An analysis of Canadian young adults' eating behaviours towards sustainable food choices

by

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Statement of Contribution

I am the sole author for Chapters 1 and 5 which were not intended for publication. Chapters 2, 3 and 4, which have been published or prepared for publication, are co-authored with other contributors.

Chapter 2 is published in the *British Food Journal*, on which I was the lead author joined by Leia M. Minaker, Jennifer K. Lynes, Derek T. Robinson and Goretty M. Dias. Chapter 3 is under review in the *International Journal of Sustainability in Higher Education*, on which I was the lead author joined by Leia M. Minaker, Jennifer K. Lynes and Goretty M. Dias. Chapter 4 is under review in the *Journal of Cleaner Production*, on which I was the lead author joined by Goretty M. Dias.

Bibliographic details for these co-authored works are provided below:

Chapter 2: Mollaei, S., Minaker, L. M., Robinson, D. T., Lynes, J. K., & Dias, G. M. (2022). Including sustainability factors in the derivation of eater profiles of young adults in Canada. *British Food Journal*, Vol. 125 No. 5, pp. 1874-1894.

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Abstract

Human health has always been a major concern when it comes to policy design, decision-making, and planning. However, in recent years and with ideas about sustainability gaining traction, planetary health has also been gaining attention from researchers, policy makers and even businesses. There is an inevitable link between human and planetary health. Activities related to food provision and food systems in general are a major determinant of human health and environmental sustainability. The global food system requires a transformation to reduce its adverse impacts on both human and environmental health and to achieve food security. While major improvements have been made in practices related to food production, advances are required from the demand side as well. From the demand side, focusing on food consumption can be a promising approach to alleviate the negative impacts associated with food systems.

In terms of sustainable eating behaviours, young adults are a critical population. They often have poor eating habits and habits gained at this stage of life can sustain overtime and become their regular eating habits. Furthermore, given the current global environmental changes, young people will experience stronger consequences from environmental challenges, such as climate change. Therefore, their habits and behaviours, including those associated with how they eat, can have major impacts on their future. This dissertation focuses on the eating habits of young adults ages 18 to 24.

In this dissertation, the first study is a quantitative analysis where a Canada-wide survey was conducted among young adults to identify the main individual, environmental, and behavioral factors affecting eating behaviours and to categorize this target population into consumer segments reflecting their eating behaviours. The study found, there were six major factors influencing eating behaviours among young adults in Canada including: (1) beliefs (ethical, environmental and personal), (2) familiarity and convenience, (3) joy and experience, (4) food influencers and Sociability, (5) cultural identity, and (6) body image; the respondents were segmented into six groups based on the importance they attributed to each

of the identified factors as follows: (1) the conventional consumer, (2) the concerned consumer, (3) the non-trend follower consumer, (4) the tradition-follower consumer, (5) the indifferent consumer and (6) the 'eat what you love' consumer; and, more than half of the population in this study have specific considerations and criteria for their food choices, which distinctly differentiates each segment.

The second study is a qualitative analysis where focus groups were conducted among university students to first identify the perceived meaning of sustainable food and sustainable eating, and second, to identify the determinants of sustainable eating behaviours among university students. The study found, university students had a wide range of perceptions regarding defining the attributes of sustainable food, and the aspects of sustainable eating behaviours. In addition to the factors previously presented in the framework by Deliens et al., 'environmental and social values and beliefs', 'campus food', 'the pandemic' and 'food guides and expert recommendation' were added as determinants of sustainable eating behaviours. Among all categories, the top two themes mentioned by the participants were food literacy, and campus food (meal plan and university food outlet). Finally, identified personal and environmental factors can motivate or act as a barrier for sustainable and healthy behaviors of university students.

