contribution has made it challenging to ascertain the real global dynamic of the sports nutrition market. Still, this evidence suggests it is increasing, and more globally widespread.

A rise in sports food availability has been signified by their appearance in a more significant number of outlets, both physical and online. Four studies addressed the first review objective and reported the availability of sports nutrition products amongst different outlets. Two studies from Australia and New Zealand said there was an ever-growing presence of sports foods in all types of outlets including gyms, health food stores, pharmacies, supermarkets, and several internet sites both local and internationally (8, 9). The same trend appears to occur for sports drinks, but on top of the same stockists as sports foods, sports drinks were also reported to be found on sale at corner stores, dairies, gas-stations and at various sporting events (9). Due to the widespread availability of these products, sales in Australia and New Zealand have indicated the most frequent points of purchase are no longer specialty health stores and now include general outlets such as supermarkets and gas stations (9).

A single study from this review reported the increased inclusion of several 'performance-enhancing type' ingredients into everyday foods, including protein powders, fast-acting carbohydrates and other dietary supplements which have signified a shift in the dynamic of the weekly supermarket shop (30). As a result, several new types of sports foods being included as 'everyday' foods such as cereals, milks, and snack bars, and are becoming increasingly organic, less processed, and convenient.

Pea protein is an example of this, with Allied Market Research reporting that the global pea protein market being worth thirty-two million \$USD in 2017 and expected to shoot up even greater to \$175 million by 2025 (25).

Table 1 highlighted only one study that assessed the availability of sports drinks as a proportion of products available for sale at supermarkets. This cross-sectional analysis of sugar-sweetened beverages for sale in major supermarkets (totalling ~90% grocery market share) across Australia, Canada, the UK and New Zealand found that sports drinks made up approximately 7% of all available food and drink products within Australia and over 10% for each of the three remaining countries' (23).

2.4.3 Objective 2: To examine the trends in the availability of sports foods and drinks over the past 14 years

Five of the 21 studies found in Table 1 included reports that showed availability trends of sports foods and drinks. Of these, only one contained figures to show an absolute change in availability through the increase in market value, although this was solely attributable to the United Kingdom. Consumer demand for all things sports have led to a significant increase in the sports nutrition market, with the UK sports supplement market alone being valued at £301 million in 2014 and forecasted to grow to £471 million by 2018 (24).

The remaining four studies examined trends in the availability of sports foods through reports on the shifts of sports foods and drinks subcategories and how over time, these have changed according to consumer demands (26, 35, 38, 39). Innova Market Insights claim there are six main subcategories within the sports nutrition market in terms of sales. These include sports powders, sports nutrition bars, "other sports products", supplements, Ready To Drink (RTD) sports drinks and protein drinks which make up 50+%, 15%, 12%, 11%, 7% and 5% of the sports nutrition market, respectively (38). This report inferred that while sports powders dominate the market due to their cost effectiveness, there is an ever-increasing demand for readier to consume forms of sports food and drink products. This trend is concordant with the increased presence and availability of sports food and drink in general retail stores, with the option of having a ready to consume sports nutrition product being available everywhere a consumer may need it, as described in Gosse (2010) (8). More specifically, within this shift in the availability of sports foods, reports suggest a growth in the market share of sports nutrition bars. Multiple sources cite the development from the early 2010s to be approximately 8%, reaching two-billion \$USD in 2014, and accounting for about 12% of the US sports nutrition market (35, 39). In the same vein, nutritional and performance drinks in the United States grew 38% in 2015 (valued at thirteen billion \$USD), with sports drinks specifically having developed 22% from the year 2010 (26).

2.4.4 Objective 3: To examine the marketing techniques used to sell sports foods and drinks

Twelve studies were directly applicable to the marketing techniques used to sell sports foods and drinks. Seven of these studies alluded to the consistent claims made by sports foods and drinks to be able to enhance performance and improve body composition (27, 29, 30, 32, 36, 38, 39). The inclusion and application of novel ingredients such as protein powders have not only been used but boasted by the companies that produce sports nutrition products. Innova Market Insights have noticed a 29% increase in sports claims between 2016 and 2018, with four product categories (ready meals, dairy, cereals and snacks) having shown significantly increased claims for protein content, sports performance or recovery (36). Manufacturers appear to include these to meet consumer demand. Product development and their subsequent marketing aim to target consumers at the level of functionality of its product, convenience, snacking-ability, and a natural image (34).

Of these 12 studies, three explore the relationship between sports food marketing and current health trends, dictated by a consumer base that is increasingly more wary of additives, and non-naturally sourced food products (27, 34, 35). Newer products have seen the inclusion of more natural ingredients while simultaneously removing components that have lost favour with the consumer base, and therefore are no longer a marketing incentive (35). The addition of natural sweeteners, less processed ingredients and the rapid emergence of consumers demanding “organic” items have seen the number of marketing claims skyrocket in the industry. One rapidly increasing health trend seems to be the shift toward veganism, with its proponents seemingly enjoying a multitude of health benefits. This has gone on to heavily influence product development in the US sports food and drink industry especially, with 11% of new product launches having a vegan positioning in 2017, compared to 7% in the food and drink industry as a whole (38). The development of sports food and drinks that also fall in line with current health trends do exceptionally well. Marketing of products containing niche ingredients such as probiotics and coconut have risen substantially, with 14% of sports drink RTDs containing coconut flavours or coconut-derived ingredients such as coconut water (39). Consumers perceive coconut water to be superior to regular water in affecting hydration due to its naturally occurring electrolyte content and has created an opportunity for manufacturers to push their sales.

Another three of the 12 studies analysing marketing techniques on sports foods and drinks found the use of external, multi-media marketing was highly prevalent in the sports nutrition market (8, 22, 37). The use of sponsorship is well utilised within the industry, with sports foods and drinks being included in various forms of advertising. This ranges from sampling at sporting events, to the extensive use of multimedia advertising (8). The recruitment of widely recognised athletic talent is one such marketing tactic to associate sports nutrition products with sports foods. Respondents in a 2010 New Zealand based survey report that “athletic endorsement can be seen to create credibility and a belief around the efficacy of a drink” (8). The recruitment of Dwyane Wade, an international basketball superstar in July of 2005 as a brand ambassador for Gatorade, arguably the most recognised sports drink around the globe has seen its marketing being successful in the US, but also saw the penetration of a foreign market superpower, in China (22).

Similarly, the recruitment of non-sports-related talent has also been used in China, where movie actor Jet Li was brought along as a brand ambassador for Mizone water, promoting its non-sport usage. One study, in particular, found that catering to a local consumer base was a powerful marketing tool, with Mizone’s Chinese campaign also utilising the strong presence of “eSports (electronic sports)” in its country (37). Marketed toward those who play computer games competitively and advertising the mental alertness benefits that it provides seeks to bridge the gap between physical sport and electronic sports.

2.4.5 Objective 4: To assess the use of sports foods and drinks amongst athletes and the general population

Ten studies were found to examine and evaluate the use of sports foods and beverages amongst general consumers and athletes. Of those ten studies, six reported the increasing usage of sports foods amongst the general population and how they differ from athletes (8, 9, 24, 26, 28, 30). The general population are now the most frequent users of sports nutrition products, with Clarke (2016) claiming that in 2012 only 5% of supplement product sales in the UK were made by athletes (24) and “Sports drinks, nutrition bars reshape market” (2015) reporting 36% of all US adults consuming sports drinks (35). However, despite sales having significantly increased amongst the general population, this is not to say that the reasons for use are the same amongst all users. The overall prevalence of sports foods and drinks amongst athletes ranged from 14% to 20% (28, 31) and approximately 11% for general consumers.

Reasons for use for different sports foods and drinks varied greatly between individual activity levels, with more active individuals using them mainly as intended, i.e. for performance enhancement and recovery. Conversely, more sedentary individuals cited different reasons for the usage of sports nutrition products that were not necessarily exercise-related. These included general rehydration, energy, “on the run fuel” and to recover from a hangover (8). This links with the notion that there are fewer people consuming sports drinks at a high rate, although this is offset by the number of casual sports drink users (1-2 sports drinks/month) that make up most consumers (30). Additionally, the general population seem to view sports foods and drinks to be generally more nutrient-dense than regular foods, and when coupled with their convenience, could at least partially explain the reason as to why sports foods and drinks have become increasingly demanded (26).

Four studies analysed the usage habits of sports foods specifically amongst athletes specifically (21, 28, 31, 33). These studies, all of cross-sectional design, report that sports food and drink usage amongst athletes not only differed from the general population but also varies depending on the type of activity they performed, i.e. protein supplements are used more with weightlifting than running (28). Athletes report a myriad of reasons for using nutritional supplements and sports nutrition products, including exercise recovery and enhanced performance (28). Non-performance related reasons have also included general health and wellbeing and supplementing nutrients (21). Of those who cite performance reasons, prevalence sports food usage included more products that contained higher protein, carbohydrate and associated recovery products (21, 28). Of the dietary supplements and sports food/drink being consumed by athletes, the most frequently used are sports drinks and carbohydrate supplements (21, 28, 31).

2.5 Discussion

2.5.1 Summary of findings

This review of the 21 studies illustrates that in the past fourteen years, the availability, use and popularity of sports foods and drinks globally have grown exponentially. With advancements in research regarding optimal sports nutrition and a greater understanding of exercise physiology, certain sports nutrition products have become staples in athletes’ nutrition regimen (21, 28, 31, 33).

The fourteen studies that assessed availability, including market share, showed that constant consumer motivation changes and high demand for availability had placed products which were previously only thought to be for the athletic elite in anyone’s reach (27, 29, 30, 34). Studies included in this review suggest the sales of such products are at an all-time high, and the global market of this industry has reached a reported value of up to sixty-five billion \$USD, according to Gude (2018) (29). The appearance of these sports foods and drinks on Western retail shelves is not the only reported trend to show increasing availability, but the growing international market also cements this. The emergence of Asia as a sports nutrition powerhouse reiterates that sports nutrition is more available across the globe than previously (32, 37).

The five studies that reported the trends of sports foods and drinks over time showed that not only is the absolute availability of such products increasing with time, but also the availability of its different subcategories (24, 26, 35, 38, 39). Sales data within Gude (2018) has estimated the increase of the market value of the sports nutrition industry to be at an approximate 8.5% compound annual growth rate, with even higher future projections (29). Furthermore, the sales composition within its products has also shifted with a greater focus on convenience, with increased sales of ready to drink products and nutrition bars (29, 34).