Finally, in third study I looked at the dietary trends of young adults in Canada and how it has changed from 2004 to 2015. Using the CCHS-Nutrition data, I presented the average diet of a Canadian young adult. Additionally, I looked at the carbon footprint (CF) of the average diet and its changes over the 10-year period. Three dietary trends were identified; first, there was a shift towards the consumption of food that is heavily recommended by Canada's Food guide; second, there was a shift towards the consumption of food that is considered to have lower CF; and third, protein intake increased and was mainly from animal-based sources for both years with almost identical ratio for animal-based to plant-based protein. The study also identified the overall CF of self-reported diets decreased only slightly in 2015. The identified trends demonstrated that although diets of Canadian young adults are moving towards the

right direction (healthy and with lower environmental impact), the shift is not significant and needs major interventions, particularly regarding reducing CF.

The research presented in this dissertation has contributed to knowledge and the scholarly literature regarding eating behaviours that support both human health and planetary health. This study also helps with the design and implementation of food-choice interventions underscoring the need for population-specific interventions, emphasis on knowledge translation and highlighting the link between food choices and their environmental impacts such as carbon footprint, and the need for interventions at the campus food environment level present a significant opportunity.

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Last but not the least, I would like to thank my family for their constant love and support and my friends for being there for me.

Dedication

I would like to dedicate this dissertation to my family who were my greatest support and believed in me every step of this journey.

To woman, life, freedom!

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Chapter 1

1.1 Overview

In this dissertation, I looked at the eating behaviours of young adults through the lens of sustainability by (1) understanding their perception of sustainable food and eating behaviours, (2) identifying and examining factors affecting their sustainable eating behaviours, and presenting consumer segmentations based on their eating behaviours, (3) and finally, examining dietary changes in this population (trends) and associated environmental impact over 10 years. These efforts establish an overview of current eating behaviours among Canadian young adults, and the extent to which sustainability is integrated into their eating behaviours, to provide insight regarding approaches (such as interventions) aimed at improving eating behaviours.

In this chapter, I provided an overall background regarding research included in my doctoral dissertation as well as how this research connects with sustainability management. Finally, an overview of how this dissertation is structured (Chapters 2 to 5) is provided in the final section of this chapter.

1.2 Introduction

Human health has always been a major concern when it comes to policy design, decision-making and planning. However, in recent years and with ideas about sustainability gaining traction, planetary health has also been gaining attention from researchers, policy makers and even businesses. The three commonly agreed pillars of sustainability include economy, society and environment (Hacking & Guthrie, 2008; Kates et al., 2005). Therefore, in a shift towards sustainability, aspects related to the well-being of society and the natural environment are interconnected.

There is an inevitable link between human health and planetary health (Burlingame et al., 2010; Gonzalez Fischer & Garnett, 2016). Human activities at different levels contribute to major environmental impacts, often adversely, such as climate change or pollution and in turn result in health-related consequences such as diseases and malnutrition. Food systems

are a big contributor to environmental degradation compared to many other activities and industries, with impacts including interference with the global nitrogen and phosphorus cycles, and land-system change, biodiversity loss, land-use change, freshwater use and greenhouse gas (GHG) emissions (Garnett et al., 2015; Willett et al., 2019). In Canada, although the contribution of food systems to GHG emissions is lower compared to other industries, these emissions are responsible for 30-40% of the overall emissions (Crippa et al., 2021).

Activities related to food provision and food systems in general are a major contributor to human health and environmental sustainability (Garnett, 2011). Food systems encompass a wide range of activities from agriculture and live-stock production, to transportation and distribution, retailing, consumption and food disposal as well a variety of stake holders such as farmers, food outlets and consumers (Ericksen, 2008). The growing population coupled with inefficiencies in our current food system can have major implications in terms of food security and other health-related social and environmental challenges (Ingram, 2011; Mbow *et al.*, 2019). Given that demand for food is estimated to increase by 50% by 2050, the current food system is failing to achieve global food security without drastic negative environmental consequences (IPCC, 2018b).

Food security is one of the main intended outcomes of food systems and is defined as

> *when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996).*

Food system activities (such as production or consumption of food) and drivers of social and environmental change within this system impact different components of food security (Ericksen, 2007). Therefore, as an urgent public health matter, food security requires context-specific solutions to manage the trade-offs among different food system activities and decision-making processes, including policy or intervention development.

The global food system requires a transformation to reduce its adverse impacts on both human and environmental health (Willett et al., 2019) and to achieve food security. While

major improvements have been made in practices related to food production, advances are required from the demand side as well (Tilman & Clark, 2014). From the demand side, focusing on food consumption can be a promising approach to alleviate the negative impacts associated with food systems. In Canada, the consumer end of a food system supply chain (including waste) is estimated to account for 20-30% of GHG emissions (Food Policy for Canada, 2021). Therefore, within the food system, consumption of sustainable food and sustainable eating behaviours present major opportunities to reduce the overall GHG emissions of food systems (Mbow et al., 2019). Dietary patterns represent an individual's dietary intake which is a combination of food and beverages over a period of time (Reedy et al., 2017). Public health often focuses on supporting dietary patterns that align with human health and address nutritional needs (Swinburn et al., 2015), but more recently, the need for a paradigm shift towards dietary patterns that are both sustainable and healthy has been underscored (Dangour et al., 2017; Ridgway et al., 2019; Ruben et al., 2021). According to Food and Agriculture Organization (FAO) sustainable diets are defined as

> *"Those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources" (FAO, 2010)*

The definition of sustainable diets by FAO illustrates that in addition to health and nutritional value, other social and environmental aspects related to diets should be taken into consideration. Therefore, a sustainable diet goes beyond just environmental impacts. Sustainable diets and eating behaviours are gaining more attention from governments and nutritionists (Carlsson et al., 2019; FAO, 2019; Health Canada, 2019; Livsmedelsverket, 2015; Ministry of health of Brazil, 2014). Countries are integrating sustainability into their dietary guidance. In 2019, Canada also revised Canada's Food Guide to Health Eating and included information and suggestions for increasing sustainability in food choices (Health Canada, 2019).

There are not set targets that can guide achieving healthy and sustainable diets; however, global attempts have been setting targets and goals to define "the safe operating space of food systems" (Willett et al., 2019). The Sustainable Development Goals (SDGs) and The Paris Agreement are examples of such endeavors (United Nations, 2015a, 2015b). The SDGs are a blueprint for a sustainable trajectory and cover issues related to human health, planetary health and other global challenges. One of the central areas of focus within the SDGs is related to food (FAO et al., 2022), which is reflected in: Goal 2: Zero hunger; Goal, Goal 3: Good health and well-being; and Goal 12: Responsible consumption and production. Although all goals are linked and inextricably intertwined, according to a recent report by FAO, in addition to goals 2, 3 and 12 the goals that contribute to food systems more than the others are: Goal 4: quality education; Goal 8: decent work and economic growth; Goal 11: sustainable cities and communities; Goal 13: Action on climate change; Goal 14: Life below the water; and Goal 15: Life on land (FAO, 2021). Moreover, in order to achieve The Paris Agreement's goal to maintain temperature increase well below 2°C (United Nations, 2015a), given the impacts of food systems on climate change, major efforts and changes in practices are required.

Having set goals and agendas to achieve a sustainable food system is beneficial, but it is not enough. Governments, policy makers, businesses and organizations, both private and public who are active in the food sector, should have targets and guidelines that directs them towards achieving a healthier and more sustainable food system. Efforts such as the *Eat Lancet Commission* report have provided actionable science-based targets aimed at shifting the current food system to a more sustainable one by focusing on healthy diets and sustainable food production (Willett et al., 2019). More specific targets and recommendations are necessary for different food environments and target populations (Brečić et al., 2017). Therefore, a closer look at critical populations in required in order to better understand their eating behaviours and food consumption characteristics.