Eleven of the twenty-one studies reviewed provided information around the usage of marketing techniques used to sell sports foods and drinks. One prevalent method used by many companies is the normalisation of performance products to appeal to the general population (36). This is further utilised by employing familiar faces in the form of marketing campaigns surrounding well-known celebrities and athletes to help sell products (8, 22, 37). These studies emphasise that consumer demand may influence product development, product claims, and the marketing techniques used to promote products.

Ten studies provided information regarding the consumption of sports food and drink products amongst both athletes and the general population. The appearance of these products in general outlets such as supermarkets has accompanied their increased usage, with only a small proportion of sales being attributed to athletes. Data on athlete intake within these studies indicate the main reasons for increased usage to be primarily performance and wellness focussed. The consumption of the type of sports foods varies between the different sports, with protein and carbohydrate supplements appearing to be the most widespread across the many sports (28). While the general public cites similar reasons for the use of these products as athletes, the primary drivers of use can be different (8). These may include weight loss and health rather than performance. More sedentary users of these products, however, may not use them for athletic endeavours but rather to provide convenient sources of energy or to replenish hydration after drinking alcohol (8).

2.5.2 Strengths

An essential strength of this literature review was its systematic approach. The specially designed search strategy was tailored to four different databases ensured an objective approach to identifying relevant literature and the search of grey literature added two relevant studies to the review. A wide range of countries was represented in this review. Studies originated from economically developed Western countries such as the US and Australia to more developing countries such as China and Uganda.

2.5.3 Limitations

One fundamental limitation of the studies in this review was the proportion of products being reported in studies that may contain the ergogenic aids as listed in the exclusion criteria. The ergogenic aids were intentionally chosen by the author to isolate the nutritive effect of sports food products themselves rather than exogenous supplementation of ergogenic aids. These products, however, were not able to be excluded in the individual studies included in the review as they were often aggregated with other products that did meet the criteria. The effect of this was, however, minimised by excluding categories of products within included studies, such as energy drinks that primarily rely on supplemented aids such as caffeine.

A further limitation of the review was an exclusion criterion of being published in a non-English language. As mentioned in the main findings, despite the United States and the Western world being the primary contributor to the global sports food market, a rapidly evolving portion of it resides within Asian countries. Thus, this excludes a sizeable amount of literature, considering the proportion of the global sports food market that these countries make. Including studies not published in English may have provided some more insight to the availability of these products around the globe, and how they may be differently marketed and used by different populations, thus improving generalisability of findings.

Availability of sports foods was assessed using several measures, including market share and dollar sales. However, there were limited data to show this. When performing the literature search among the four chosen databases, several papers showed the potential to be included in the final pool of literature. However, due to sensitive market information, access was restricted based on the requirement to pay to access the data/study. Thus, these studies were excluded as the full text was not able to be obtained.

Due to the heterogeneity of the studies sourced, it was challenging to combine the study outcomes quantitatively and to compare study quality. The nature of the studies and the broad spectrum of measures by which the objectives were assessed made it difficult to apply a single generalised tool to compare study quality.

A bias assessment was not conducted within this systematic review due to the broad range of study types within the selected studies. The ability to create a unified criterion to assess bias between all these studies would have been challenging to develop, and not within the logistical scope of this review and overall thesis. However, the main limitations and bias, if any, were listed within Table 1.

2.5.4 Applicability to the New Zealand market

A guiding purpose of this review was to inform further research into the sports food market in New Zealand. With New Zealand being a small country with a high potential to be successful in sport, knowing what is available within the sports food market is crucial to aid local athletes. New Zealand, also being a highly economically developed Western country, is similarly classified as a high-income country by the OECD as many of the countries that were included in this review. Furthermore, due to strong business relations with the US, many products that originate from there will also be imported into New Zealand, thus making it directly relevant to study the dynamics of the US sports food market.

2.5.5 Implications for researchers, athletes, sporting organisations and manufacturers

With the ever-increasing availability of sports foods and drinks becoming more apparent, it is of utmost importance for athletes to be aware of what is available. The use of these supplements can elevate performance and training to give a competitive edge but are not without risk. Contamination amongst sports supplements has been well reported and can affect, or even end an athlete's career without their knowledge (40). Unintentional doping is a genuine risk that athletes must be concerned about when purchasing sports foods, and the increased availability of such products brings about more significant concern when many products are unregulated. Thus, it is of high interest of athletes, sporting organisations and regulatory bodies alike to monitor the growth, regulation and constant invigilation of this field. Similar research to this, as well as cases of unintentional doping, should also spur manufacturers to become more stringent when producing sports foods.

2.5.6 Recommendations for future research

To be well informed should be the goal of any sporting body, government organisation, elite athletes or active-minded individual alike. To further build on this systematic review, further research should be conducted surrounding the population by which these products are being purchased and used. Country specific data surrounding the availability and consumption of such products will also be of great use by the same organisations. It is recommended this work be completed by third party organisations not involved within the food industry.

Ultimately this can influence the decisions by which the industry develops new products, or how regulatory bodies can impose legislations to ensure the safety of athletes and the general population.

2.6 Conclusion

This systematic literature review sought to assess the availability, trends, marketing and consumption patterns of sports food and drink globally. From the twenty-one final studies included, nineteen studies included information regarding sports food availability and how it has evolved over the past fourteen years, eleven papers provided insight into the marketing strategies used within the sports nutrition market and ten studies outlining the usage patterns of these foods amongst athletes and the general population. The original hypothesis that claims sports foods are increasing in availability and range was supported, with the global sports food market going through rapid increases of market value, availability amongst outlets, and the range of sports foods being produced.

Following on from the third objective of this review, it was also interesting to note the type of marketing that the food industry used to promote these products, ranging from using front of package labelling and health claims to multi-million dollar athlete endorsements and multimedia advertising. With the shift of sales of these products moving from athletes to the general population, it is evident by the widespread marketing techniques used by the industry that elite athletes are no longer their primary target demographic anymore. As far as the author of this review is aware, there are currently no comparable pieces to compare to the findings of this review.

The better understanding of how these foods have become more available give sporting organisations, athletes and regulatory bodies some information regarding what is being accessed and used. This may further be used to assist in avoiding unintentional doping cases or to elevate performance by consuming what is readily available. Further independent research should be conducted on the populations consuming these products, to advance sporting performance, and to protect public health.

3 Chapter Three. Sports Food availability in New Zealand supermarkets: Analysis of the Nutritrack database

3.1 Introduction

Sports nutrition and general principles of proper nutrition play an essential role in the health and performance of every elite athlete. Based on key consensus papers (41) athletes are advised to focus on adequate intake of energy to compensate for energy expended during exercise as their primary nutritional concern. The degree to which these guiding principles translate into general health advice for the weekend warrior is less clear. However, this has failed to stop the significant increase in products, once only available in specialty stores, now gracing the everyday supermarket.

Internationally, an expanding range of sports foods and beverages are being made available for sale at supermarkets. The systematic review included in Chapter 2 of this thesis supports this trend (22, 25, 27, 29, 37, 39). Sports foods are being targeted toward both active and general populations. The divide between “sports foods” and regular food items are now becoming increasingly blurred. This systematic review looked at global trends in sports foods availability and outlined several key findings. Research into the global sports foods market has provided infrastructure on how to conduct similar research within the New Zealand context. This was achieved with collaborations from the University of Auckland, the National Institute of Health Innovation (NIHI) and High Performance Sport NZ (HPSNZ).

The focus of this chapter is to identify and characterise “sports foods” within New Zealand supermarkets as they are available for sale, based on accepted definitions of “sports foods”, and include trends over the last six years. Analysis of food package data derived from NIHI and the University of Auckland’s joint “Nutritrack” food composition database was conducted. The descriptive analyses were provided for not only the availability of sports foods but also included the marketing techniques by which these sports foods use to promote themselves to consumers. This research aims to be shared with Drug-Free Sport New Zealand and New Zealand based performance nutritionists to stay informed and shaping education to provide safety advice for the use of sports foods for both athletes and the general public.

3.2 Aim

The overall aim for this chapter is to explore the availability of sports foods within New Zealand supermarkets over the last six years and to assess the marketing techniques being used to promote these products.

3.2.1 Objectives

1. To determine the number of sports foods products available for sale in New Zealand supermarkets
2. To explore the trend in availability of sports foods in New Zealand supermarkets across the last six years (2013-2018)
3. To assess marketing techniques used by manufacturers of sports foods currently sold in New Zealand (2018)

3.3 Methods

The availability and marketing of sports foods within New Zealand supermarkets over the six years was conducted using data extracted from the “Nutritrack” database.

3.3.1 The Nutritrack database

Nutritrack, a database of packaged foods and beverages sold in New Zealand supermarkets, is owned and operated by the National Institute of Health Innovation (NIHI) at The University of Auckland. It contains information on nutrient composition, brand, package and labelling of all food and beverages displaying a Nutrition Information Panel and sold in one of four leading New Zealand supermarket chains (42). Data are collected and updated annually between February to April in one of each of these supermarket chains in Auckland; New World, 4Square, Pak’nSave Countdown. These four supermarkets are owned by the two largest supermarket retailers in New Zealand; Progressive Enterprises and Foodstuffs NZ Ltd, which account for ~75% of all food purchased in the country (42). Trained fieldworkers operating a smartphone application take photographs of all sides of the product package, which are subsequently uploaded into the online Nutritrack database (NutriWeb). These are categorised into 15 main food groups, 66 further categories of food and 177 subcategories as per a standardised categorisation system, developed by the Global Food Monitoring Group (43).

From 2013-2018, product information from Nutritrack was provided to the candidate in Microsoft Excel format. A login to NutriWeb was also provided to enable viewing of product photos and marketing information, the latter which is not routinely entered into the database.

Table 2. Dates and Product information availability in the Nutritrack database (2013-2018)

Information field	Years available
Barcode	2013-2018
Brand	2013-2018
Product name	2013-2018
Pack size	2013-2018
Recommended serve size	2013-2018
Mandatory and non-mandatory nutrient information on the Nutrition Information Panel	2013-2018
Ingredients	2013-2018
Gluten status	2013-2018
Heart Foundation Tick	2013-2016
Daily Intake Guide	2013-2018
Health Star Rating (HSR) ¹	2015-2018
Estimated HSR value	2018
Eligibility to display health claims (estimated NPSC score) ²	2018

¹Front of pack label to provide quick information of nutritional value (voluntary).

²Only packaged foods above a certain score may exhibit health claims based on their Nutrient Profiling Scoring Criterion (NPSC) score.

The number of total products included in the Nutritrack database each year range from 13,572 to 15,318 (as below):

Table 3. The count of unique barcodes (defined as unique barcodes) listed in the Nutritrack database for each year

Year	Unique products
2013	13,572
2014	14,416
2015	14,434
2016	15,318
2017	14,909
2018	15,193

While Nutritrack excludes dietary supplements such as vitamins and other mineral supplements, information is collected on sports foods. However, the classification of sports foods in Nutritrack may differ in some cases from the definition used within this thesis and therefore may result in discrepancies between the sports foods being identified in this research, and the sports foods that may fit within the Nutritrack database.

To ensure the quality of Nutritrack data, accuracy checks are regularly performed by fieldworkers on a random sample of 15% of the collected products. The entered data were cross-referenced with the information displayed on the respective NIP photographs. For the years specified in this project, the accuracy rates varied between 98.5% and 99.2% with 2018 recording the database's highest accuracy reading.

3.3.2 Classification of sports foods

For this research, a food item was classified as a sports food in Nutritrack if it met the definition set out by HPSNZ:

“Sports Foods are goods produced, imported, and/or offered for sale under the Food Act 2014, and any applicable standards, including but not limited to the Australia New Zealand Food Standards Code and the New Zealand Food (Supplemented Food) Standard 2016 and includes sports drinks, sports bars, sports gels (not containing anything other than recognised flavouring), cherry juice, blackcurrant powders and tablets, meal replacements and electrolytes. Sports Foods exclude Ergogenic Aids” (1, 18)”.

The Food Standards Australia New Zealand (FSANZ) definition for formulated supplementary sports foods referenced above is “a product that is specifically formulated to assist sports people in achieving specific nutritional or performance goals” (1).

The definition of a sports food was set by High Performance Sport NZ to encompass the current FSANZ standpoint surrounding sports foods, but also to exclude products that improve performance outside of basic nutrition and nutrition-related markers such as caffeine, creatine, beta-alanine, nitrates, and sodium bicarbonate, often referred to as ergogenic aids.

3.3.3 Identification of sports foods within the Nutritrack database

Sports foods and drinks from the six years of Nutritrack data were identified manually using the food group and product name in addition to the definition used in the review. Subjectivity surrounding these criteria meant clarity was challenging if a product met the exact definition. In such cases, a consensus was arrived at by involving an expert panel comprised of Dr Andrea Braakhuis (affiliation) and Ms Jeni Pearce (affiliation), who are both dietitians with expertise in sports nutrition.

As per the definition set out by HPSNZ, the following products were initially identified as a sports food; sports drinks, sports bars, sports gels, electrolyte formulations, and meal replacements. After consultation with the expert panel, further criteria were applied to include products which were explicitly sports marketed but did not necessarily fit the initial criteria. The products that had the addition of protein powder, fast-acting carbohydrates such as dextrose and other ingredients generally included for performance or recovery. This was achieved by viewing the photographs of the nutrient information panel and ingredients list for each product within the online Nutritrack database.

Products in NutriTrack were classified as being marketed as a sport marketed food if the labelling contained a figure or mention of a sport or physical activity. These were once again double-checked and confirmed by the panel. An example of a product containing all three claims is shown below:



Figure 2. Front and back view of a sports food product from the Nutriweb photography database

Items categorised as sports foods remained in their NutriTrack food groups and subcategories. A pivot table was created using Microsoft Excel to calculate the frequency of sports foods across all food groups, categories and subcategories as appropriate. Sports foods across all six years of data were aggregated into one spreadsheet to assess trends in availability.

3.3.4 Assessment of techniques used to market sports foods in NutriTrack

The product ID was entered into the search field of Nutriweb, and the relevant year was selected to avoid duplicate products across multiple years appearing in the results. Photographs were viewed to determine which foods used marketing techniques, and a categorisation system was applied to each technique identified (Table 4).

To be able to quantify the marketing techniques used by the final pool of sports foods, a categorisation system was applied to the front of package labelling of these items.

Table 4. Marketing techniques used on the front of package labelling of sports foods

Technique	Criteria	Example
Nutrient Claim	A claim of inclusion of a particular ingredient to aid in sport/recovery	
Sporting Claim	Claim to elaborate on how the product or its constituents will aid in an athletic goal	
Imagery	The appearance of sporting insignia, activity or sports being played	

Subjectivity surrounding the classification of products of marketing techniques used on products were discussed with and verified by Dr Andrea Braakhuis.

3.3.5 Statistical analysis of sports food availability and marketing

Descriptive analyses were used to determine the availability of sports foods across the six years of Nutritrack data provided. The total number of sports foods across all 15 food groups and 66 subcategories were counted as a percentage of sports foods calculated for each category and year.

To examine trends in the availability, data from the first three years, 2013-2015 (early years) and the later three years (2016-2018) were aggregated into two groups (Appendix 3). These two groups were chosen post viewing the availability data for each year, where an apparent change in availability appeared after the third year (later confirmed in Table 5). The proportion of foods categorised as sports foods for each main food group was then compared between the later and early period, and statistical significance was tested using a Chi-square test on Graphpad Prism v7.03. To perform the Chi-square test, any tests that involved $n=0$ in any count were changed to $n=1$, as Chi-square analyses cannot be accomplished without at least a count of one. For the food groups “Non-alcoholic beverages” and “Special foods”, their subcategories were also assessed further.

These food groups contained a large proportion of clearly defined sports foods and had a large sample size ($n>100$), thus giving high statistical power.

The Chi-square tests provided a Chi-square value, an effect size and confidence interval, and a p-value. Tests on food groups/subcategories that yielded a p-value<0.05 were identified as statistically significant.

To examine the trends within sports food marketing, the frequency of the marketing techniques was recorded. To further analyse data, products that used only one of either “Nutrient claims”, “Sporting claims”, or “Imagery” were also recorded separately, and listed as a product that used each claim as their sole marketing technique. Other trends were analysed, including the frequency of products using one, two or three marketing techniques and the different permutations of the three marketing techniques. This was completed for all the products classified as sports foods from both the 2013 and 2018 databases.

3.4 Results

The following section displays and discusses the results of the primary objective of this thesis which was to assess the availability of Sports Foods within New Zealand supermarkets. The absolute availability of sports foods as a measure of unique food products, availability amongst the Nutrtrack subcategories, and the proportion of which sports foods comprise the total number of items scanned between 2013 and 2018 are all presented within this subchapter.

3.4.1 The availability of sports foods within the Nutrtrack database

Descriptive analysis of the Nutrtrack dataset (Table 5) shows the number of sports foods, number of total foods, and percentage of total foods being labelled as sports foods between 2013 and 2018 for the 11 (of a total of 15) main food groups and 28 (of a total of 67) further subcategories that contained sports foods.

Table 5. Availability of Sports Foods in New Zealand supermarkets

	2013			2014			2015			2016			2017			2018		
	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods
Bread and bakery products	2	1649	0.12	5	1657	0.30	2	1693	0.12	3	1789	0.17	3	1593	0.19	11	1713	0.64
Biscuits	1	698	0.14	5	753	0.66	1	743	0.13	1	745	0.13	1	697	0.11	8	789	1.01
Bread	1	501	0.20	0.00	483	0.00	1	511	0.20	2	543	0.37	2	471	0.42	3	477	0.63
Cereals and cereal products	10	1317	0.75	15	1412	1.06	22	1434	1.53	30	1573	1.91	33	1505	2.19	35	1543	2.27
Breakfast cereals	8	309	2.59	7	362	1.93	10	349	2.87	12	421	2.85	11	399	2.76	8	398	2.01
Cereal bars	2	221	0.90	8	224	3.57	12	212	5.67	18	250	7.20	22	235	9.36	27	247	10.93
Confectionery	1	799	0.12	2	809	0.25	1	905	0.11	3	858	0.35	0	890	0.00	1	914	0.11
Chocolate and sweets	1	700	0.14	2	720	0.28	1	802	0.12	3	752	0.40	0	800	0.00	1	810	0.12
Dairy	0	1793	0.00	0	1790	0.00	1	1808	0.06	3	1942	0.15	18	1997	0.90	20	1941	1.03

Continued

	2013			2014			2015			2016			2017			2018		
	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods
Cheese	0	623	0.00	0	614	0.00	0	630	0.00	0	657	0.00	0	701	0.00	1	655	0.15
Ice cream and edible ices	0	362	0.00	0	347	0.00	0	350	0.00	0	414	0.00	5	397	1.26	5	432	1.16
Milk	0	267	0.00	0	294	0.00	1	299	0.33	3	293	1.02	6	314	1.91	4	322	1.24
Yoghurt and yoghurt drinks	0	327	0.00	0	315	0.00	0	313	0.00	0	369	0.00	7	381	1.84	10	357	2.80
Fruit and vegetables	0	1624	0.00	2	1792	0.11	2	1748	0.11	4	1890	0.22	9	1882	0.48	18	1906	0.94
Fruit	0	444	0.00	0	463	0.00	1	466	0.21	4	526	0.76	9	517	1.74	17	547	3.11
Nuts and seeds	0	184	0.00	1	200	0.05	0	197	0.00	0	251	0.00	0	251	0.00	1	256	0.39
Meat and meat products	0	849	0.00	2	1066	0.19	1	1030	0.10	1	1098	0.09	2	1031	0.19	2	1040	0.19