In terms of sustainable eating behaviours, young adults are a critical population. Looking back at the definition of sustainable development, intergenerational justice is one of the main

concerns (Brundtland, 1987). To this end, young people should have the resources to fulfil their needs in the future. Furthermore, given the current global environmental changes, young people will experience stronger consequences from environmental challenges, such as climate change (IPCC, 2018b). Therefore, their habits and behaviours, including those associated with how they eat, can have major impacts on their future. To address this concern, there are a variety of studies and projects aimed at improving dietary habits particularly among young adults (Bauer & Reisch, 2019; Belogianni & Baldwin, 2019).

This dissertation focuses on young adults as its target population which encompasses ages 18 to 24. Concerning eating behaviours and studies related to food consumption the importance of young adults as the target group are threefold:

1. First, the transition from adolescence to young adulthood is a critical stage of life and an important milestone. It is often at this stage that the separation from families happen and they move towards creating their own identity as an independent person (Nelson et al., 2008). The newly gained independence and autonomy provides young adults with the opportunity to try and demonstrate new behaviours and habits, including food related behaviours. Furthermore, changes in living arrangements and daily schedule, possibly generating personal income and the necessity to manage their budget all make this transition more important in terms of habit formation (Nelson, Kocos, Lytle, & Perry, 2009).
2. Second, a review of the literature shows that young adults often have poor eating habits. High consumption of sugar-sweetened drinks and saturated fats, higher fast food intake, lower fruit and vegetable intake and skipping breakfast are examples of these negative eating habits (Alghamdi et al., 2018; Michels et al., 2019; Sharma et al., 2018). Academic or social stress and pressure, lack of self-discipline and time, as well as budget constraints are some of the reasons identified in the literature that contribute to these behaviours (Marquis et al., 2019). Furthermore, poor eating habits have been linked to health concerns such as obesity (Emmett & Jones, 2015).

3. Third, habits gained at this stage of life can sustain overtime and become their regular eating habits (Larson et al., 2012; Laska et al., 2012; Vaitkeviciute et al., 2015) which they can also transfer to future generations (Appannah et al., 2021).

Therefore, studying this population and their eating behaviours is an important topic from a health standpoint as well as how it might impact the environment (given the contribution of dietary choices to the environment in general). Many interventions aimed at improving eating habits focus on young adults and particularly university/college students (Ashton et al., 2019). Post-secondary institutions provide a unique and important food environment where different interventions can be implemented and tested (Lee et al., 2021). Results from the current study provide valuable insight on how to approach this population in terms of intervention design and implementation.

Studies on topics such as food systems which require a holistic way of thinking, require a systems-thinking approach. In literature related to food systems and its consequences for food security, a variety of tools, approaches and concepts have been utilized (Ingram & Zurek, 2019). A common theme between these approaches (such as Ericksen (2008)) is the interrogation of food systems through a holistic and systematic lens. As an approach, sustainability management can be applied to examine challenges related to food systems and the concern of food security (including access, affordability and availability). Sustainability management is a novel field in academia that approaches environmental, social and economic challenges through an interdisciplinary lens. Sustainability management acknowledges the interconnection and interdependence of topics and concerns related to sustainability (Hammer & Pivo, 2017). Therefore, when analyzing a complex issue such as food systems, sustainability management provides a comprehensive point of view that can encompass different aspects, actors, connections and interdependencies, and provide insight on how to manage the transition to a more sustainable state.

1.3 Research Gap

There is a growing body of literature focused on illustrating the link between food and sustainability and transition approaches to a sustainable food system (Ericksen, 2007, 2008; Gaitán-Cremaschi et al., 2019). A review of the literature shows that although sustainability of food choices is gaining momentum, the majority of research in this area focuses mostly on nutrition and health, with very limited studies focusing on both human and planetary health (Lee et al., 2021). However, there are still opportunities to take a systems-thinking approach while tackling challenges related to food systems particularly with a focus on the demand side.