Continued

	2013			2014			2015			2016			2017			2018		
	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods
Meat alternatives	0	69	0.00	0	66	0.00	0	65	0.00	0	70	0.00	1	66	1.52	1	70	1.43
Processed meats	0	779	0.00	2	1000	0.20	1	965	0.10	1	1028	0.09	1	965	0.10	1	969	0.10
Non-alcoholic beverages	64	1149	5.57	53	1356	3.91	58	1328	4.37	51	1404	3.63	55	1386	3.97	48	1419	3.38
Beverage mixes	19	54	35.19	12	79	15.19	14	96	14.58	12	79	15.19	11	71	15.49	6	71	8.45
Electrolyte drinks	32	35	92.43	29	31	93.55	33	33	100.00	23	26	88.46	27	27	100.00	33	35	94.29
Energy drinks	2	69	2.90	3	82	3.66	1	73	1.37	3	77	3.90	0	79	0.00	2	82	2.44
Fruit and vegetable juices	1	367	0.27	2	364	0.55	1	362	0.28	0	371	0.00	0	355	0.00	0	328	0.00
Soft drinks	9	283	3.18	0	331	0.00	6	317	1.89	7	372	1.88	0	381	0.00	3	385	0.78
Waters	1	68	1.47	7	148	4.73	3	140	2.14	6	171	3.51	4	143	2.80	4	168	2.38

Continued

	2013			2014			2015			2016			2017			2018		
	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods
Sauces and spreads	2	1578	0.13	2	1778	0.11	1	1768	0.06	0	1781	0.00	0	1759	0.00	0	1807	0.00
Spreads	2	378	0.53	2	425	0.47	1	396	0.25	0	453	0.00	0	442	0.00	0	493	0.00
Snack foods	0	434	0.00	0	398	0.00	0	438	0.00	0	485	0.00	1	513	0.19	0	545	0.00
Crisps and snacks	0	434	0.00	0	398	0.00	0	438	0.00	0	485	0.00	1	513	0.19	0	545	0.00
Special foods	168	446	37.67	154	406	37.93	149	385	38.70	208	476	43.70	165	422	39.10	197	465	42.37
Breakfast beverages	18	39	46.15	26	40	65.00	32	44	72.73	37	49	75.51	28	36	77.78	27	30	90.00
Diet drink mixes	12	14	85.71	7	7	100.00	20	28	71.43	24	27	88.89	16	19	84.21	22	24	91.67
Diet soup mixes (meal replacements)	9	9	100.00	19	19	100.00	9	9	100.00	7	7	100.00	8	8	100.00	7	7	100.00

Continued

	2013			2014			2015			2016			2017			2018		
	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods	Sports foods (n)	Total food items (n)	% Sports foods
Other fitness or diet products	16	18	88.89	1	1	100.00	3	3	100.00	13	15	86.67	6	6	100.00	7	10	70.00
Protein and diet bars	63	63	100.00	57	57	100.00	52	53	98.11	80	80	100.00	77	78	98.72	98	98	100.00
Protein powders	47	47	100.0	39	39	100.0	33	33	100.00	41	42	97.62	28	28	100.0	37	37	100.00
Sports gels	7	7	100.0	9	9	100.0	2	2	100.00	6	6	100.00	2	2	100.00	3	3	100.00
Vitamins and supplements*	0	0	0.00	0	0	0.00	0	0	0.00	0	20	0.00	0	7	0.00	1	22	4.55
Total	247	13,296	1.86	237	14,416	1.63	239	14,434	1.64	303	15,318	1.98	286	14,909	1.92	325	15,193	2.13

* Not one of the 15 main food groups but included within the given dataset

^ Indicates an increase from 2013

∨ Indicates a decrease from 2013

In 2018, the most recent year of Nutritrack data in this project (and therefore the best reflection of the sports foods currently available) there were 15,913 unique food items in Nutritrack. Of these, 325 were defined as sports foods or 2.13%.

Of the 15 main food groups within the Nutritrack database, nine of these contained sports foods within the 2018 dataset and eleven of them contained at least one sports food within the six years of this data. The food groups that did not include sports foods within the entire span of the research were “convenience foods”, “edible oils and oil emulsions”, “fish and seafood products”, and “sugars, honey, and related products”.

Under the Nutritrack categorisation system, it is to be expected that the proportion of sports foods in the “Special foods” group is high (by definition), with the 2018 data showing a percentage of 42.4% (Table 5). Similarly, “Non-alcoholic beverages” is a food group that encompasses electrolyte drinks, which directly falls under this thesis’ definition of sports foods and in 2018 had a percentage of 3.38%. Aside from these two food groups, the range in the proportion of sports foods across the other main food groups varied from 0.00% to 2.27% (exclusive of “Vitamins and supplements”), with “Cereals and cereal products”, “Bread and bakery products”, “Fruits and vegetables”, and “Dairy” having the highest proportion of sports foods. Subcategories within these notable food groups that had the highest percentage of sports foods were breakfast cereals, cereal bars, yoghurt and yoghurt drinks, and fruit (2.01%, 10.93%, 2.80%, and 3.11%, respectively)

3.4.2 Examining the trend of sports food availability within the Nutritrack database

Trends in the availability of sports in New Zealand supermarkets between 2013 and 2018 are shown below (Figure 3).

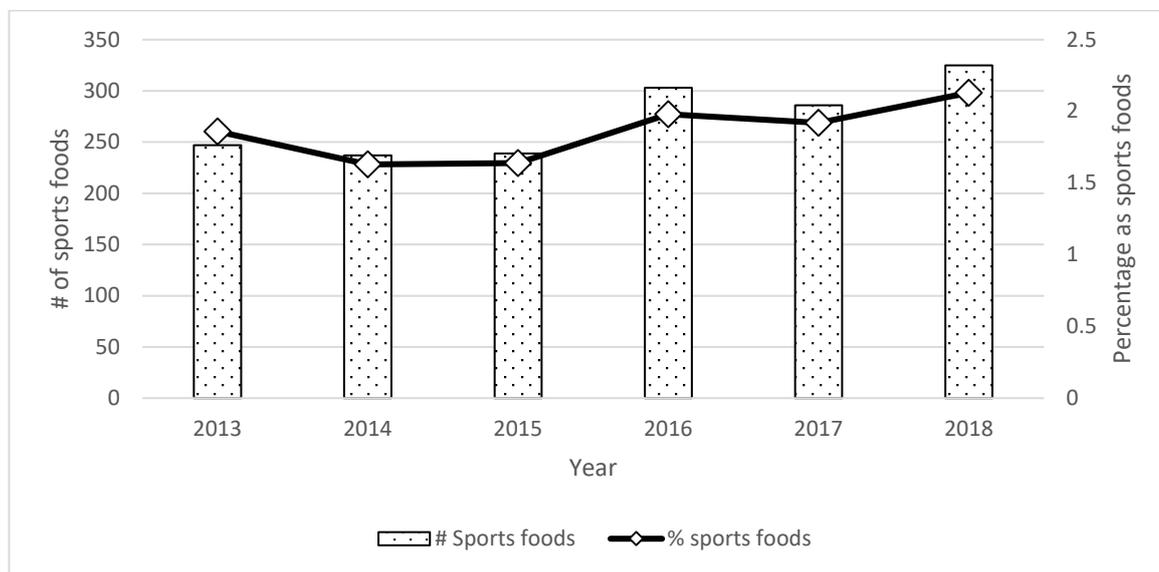


Figure 3. Total number of sports foods shown by year and the trend by which the percentage of sports foods change between 2013 and 2018

Table 6. The difference in the percentage of sports foods between the years 2013-2018. n denotes the number of sports foods in a given year, and Δn indicates the change in the count of sports foods from 2013 to 2018.

	2013 % Sports foods (n)	2018 % Sports foods (n)	Difference in % (Δn)
Bread and bakery products	0.12 (2)	0.64 (11)	0.52 (+9)
Biscuits	0.14 (1)	1.01 (8)	0.87 (+7)
Bread	0.20 (1)	0.63 (3)	0.43 (+2)
Cereals and cereal products	0.75 (10)	2.27 (35)	1.52 (+25)
Breakfast cereals	2.59 (8)	2.01 (8)	-0.58 (0)
Cereal bars	0.90 (2)	10.93 (27)	10.03 (+25)
Confectionery	0.12 (1)	0.11 (1)	-0.01 (0)
Chocolate and sweets	0.14 (1)	0.12 (1)	-0.02 (0)
Dairy	0.00 (0)	0.57 (11)	1.03 (20)
Cheese	0.00 (0)	0.15 (1)	0.15 (+1)
Ice cream and edible ices	0.00 (0)	1.16 (5)	1.16 (+5)
Milk	0.00 (0)	1.24 (4)	1.24 (+4)
Yoghurt and yoghurt drinks	0.00 (0)	2.80 (10)	2.80 (+10)
Fruit and vegetables	0.00 (0)	0.94 (18)	0.94 (+18)
Fruit	0.00 (0)	3.11 (17)	3.11 (+17)
Nuts and seeds	0.00 (0)	0.39 (1)	0.39 (+1)
Meat and meat products	0.00 (0)	0.19 (2)	0.19 (+2)
Meat alternatives	0.00 (0)	1.43 (1)	1.43 (+1)
Processed meats	0.00 (0)	0.10 (1)	0.10 (+1)
Non-alcoholic beverages	5.57 (64)	3.38 (48)	-2.19 (-16)
Beverage mixes	35.19 (19)	8.45 (6)	-26.74 (-13)
Electrolyte drinks	92.43 (32)	94.29 (33)	1.86 (+1)
Energy drinks	2.90 (2)	2.44 (2)	-0.46 (0)
Fruit and vegetable juices	0.27 (1)	0.00 (0)	-0.27 (-1)
Soft drinks	3.18 (9)	0.78 (3)	-2.40 (-6)
Waters	1.47 (1)	2.38 (4)	0.91 (+3)
Sauces and spreads	0.13 (2)	0.00 (0)	-0.13 (-2)
Spreads	0.53 (2)	0.00 (0)	-0.53 (-2)
Snack foods	0.00 (0)	0.00 (0)	0.00 (0)
Crisps and snacks	0.00 (0)	0.00 (0)	0.00 (0)

	2013 % Sports foods (n)	2018 % Sports foods (n)	Difference in % (Δn)
Special foods	37.67 (168)	42.37 (197)	4.70 (+29)
Breakfast beverages	46.15 (18)	90 (27)	43.85 (+9)
Diet drink mixes	85.71 (12)	91.67 (22)	5.96 (+10)
Diet soup mixes (meal replacements)	100.00 (9)	100.00 (7)	0.00 (-2)
Sports gels	100.00 (7)	100.00 (3)	0.00 (-4)
Vitamins and supplements	0.00 (0)	4.53 (1)	4.53 (+1)
Total	1.86 (247)	2.13 (325)	0.27 (+78)

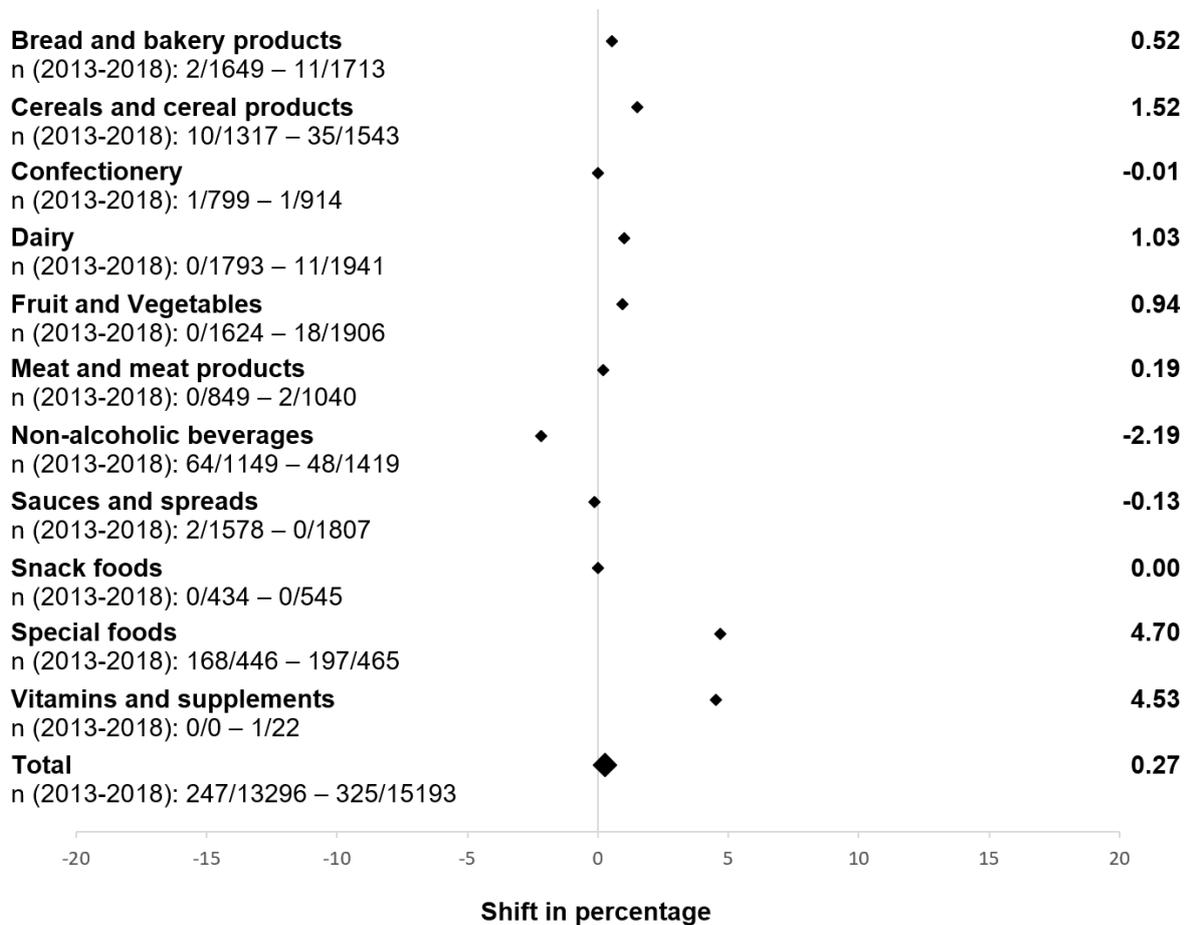


Figure 4. Forest plot showing the change in the percentage of sports foods by food group from 2013-2018. n (2013-2018) represents the number of sports foods out of the number of total foods from 2013 and 2018, separated by a dash.

Table 7. The difference in the percentage of sports foods available in the earlier three years (2013-2015) and latter three years (2016-2018) by food groups and relevant subcategory

Food Group	Chi-square value (χ^2)	Effect size ($\Delta\%$ of sports foods)	95% Confidence interval	P-value
Bread and Bakery products	2.31	0.15	-0.07 – 0.38	0.1289
Cereals and cereal products*	12.84	0.96	0.42 – 1.50	0.0003*
Confectionery	0.00	0.00	-0.28 – 0.29	0.9704
Dairy*	32.85	0.67	0.52 – 0.82	<0.0001*
Fruit and Vegetables*	18.33	0.47	0.25 – 0.71	<0.0001*
Meat	0.36	0.06	-0.19 – 0.30	0.5462
Non-alcoholic beverages*	3.87	0.84	-0.03 – 1.69	0.0491*
Beverage mixes	0.14	1.05	-4.76 – 6.90	0.7058
Electrolyte drinks	0.02	0.07	-9.80 – 11.23	0.8903
Energy drinks	0.16	0.06	-3.00 – 3.88	0.6910
Fruit & vegetable juices	1.69	0.03	-0.37 – 0.85	0.1937
Soft drinks	2.25	0.71	-0.04 – 1.74	0.1341
Waters	0.23	0.17	-2.60 – 2.60	0.8798
Sauces	2.84	0.08	-0.07 – 0.20	0.0920
Snack foods	0.02	0.01	-0.42 – 0.37	0.8904
Special foods	1.62	1.91	-1.07 – 4.88	0.2026
Breakfast beverages	1.64	6.25	-3.66 – 15.98	0.2009
Diet drinks	0.15	2.65	-11.32 – 16.35	0.6990
Meal replacements	0.00	0.00	-19.22 – 19.22	>0.9999
Other fitness or diet products	0.04	2.00	-18.45 – 22.52	0.8433
Protein bars	0.00	0.05	-6.92 – 7.01	0.9892
Protein powders	0.00	0.23	-9.24 – 9.71	0.9603
Sports gels	0.00	0.00	-27.03 – 27.03	>0.9999
Vitamins and supplements^	n/a	48.00	0.63 – 96.38	0.0762

* = Statistically significant

^ = Fischer's Exact Test conducted as n was too low

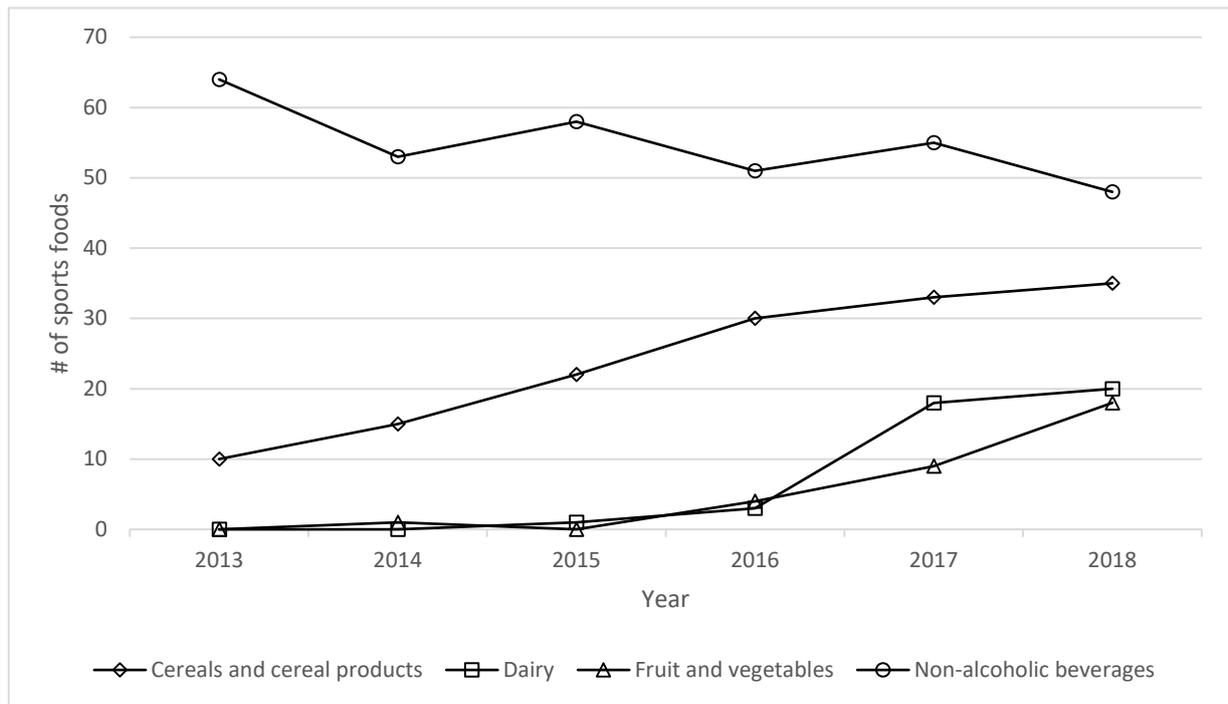


Figure 5. The trend in the availability of sports foods between the early and late years, for food groups with significant changes over time

The data appears to suggest that across the span of this research, the total availability of sports foods has increased. In 2013, the number of sports foods that fit within the definition was 247, and by 2018, this number had risen to 325, an increase of 31.6% (Table 5). The relative availability of sports foods as a proportion of total packaged food items available also increased, from 1.86% in 2013 to 2.13% in 2018 (0.27% increase; Table 5, Figure 4). As seen in Figure 3, however, this trend increased non-linearly, with drops in the number of sports foods between 2013-2014, and 2016-2017. This overall increase can be further seen in Figure 4, which shows the proportion shifts of sports foods between 2013 and 2018, across the main food groups.

Sports foods also appeared in more food groups and subcategories in 2018 compared with 2013 (11 vs. 6 food groups, and 25 vs. 19 subcategories respectively). As shown by Table 7, four main food groups, namely “Cereals and cereal products”, “Dairy”, “Fruit and vegetables”, and “Non-alcoholic drinks” showed statistically significant differences between the early years of the dataset and its later years. The same test was conducted for further subcategories within food groups that comprised of foods that closely aligned with the thesis’ definition of sports food and found no statistically significant differences. Of the statistically significant differences found within the food groups, only “Non-alcoholic beverages” showed a decrease in its proportion of sports foods.