On the one hand, diets are the intersection between food systems and public health outcomes (Fanzo & Davis, 2019). On the other hand, consumption trends and patterns also affect the impacts of food systems on the natural environment and the society (Ericksen, 2008). Therefore, knowledge related to diets and the types of food people consume is essential in shaping nutrition policies, practices within food systems, and the promotion of healthy and sustainable food consumption. Given the lack of holistic studies looking at sustainable and healthy diets, and the importance of young adults as a target population, the overarching goal of this dissertation is to conduct a comprehensive examination of the dietary behaviours of young adults in Canada by utilizing both qualitative and quantitative research methodologies. Furthermore, results from this study are to be utilized for the design and implementation of interventions aimed at improving (healthy and sustainable) eating behaviours.

1.4 Research Significance and Contributions

The role of food in supporting human health and its impact on the planet is inevitable (Gonzalez Fischer & Garnett, 2016), but trends show our current food system and diets are having mostly negative impacts (Clark et al., 2018; FAO et al., 2021, 2022). To eradicate these negative impacts, there has been much attention aimed towards identifying the drivers of recent dietary trends as well as interventions that promote improved eating (Swinburn et al., 2015). Given that most of such endeavors (such as policy interventions or social

campaigns) have been geared towards healthy eating patterns and to a lesser extent towards sustainable diets (Arno & Thomas, 2016; Broers et al., 2017; Deliens et al., 2016; Roy et al., 2015), more attention should be channeled into simultaneously supporting diets with lower environmental impacts.

Data from real-world settings can inform policy and behavioural interventions, examine the synergies and trade-offs associated with the interventions, and assess the scalability and effectiveness of such interventions for specific populations or settings in order to achieve a paradigm shift towards sustainable food systems (Lee, 2021). The current research contributes to this paradigm shift by exclusively looking at young adults and providing insight into their specific eating behaviour characteristics, trends and environmental impacts, as well as individual/environmental/social determinants of these behaviours. This insight enables focused and tailored intervention design and implementation. Given that food interventions include a variety of strategies (such as provision of information, environmental (physical environment) interventions, or use of salience and social norms) (Bauer & Reisch, 2019; Belogianni & Baldwin, 2019) and can have different types of message framing (focused on sustainability, health or both) (Cho & Baskin, 2018; Cordts et al., 2014), choosing the appropriate intervention is critical. Results from the current study can help identify which type of intervention and message framing are more appropriate for young adults and increases the likelihood of success.

1.5 Ontological and epistemological perspective and theoretical lens

Ontology is concerned with the nature of reality and answers to questions such as ‘what is there that can be known?’, ‘What exists?’, and ‘What is true?’ (Crotty, 2003). The ontology of this study falls in the middle of the spectrum ranging from realism, where only one reality exists (the truth), and relativism, where multiple realities exists according to individuals’ perception (no one ‘true’ reality exists) (Moon & Blackman, 2014). Therefore, the ontology of this study is aligned with critical realism where reality is explained through multiple layers (the empirical, the actual and the real/causal level) (Bhaskar, 1978). There is a reality that we

can experience with our senses (the empirical), a reality that may or may not be observed/experienced but exists (the actual) and the reality beyond empirical or sensation.

Epistemology is concerned with how we understand, our knowledge and how we know what we know (the logic behind our knowledge) (Crotty, 2003). In the current research the epistemological approach is that the truth or reality is the result of our engagement with the world which is in line with constructionist epistemology. In constructionism "meaning [is] created from interplay between the subject & object" (Moon & Blackman, 2014, p. 1169).