Of the statistically significant differences within the food groups, their trends across all six years were explored and are shown in Figure 5. Within the early years of the period, both “Dairy” and “Fruits & vegetables” cumulatively have 1 and 4 sports food products in the early years, respectively (Appendix 3). This increases to 41 and 31, respectively, within the later three years. “Cereals and cereal products” consistently increased in its number of sports foods, rising from 10 to 35 items. Conversely, the “Non-alcoholic beverages” group decreased non-linearly but across the years had a statistically significant decrease from 64 (5.57%) to 48 (3.38%) from 2013 to 2018 (Table 5).

3.4.3 Marketing techniques used to promote sports foods in Nutritrack

Table 8. Descriptive analyses showing the three marketing techniques used on food packages of sports foods in the Nutritrack database (2013 and 2018).

	Nutrient Claims		Sport Claims		Imagery	
	2013	2018	2013	2018	2013	2018
Total # of sports foods using marketing technique	215	321	78	71	44	32
% of sports foods using technique	87.04	98.47	31.58	21.78	17.81	9.82
# of sports foods using as sole technique	156	251	24	2	0	1
% of sports foods using as sole technique	47.85	77.00	7.36	0.61	0	0.31

Table 9. Products using more than one marketing techniques on the package in Nutritrack (2013 and 2018).

	2013 (N = 247)	2018 (N = 325)
% of sports foods with 1 claim (n)	72.87 (180)	78.15 (254)
% of sports foods with 2 claims (n)	14.98 (37)	17.23 (56)
Nutrient claim + Sport claim	10.52 (26)	14.15 (46)
Nutrient claim + Imagery	4.45 (11)	2.77 (9)
Sport claim + Imagery	0.00 (0)	0.31 (1)
% of sports foods with all 3 claims (n)	11.33 (28)	4.62 (15)

Table 8 shows the number and percentage of products using Nutrient Claims appeared to increase between 2013 and 2018, with 2018 marking ~98% inclusion within sports foods, an increase of ~11% since 2013. This is, however, not the same for both Sports Claims and Imagery. There was a decrease in the use of these marketing techniques from 31.58% to 21.78%, and from 17.81% to 9.82% from 2013 to 2018, respectively.

The percentage of products using a single claim rose from 72.87% in 2013 to 78.15% in 2018, as shown in Table 9. This falls in line with the increase in the number of products using Nutrient Claims as their sole marketing technique within these years, which has increased from 156 (47.85% of products) to 251 products (77%).

Of the products using two claims, the most common pairing was a Nutrient Claim and a Sports Claim, increasing from 10.52% to 14.15% from 2013 to 2018 as per Table 9. Similarly, as Sports Claims and Imagery have decreased as a sole marketing technique, the pairing of these two marketing claims also reduced. Products that used all three marketing claims decreased to 4.62% in 2018, from 11.33% in 2013.

3.5 Discussion

This subchapter reiterates the critical findings of the Nutritrack database analysis on sports foods and discusses the strengths and limitations of the research design. Furthermore, the implications of this research will also be expanded on, including how the findings may be used within the New Zealand supermarket context and how different individuals and organisations may be affected. Building on this discussion, directions and recommendations for future research are also elaborated on.

3.5.1 Key findings of the Nutritrack database research

The three main objectives of this research on the Nutritrack database were to assess the availability of sports foods within New Zealand supermarkets, to examine the trend in availability over the six years (2013-2018), and to explore the marketing techniques used to promote sports foods sold in New Zealand supermarkets.

The findings regarding the availability of sports foods were consistent with international trends in the systematic review in Chapter 2, i.e. an increase in the availability of sports foods over time (22, 25, 27, 29, 37, 39). The New Zealand data showed an increase from 247 (1.86% of total foods) to 325 (2.13%) from 2013 to 2018. Postulated reasons for such an increase in consumer interest in sports foods include an increasingly ageing population that is becoming more health-conscious and an appreciation of the effect of diet on health and performance (44). Similar reasons were re-iterated within an Australasian based report where respondents that consumed sports foods had complementary healthy behaviours. These included regular exercise and adequate daily consumption of vegetables with the belief that the use of sports foods would aid them in their health and fitness goals (9).

As shown in the Nutritrack data, the diversity of the types of foods that are classified as sports foods has also increased, with 9 of 15 main food groups containing at least one sports food item in 2018 compared with 6 of 15 in 2013. Previous research has indicated that the appearance of sports nutrition ingredients within everyday food items in efforts to increase nutritional value to enhance performance has piqued consumer interest (16). As per Harrison (2016) (16), consumer demand has always dictated product innovation, but the industry itself can also generate demand by way of product marketing. With the normalisation of sports nutrition into everyday eating, the appearance of several items being considered sports foods within a greater number of food groups within this data supports this conclusion (Table 5).

The trend of sports food availability within this dataset, as shown by Figure 3 is also consistent with global data, as per the systematic review. This is reflected in the increasing number of sports foods being available within the last five years in New Zealand, and the same trend occurring over the past several decades around the world (24, 26, 35, 38, 39). The most substantial increases in the availability of sports foods within each food group occurred within “Cereals and cereal products”, “Dairy” and “Fruit and vegetables” show the rise in availability of sports foods within staple food groups.

This was not found within the Non-alcoholic beverage food group, however, which saw a statistically significant decrease within the number of sports foods in the food group (Table 7). Within the smaller subcategories, the “Electrolyte drinks” subcategory has stayed consistent in both number and percentage of sports foods, and “Beverage mixes” shows a substantial decrease. “Beverage mixes” primarily include mixable drink powders, with electrolyte drink powders being a typical sports food found within this subcategory. Williams (2018) (38) states that ready to drink and ready to eat products have progressively been increasing their share of the sports nutrition market, thus displacing powders, due to their convenience. This is cited as one of the top reasons for purchase.

However, beverage mixes still dominate the overall sports nutrition market due to its cost-effectiveness. To be noted, however, this report uses \$ sales as a parameter of availability, whereas this research utilises the number of unique food items to assess availability.

Between 2013 and 2018, the most notable trend for marketing claims on the front of package labelling of sports foods was the increase in the use of Nutrient Claims. FSANZ (2013) reports that amongst sports food users, the top three reasons for use were “Energy”, “Building Muscle” and “High Protein”, two of which can be classified as a Nutrient-related reason (9). Within the criteria for defining a Nutrient Claim in this research, having high energy content or high protein was included. Single nutrient claims also provide a quick synopsis of a nutritive benefit that pertains to the sports food a consumer may use. Consumers have been known to use front of package labelling to quickly assess the health level of a specific packaged product (45). When favourable nutrition information is presented on a packaged product, it has been shown to increase a consumer’s attitude toward the health status of an item (46). This may explain the increase in the frequency of Nutrient Claims between 2013 and 2018, with consumers who may be untrained in assessing nutritional quality of packaged items using front of package label claims such as Nutrient Claims to form an opinion on how nutritionally beneficial a product may be. Conversely, the proportion of sports food items using Sports Claims and Imagery as their sole technique decreased between 2013 and 2018. The number and percentage of products featuring either of these techniques non-exclusively, however, had not changed. The proportion of products coupling either of these techniques with a Nutrient Claim increased, once again reiterating the food industry’s utilisation of front of package labelling to exacerbate the nutritional quality of a product using a single Nutrient Claim.

3.5.2 Strengths of the Nutritrack database

With the objective of this research being the assessment of the availability of sports food products to both athletes and the general public, it was a key strength of this study to use the Nutritrack database to find the number of unique packaged products that fall under the definition of sports foods which includes data from supermarkets and is, therefore, relevant to athlete and non-athlete populations. The Nutritrack database allowed for highly descriptive food composition information from a wide range of packaged products which not only assessed the availability of sports foods but helped clearly define foods that were and weren’t applicable. Having this as a parameter to examine availability is thus more in line with the objective rather than something like \$ sales, as that may skew a particular subcategory of food in viewing relative availability and may not truly represent everything available. This being said, sales are still an important and relevant measure which can contribute to the view of overall availability.

The collection of such large amounts of data can often lead to errors in the entering of, maintenance of and accuracy of such entries. However, consistent quality assurance across every year of data collection resulting in a range of 98.5%-99.2% accuracy has strengthened the reliability of the data used within this research.

The collection of this data from a wide range of supermarkets within New Zealand helped strengthen the applicability of this research to the general food supply within New Zealand. Between Pak’n’save, Countdown, 4Square, New World and their parent companies, this represents over 75% of the purchasing for packaged products in New Zealand (47). Furthermore, the regions by which these supermarkets were selected accounted for a wide range of socio-economic deprivation which better reflects the diversity of the New Zealand food supply (48).

3.5.3 Limitations of the Nutritrack database

While ~75% of the purchases of packaged foods in New Zealand are accounted for by the inclusion of these four supermarket chains, this still leaves a large proportion of the packaged food purchases within New Zealand not included and therefore unable to be used to assess sports food availability. Thus, this is not entirely transferrable to the general New Zealand food supply, and the findings of this research cannot be applied to all food outlets.

One inherent limitation of the study of packaged foods utilising the Nutritrack database is the exclusion of packaged products without a Nutrition Information Panel (NIP). This may omit several foods that may be defined as sports foods and may include non-packaged fruit/vegetable mixes, or international food items. These products do not have the same requirement to display a NIP as per Standard 1.2.8 of the Australia New Zealand Food Standards Code (49).

Assessing the availability of sports foods can be done through several measures. While the appearance of a unique food item can be used to examine the types of products available to consumers; there are also other parameters to assess the market share of a product. Other measures also include how much shelf space it can occupy, and these can be extrapolated to hypothesise consumption amongst consumers. Thus, to get a complete representation of the availability of sports foods a measure such as the frequency of appearance of a product or the stock count of a food item should be used along with the presence of a unique food item and sales data.

With only one measure of availability in the form of appearance of a unique food item, there is little relevance to the usage of marketing techniques to this end. To further strengthen this, a more direct quantifiable measure such as the \$ sales of a specific product and the appearance of certain marketing techniques on an item's front of package labelling may be more appropriate.