The Social Cognitive Theory (STC) is used as a reference to describe the determinants of behaviour in this study. The STC explains the interaction and relation between personal factors, environmental factors and behaviours (Bandura, 1999). Continuous, dynamic and reciprocal interaction between these factors determines an individual's behavior, including their eating behaviours and answer questions such as why people might adapt a healthy and sustainable diet. The SCT describes behaviours on an interpersonal level and explains the connections between individuals, social influences and their relationship with their surrounding environment. This theory was used as a reference to segment the population as it helps explain the eating behaviour characteristics of the population. In addition to STC, the current study also uses previously published frameworks such as the framework by Deliens et al. (2014) which presents the determinants of eating behaviours of university students.

1.6 Thesis Overview

This dissertation is organized as follows: Chapter 1 is an introductory chapter including an overview of this study, a review of the literature and the main gaps, how this study links to sustainability management, the significance of this study, and finally an overview of the organization of this dissertation.

In Chapter 2, using quantitative analysis a Canada-wide survey was conducted among young adults (aged between 18-24) in order to identify the main individual, environmental and behavioral factors affecting eating behaviours. Furthermore, these factors were then used to categorize this target population into consumer segments reflecting their eating behaviours.

Chapter 3 included a qualitative analysis where focus groups were conducted among university students (aged between 18-24) in order to first identify the perceived meaning of sustainable food and sustainable eating, and second, to identify the determinants of sustainable eating behaviours among university students.

In Chapter 4, I looked at the dietary trends of young adults in Canada and how they changed from 2004 to 2015. Using the CCHS-Nutrition data, I presented the average diet of a Canadian young adult in terms of type of food and amount consumed. Additionally, I looked at the carbon footprint of the average diet and its changes over the 10-year period.

Finally, in Chapter 5, I concluded by reflecting upon the contributions of this thesis, and suggesting areas for future work.

Chapter 2

Including sustainability factors in the derivation of eater profiles of young adults in Canada

The contents of this chapter are published:

Mollaei, S., Minaker, L. M., Robinson, D. T., Lynes, J. K., & Dias, G. M. (2022). Including sustainability factors in the derivation of eater profiles of young adults in Canada. *British Food Journal*, Vol. 125 No. 5, pp. 1874-1894.

2.1 Abstract

Purpose – The purpose of this research is to (1) identify factors affecting food choices of young adults in Canada based on environmental perceptions, personal and behavioral factors as determinants of eating behaviors; (2) segment Canadian young adults based on the importance of the identified factors in their food choices.

Design/methodology/approach – An online survey was administered to Canadians aged between 18 and 24 to collect data on socio-demographic factors and eating behaviors (N 5 297). An exploratory factor analysis (EFA) was used to identify the main factors affecting eating behaviors in young adults, followed by K-means clustering to categorize the respondents into consumer segments based on their propensity to agree with the factors.

Findings – Six factors were extracted: beliefs (ethical, environmental and personal); familiarity and convenience; joy and experience; food influencers and sociability; cultural identity; and body image. Using these factors, six consumer segments were identified, whereby members of each segment have more similar scores on each factor than members of other segments. The six consumer segments were: “conventional”; “concerned”; “indifferent”; “non-trend follower”; “tradition-follower”; and “eat what you love”.

Originality/value – Identifying major factors influencing eating behaviors and consumer segmentation provides insights on how eating behaviors might be shaped. Furthermore, the outcomes of this study are important for designing effective interventions for shaping eating behaviors particularly improving sustainable eating habits.

2.2 Introduction

Eating habits are important from a sustainability perspective because food systems have significant environmental impacts (Garnett, 2011) from farm-to-fork. Food systems are responsible for almost one-third of global GHG emissions (Garnett et al., 2015) and contribute significantly to exceeding planetary boundaries (Rockström et al., 2009), particularly in terms of land and water use, biodiversity, and biogeochemical flows of nitrogen and phosphorous (Campbell et al., 2017; Hallström et al., 2015). Diets high in animal proteins have higher environmental impacts than plant-based diets (Aleksandrowicz et al., 2016a; Veeramani, 2015) and are associated with higher incidences of non-communicable diseases (Pan et al., 2011; Rouhani et al., 2014; Wang et al., 2015). Thus, shifts towards plant-based diets at the population level could have positive human and planetary health outcomes (Nelson, Hamm, Hu, Abrams, & Griffin, 2016; Willett et al., 2019).