Subjectivity surrounding the criteria for the classification of sports foods is an inherent limitation of this research. One point of contention in the labelling of sports foods was the appearance of physical activity, sport, or athlete on the labels of the potential sports food item. With the emergence of items that do not necessarily fall under the initial definition and are instead more closely aligned to everyday foods, this created the need for an expert panel in the form of Dr Andrea Braakhuis and Ms Jeni Pearce. These two women are some of the most experienced and highly-respected performance nutritionists and sports dietitians in New Zealand.

Similarly, the criteria of the addition of a sports nutrition ingredient such as pea protein into food may not necessarily have been for sports performance or recovery, in which case this was also taken up for discussion with the panel. Therefore, there is the potential of items not being classified as a sports food within this research that should have been and may not reflect their true availability within supermarkets.

3.5.4 Implications

The primary reason this research was conducted was to be able to compile information for every consumer's use. With the shift of purchasing and consumption of sports foods from only the athletically elite, to now being purchased and consumed by the mass public, information regarding their availability will be useful to a wide variety of people and groups.

Health-related decisions such as food choice are often made within seconds to the average consumer (50). Several factors, such as taste influence consumer's healthy food choices. One such factor directly applicable to this research is the availability of a certain type of product as it plays into the purchasing psychology of a consumer (50).

In this research, the increased availability in sports foods within supermarkets may influence consumers to purchase higher volumes of these products, with the presumption of these foods being healthier. However, research into the sales of sports foods within these supermarkets must also be conducted. When sports foods are not used as intended, their extra nutritive benefits do not elevate performance as designed. In those not requiring this excess nutrition, this can lead to overconsumption of energy. Sports drinks are often formulated with high levels of sugar for recovery and glycogen replenishment (51). General consumers of sports drinks usually do not require the sugar to aid in recovery and can lead to an excess energy intake when taken inappropriately in this manner (52). To extrapolate this further, Sugar-Sweetened Beverages (SSBs), of which sports drinks are a further subcategory, is linked to obesity. Adolescents and young children are particularly susceptible to due to these populations having no evidence in requiring such specialised sports nutrition, even when active ((53). Of note, Australian data shows that 52% of their population's free sugar consumption is attributed to beverages, including soft drinks, energy drinks and sports drinks (54). Consumers are poor judges of the health effects of excess SSB consumption (55). This research shows the increasing availability of these products, which should pique the interest of public health experts to further inform and educate consumers about the implications of sports foods.

Adaptations to training are the reason for consistently elevated levels of performance in athletes. Nutrition can enhance these adaptations and directly affect performance (56). However, exogenous nutritive compounds may unfairly elevate performance in athletic competition. Dietary supplements are a category of food that is closely linked with sports foods which have unfortunate doping implications (40). Whether or not intentional, it is the responsibility of athletes and their support staff to ensure that the level of competition they bring is to their natural athletic best. With the prevalence of doping in the world of athletics being an ever-present risk, it is recommended that athletes only consume dietary supplements that have been analysed batch by batch to ensure the exclusion of prohibited substances (57).

Doping can occur as a result of explicit manufacturer malpractice or by cross-contamination of products which may cause supposedly innocent products to test positive for banned substances (57). As such, the risk of unintentionally consuming unapproved ingredients as declared by various sporting bodies is a risk that athletes must try minimising by consuming only approved supplements and sports foods.

In the case of Jessica Hardy, who was a gold medal contending swimmer set to compete in the 2008 Beijing Olympics. In the effort to compete at the highest level and yield the highest level of return from her training she consumed a dietary supplement. Unbeknownst to her, the unintentional contamination of this product would cost her the ability to compete in the Olympics that year (58). The suspension of her career was only a year-long due to her due diligence in researching the product, its label, and an explicit recommendation from her athletic team. However, the mere fact that her drug tests returned positive was enough grounds for the World Anti-Doping Agency (WADA) to rule her ineligible to compete further for the period of suspension. Although this was a case of unintentional contamination, every sports food and nutritional supplement runs a risk of being cross-contaminated with prohibited substances due to the nature of manufacturing (59). Thus, it remains a genuine concern for athletes and sporting bodies to be able to recognise the risk these types of products carry with them.

Testing status is one measure that the Nutritrack database did not contain but would prove useful for sporting bodies and athletes. Knowing the availability of these products within supermarkets, however, does provide both parties with some basis of informed choice, and may give foundation to push for more approved supplements to be available.

With absolutely no guarantees by over the counter supplements to eliminate the possibility of containing banned substances, the choice to go with a third-party tested product will minimise this risk (60). A promising sign, however, is the increase of third-party certified dietary supplements being released within the United States, the leading market around the globe in the context of sports foods and nutrition supplements (61). The certification of these products not only extends reassurance to athletes seeking a performance edge but even to the regular gym-goer who may use sports foods to aid in their recovery. With the increased emergence of sports foods within supermarkets and general retail outlets, it must be noted by both athletes and their respective sporting organisations due to most of these products being available without being batch tested.

Commonly used sports foods and dietary supplements for muscle building and weight loss are popular amongst the general population, but also pose risks with contaminants ranging from anabolic steroids to stimulants that have potential to be toxic to the cardiovascular system (13). The implications of these undisclosed, unregulated and illegal ingredients extend not only to athletes who run the risk of doping but also to the health of the general consumer who may use these sports foods innocently wanting to increase their athletic progress. This is especially of concern with the addition of such ingredients into everyday foods and the normalisation of sports foods that are now increasingly available to the general public.

3.5.5 Recommendations for future research and beyond

Further investigation within this field should not only look at the availability of sports foods in the form of unique food items being present, but also the count of stock. This would further explain the relative availability of different subsets of sports foods rather than just the existence of individual types of products within supermarkets. Furthermore, sales data can be used to determine the impact of these foods on public health better. By looking at what is being bought by consumers, public health researchers may be able to target frequently purchased sports foods for policies that outline only the true nutritive or performance-enhancing benefits.

Furthermore, ingredient and consumption data are of interest to sporting bodies to disseminate information to athletes surrounding the risks of unintentional doping, or with sufficient data, be able to introduce higher amounts of third-party tested products within the sports food market in supermarkets.

Similar research should also be conducted within not only supermarkets but in specialist health stores, sporting goods stores and internet retail outlets that distribute sports food products within New Zealand. Supermarkets currently account for 75% of packaged food products within New Zealand (47). However, specialist stores that have health and fitness as their primary motivator will likely have a higher proportion of sports foods as part of their stock. Thus, it would be of benefit for regulatory bodies such as the Food Standards Authority to examine the availability of sports foods in these retail outlets. The top five sources to purchase sports foods in New Zealand and Australia being supermarkets, health food stores, pharmacies, sports stores and the internet (9). Similar research conducted across these outlets could build a stronger case for higher regulation in the interest of public health, consumer safety and athlete development.

While this research has shown an increase in the number of staple foods being represented in the sports food category, specialist stores have a higher volume of sports foods that may double as dietary supplements. Dietary supplements are a closely related category of product that has seen substantial growth alongside sports foods, have similar reasons for consumption by consumers and confer the same or higher risks for athletes (62). Confusion within the consumer base should be of significant concern for public health experts with no current regulations surrounding

efficacy and arguably minimal regulations surrounding safety (61). For the same reasons sports foods should be carefully monitored in terms of availability, purchasing and marketing, monitoring dietary supplements is also advised. Dietary supplements are products that may confer beneficial health effects within the right context and population, but also have a myriad of unintended side effects that may cause harm if consumed without proper reason.

The Nutritrack database is a powerful tool to be able to analyse trends in availability. Whilst limited to only the appearance of unique packaged products in supermarkets, it can still provide insight into what is available to general consumers in New Zealand.

3.6 Conclusion

The findings of this New Zealand research were similar to that of the systematic review in Chapter 2, which looked at the global sports food market. The key results from the Nutritrack database were comparable to those observed in the literature regarding the global sports food market, i.e. the number of sports foods available to New Zealand consumers in supermarkets has increased (2.13% in 2018 compared with 1.86% in 2013). Significant increases in the availability of sports foods were observed in several food groups, i.e. “Dairy”, “Fruit and vegetables”, “Non-alcoholic beverages” and “Cereals and cereal products”.

The front of package marketing techniques used by the food industry to promote sports foods also evolved between 2013 and 2018. i.e. Nutrient Claims became more prevalent (from 87% among the classified sports foods in 2013, to over 98% in 2018). However, use of Sporting Claims and Imagery appeared to decrease (from 32% to 22% and 18% to 5%, respectively) in relative prevalence when used as a single technique (but appeared at the same prevalence of approximately 14% and 3%, respectively, when coupled with Nutrient Claims).

The findings of this research, while limited to only four supermarkets, do represent a large proportion of the readily available sports foods within New Zealand. Dissemination of this research will inform health and fitness, conscious consumers, enable of upskilling health professionals, public health and governmental bodies, and support sporting organisations to understand the potential risks present for their athletes. Further research in this field and using the Nutritrack database should focus on sales data and stock availability to monitor trends over time. This data can allow researchers and health professionals better understand consumers, and develop a case for stricter safety regulations or labelling changes of sports foods in the interest of public health and athlete well-being and credibility.

4 Conclusion of research

Sports foods are a subset of food products that are produced to meet the specialised nutritional demands of sport and physical activity. These food items often contain heightened levels of certain nutrients to meet the high need for recovery from a sport, or to increase performance to provide training adaptations further or during an event in the case of a competitive sportsperson. However, many sports food products are classified as a supplementary food rather than a whole food due to the omission of a wide range of nutrients such as micronutrients and phytochemicals that whole foods contain, and they do not. The specialised nature of a sports food means that it should only be a complement to a varied diet, and not consumed in place of whole foods. Thus, this is a potential concern if consumers were to utilise sports foods as a source of nutrition, rather than to use them to supplement a whole food diet. The general consumer has now been shown to consume more of these products more than ever, leading to public health concerns. Excessive intake of these products can lead to consumers wasting money, prioritising the wrong nutrients or in the case of athletes, unknowingly consuming banned substances.

The main findings from the systematic review were:

- Over the past fourteen years, the availability of the global sports food market had grown substantially. The global market for sports foods in 2018 was reported to be valued at USD 65b, with a compound annual growth rate of 8.5% (29)
- The USA dominated the global sports food market, with many products found globally originating from there
 - While the Western sports food market is the most significant contributor to the global sports food market, Asia has been steadily growing its globality and global availability of sports foods
- Across the fifteen years, not only has the absolute availability of sports food increased, the types of sports foods have become more varied, and particular niches have also become increasingly available
 - Consumer purchasing has influenced the production of sports foods, and a shift in focus to more convenience has increased the availability of sports nutrition bars and ready to drink type products
- Marketing of sports foods varies substantially depending on the type of sports food product
 - Sports drinks often heavily market using television advertisements and employ both athletes and well-known celebrities to promote products
 - Most marketing for sports foods such as protein powders and bars are within magazines, TV, on t-shirts and the internet
 - Both types of products are marketed heavily at athletic events such as marathons and competitions via sponsorship and poster advertising
 - The marketing claims used by the food industry to promote sports foods and product innovation are dictated on consumer demand and the trends within health and fitness at the time
- Sports foods were initially produced for the athletically competitive to be able to recover faster and perform at a higher level. While this is still the case, only a small proportion of sales are attributed to athletes

- Athletes and more active individuals cite reasons for the use of sports foods to be mainly performance and recovery, those more sedentary cite weight loss and muscle gain for primary reasons to use sports foods

The main findings from the Nutritrack database research were:

- In 2018, sports foods made up 2.1% of the packaged food and beverage items within the Nutritrack database, up from 1.9% in 2013, with the number of sports foods increasing from 247 to 325 within this period
- The number of food groups that contained sports foods also increased from six to eleven across the six years, and the number of further subcategories has risen from 19 to 25
- From the earlier years (2013-2015) and later years (2016-2018), the food groups that showed statistically significant differences were “Dairy”, “Fruit and vegetables”, “Cereals and cereal products”, and “Non-alcoholic beverages.”
 - Of these food groups, sports foods increased in availability for all groups except “Non-alcoholic beverages” where there was a significant decrease
- The marketing techniques used on the front of sports food packages have also changed between 2013 and 2018 with higher use of nutrient claims
 - From 2013 to 2018, the percentage of packaged products using nutrient claims increased from 87.04% to 98.47% (# from 215 to 321)
 - The use of both sports claims and sporting imagery decreased across the six years, from 31.58% to 21.78%, and from 17.81% to 9.82%, respectively
- From 2013 to 2018, the number of products using only one marketing on the package increased, with the vast majority of these being nutrient claims (73 to 78%)
- The amount and percentage of products using two techniques rose from 14.98% to 17.23%, with the nutrient claim + sport claim pairing being the most common (Over 17% of sports food products in 2018)

In conclusion, the overall findings of this thesis suggest that sports foods have been increasing in availability globally and in New Zealand. The trends of the global market also seem to reflect what is happening in New Zealand, with the primary proponent of the global sports food market being the United States, and their exports reaching the local sports food field. The systematic review and data analysis both suggested the normalisation of sports foods, with everyday foods being turned into or marketed as sports foods, primarily through the addition of a sports food ingredient or the marketing of such as a sports food.

Research from the analysis of the Nutritrack database served as a measure of the availability within New Zealand supermarkets and currently, the only representation of this within a piece of literature. The final objective of this thesis was to inform sporting bodies, governmental organisations and consumers of these products to not only make better choices for their athletic goals but hopefully, also enforce more considerable safety precautions in the interest of public health. While this research can help with this, more research must be conducted to be able to provide a stronger argument for labelling changes and testing amongst sports foods. Further research must build on from this thesis and into sales trends /consumer data should be conducted to analyse those who use sports foods most frequently. Other than sales data, other parameters of availability, such as stock count may also aid in being able to assess the true availability of these products on supermarket shelves in New Zealand. For sporting bodies, more information surrounding the number of tested products compared to non-tested should also be looked into as it gives a better point of education for their athletes and teams.

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Appendices

Appendix 1: Extraction form for studies included in Table 1 of the systematic literature review.

Review title or ID

Study ID (<i>surname of first author and year first full report of study was published e.g. Smith 2001</i>)

Report IDs of other reports of this study (<i>e.g. duplicate publications, follow-up studies</i>)

Notes:

- **General Information**

Date form completed (<i>dd/mm/yyyy</i>)	
Name/ID of person extracting data	
Report title (<i>title of paper/ abstract/ report that data are extracted from</i>)	
Report ID (<i>if there are multiple reports of this study</i>)	
Reference details	
Report author contact details	
Publication type (<i>e.g. full report, abstract, letter</i>)	
Study funding source (<i>including role of funders</i>)	
Possible conflicts of interest (<i>for study authors</i>)	

- Eligibility

Study Characteristics	Review Inclusion Criteria <i>(Insert inclusion criteria for each characteristic as defined in the Protocol)</i>	Yes/ No / Unclear	Location in text <i>(pg & ¶/fig/table)</i>
Type of study	Randomised trial	...	
	Non-randomised trial	...	
	Controlled before-after study <ul style="list-style-type: none"> • Contemporaneous data collection • At least 2 intervention and 2 control clusters 	...	
	Interrupted time series OR Repeated measures study <ul style="list-style-type: none"> • At least 3 timepoints before and 3 after the intervention • Clearly defined intervention point 	...	
	Other design (specify):	...	
Participants		...	
Types of outcome measures		...	
Decision: ...			
Notes:			

DO NOT PROCEED IF STUDY EXCLUDED FROM REVIEW

- **Population and setting**

	Description <i>Include comparative information for each group (i.e. intervention and controls) if available</i>	Location in text <i>(pg & ¶/fig/table)</i>
Population description <i>(from which study participants are drawn)</i>		
Setting <i>(including location and social context)</i>		
Inclusion criteria		
Exclusion criteria		
Method/s of recruitment of participants		
Notes:		

- **Methods**

	Descriptions as stated in report/paper	Location in text (pg & ¶/fig/table)
Aim of study		
Design (e.g. parallel, crossover, non-RCT)		
Unit of allocation (by individuals, cluster/ groups or body parts)		
Start date		
End date		
Duration of participation (from recruitment to last follow-up)		
Notes:		

- **Risk of Bias assessment**

See [Chapter 8](#) of the Cochrane Handbook. Additional domains may be required for non-randomised studies.

Domain	Risk of bias <i>Low/ High/Unclear</i>	Support for judgement	Location in text (pg & ¶/fig/table)
Selective outcome reporting? (reporting bias)	...		
Other bias	...		
Notes:			

- Participants

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
Clusters <i>(if applicable, no., type, no. people per cluster)</i>		
Age		
Sex		
Race/Ethnicity		
Other relevant sociodemographics		
Subgroups measured		
Subgroups reported		
Notes:		

- Outcomes

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
Outcome name		
Time points measured <i>(specify whether from start or end of intervention)</i>		
Time points reported		
Outcome definition <i>(with diagnostic criteria if relevant and note whether the outcome is desirable or undesirable if this is not obvious)</i>		
Unit of measurement <i>(if relevant)</i>		
Notes:		

Appendix 2: Food groups and subcategories included in the Nutritrack database

Food Group	Further food subcategory
Bread and bakery products	Biscuits
	Bread
	Cakes, muffins and pastries
Cereals and cereal products	Breakfast cereals
	Cereal bars
	Couscous
	Noodles
	Pasta
	Rice
	Unprocessed cereals
Confectionery	Chewing gum
	Chocolate and sweets
	Cough lollies
	Jelly
Convenience foods	Meal kits
	Other frozen foods
	Pizza
	Pre-prepared salads and sandwiches
	Ready meals
	Soup
Dairy	Cheese
	Cream
	Desserts
	Ice cream and edible ices
	Milk
	Yoghurt and yoghurt drinks
Edible oils and oil emulsions	Cooking oil spray
	Cooking oils
	Edible oils
Eggs	
Fish and seafood products	Processed fish
Fruit and vegetables	Fruit
	Herbs and spices
	Jam and marmalades
	Nuts and seeds
	Vegetables

Food Group	Further food subcategory
Meat and meat products	Meat alternatives
	Processed meat
Non-alcoholic beverages	Beverage mixes
	Coffee and tea
	Cordials
	Electrolyte drinks
	Energy drinks
	Fruit and vegetable juices
	Soft drinks
	Waters
Sauces and spreads	Mayonnaise and salad dressings
	Sauces
	Spreads
Snack foods	Crisps and snacks
Special foods	Baby foods
	Breakfast beverages
	Diet drink mixes
	Diet soup mixes (meal replacements)
	Other fitness or diet products
	Protein and diet bars
	Protein powders
	Sports gels
Sugars, honey, and related products	Condensed caramel
	Dessert additions
	Dessert toppings
	Honey
	Icing
	Other sugar-based products
	Sugar
	Sweeteners
	Syrup
Vitamins and supplements*	

*Not one of the main 15 food groups

Appendix 3: Counts of total and sports foods used for Chi-square analysis

Food Group		Total Foods	Sports Foods
Bread and Bakery products	Early	4999	9
	Late	5095	17
Cereals and cereal products	Early	4163	47
	Late	4621	98
Confectionery	Early	2593	4
	Late	2662	4
Dairy	Early	5391	1
	Late	5880	41
Fruit and Vegetables	Early	5164	4
	Late	5678	31
Meat	Early	2945	3
	Late	3169	5
Non-alcoholic drinks	Early	3833	175
	Late	4209	154
Beverage mixes	Early	229	27
	Late	221	29
Electrolyte drinks	Early	99	94
	Late	88	86
Energy drinks	Early	224	6
	Late	238	5
Fruit & vegetable juices	Early	1093	4
	Late	1054	1*
Soft drinks	Early	931	15
	Late	1138	10
Waters	Early	356	11
	Late	482	14
Sauces	Early	5124	5
	Late	5347	1*
Snack foods	Early	1270	1*
	Late	1543	1

Food Group		Total Foods	Sports Foods
Special foods	Early	1237	471
	Late	1363	570
Breakfast beverages	Early	123	76
	Late	115	92
Diet drinks	Early	49	39
	Late	70	62
Meal replacements	Early	37	37
	Late	22	22
Other fitness or diet products	Early	22	20
	Late	31	26
Protein bars	Early	173	172
	Late	256	255
Protein powders	Early	119	119
	Late	107	106
Sports gels	Early	18	18
	Late	11	11
Vitamins and supplements	Early	1*	1*
	Late	49	1

Bold = Main food group

Not bold = underlying subcategories

* = true value was 0, changed to 1 for Chi-square analysis