Nevertheless, changing eating behaviours is challenging as food decisions are complex and impacted by a variety of personal and environmental factors (Glanz et al., 2005). Some of the most common interventions employed by governments, institutions and other entities to improve eating behaviours include: banning or taxing unhealthy food, limiting options, putting pressure (i.e. increasing prices) on customers, and "nudges" such as promotion of healthier options or provision of information (Bauer & Reisch, 2019; Belogianni & Baldwin, 2019; Guthrie et al., 2015). The effectiveness of these interventions depends on how they are implemented (Shang, 2018) and the degree to which they are tailored to a specific target population.

Within a population comprising similar demographic characteristics, there can be different types of consumers. Consumers can have different attitudes towards interventions aimed at improving their eating behaviours and therefore a "one size fits all" approach may not be effective (Brečić et al., 2017). In other words, consumers may react differently to a particular intervention or promotional activity. Preliminary research to understand the diversity of these reactions has included the development of consumer segments, based on factors affecting

eating behaviours, which derived different segments (e.g., convenient, conservative, and healthy and tasty food lover consumers) with different intervention responses (Brečić et al., 2017; Funk et al., 2021; Jakubowska & Radzymińska, 2019; Kamenidou et al., 2019; Marquis et al., 2019; Szakály et al., 2012). Examples of such factors from the literature include price sensitivity, perceptions of "ethical eating", convenience, health considerations and other Psychological and Socio-environmental factors (Jenkins et al., 2021; Maillet & Grouzet, 2021). In similar work, Jakubowska and Radzymińska, segmented Polish and Czech young adults based on their health and environmental attitudes and values in food choices (Jakubowska & Radzymińska, 2019). Szakály et al. used lifestyle, health and behavioral factors to segment a sample population in Hungry (Szakály et al., 2012). Kamenidou et al., focused more on sustainability related characteristics and segmented university students into two groups based on sustainable food consumption and attitudes (Kamenidou et al., 2019). However, food consumer segmentation has predominantly taken place outside of Canada (e.g., Eastern Europe, Switzerland, Greece), with the exception of one study in Quebec, Canada (Marquis et al. 2019). Marquis et al. focused on university students in Quebec, Canada and categorized them into four eater profiles (e.g. The planet-nutrition-kitchen lover, The utilitarian lonely eater, The body-driven eater, and The mindless eater) (Marquis et al., 2019). Therefore, there is a gap in consumer segmentation related to food choices in the Canadian context.

Most research related to eating habits that aims to segment consumers have examined factors related to nutritious food consumption among consumers, rather than the environmental sustainability aspects. In sustainability and health-related purchases and behaviours, socio-demographic characteristics can play an important role (Sarti et al., 2018). For example, young adult men are less receptive to health promotion messages than women, while women generally tend to purchase more 'green' products (Munt et al., 2017). However, there remains a lack of consumer segmentation research about ethical, environmental, and general sustainability considerations, in addition to common factors affecting food choice, such as price or taste. Understanding different characteristics of consumer segments and factors

affecting their eating behaviours is the first step toward increasing the effectiveness of interventions to improve sustainable eating behaviours.

As a step toward filling this gap in consumer segmentation research, we identified eater profiles (consumer segments) of young adults in Canada, based on environmental perceptions as well as personal and behavioural factors as determinants of eating behaviours, to improve our understanding about the relationship between consumer segments and sustainable eating behaviours. Since young adulthood is a time of transition, which includes transformation of eating behaviours, this was the target population for the study. This study represents a first step to derive insights about the factors that affect eating behaviours that can help design successful interventions towards sustainable food consumption. Young adults often have unhealthy and poor dietary habits (Deforche et al., 2015) due to a variety of factors such as academic or social stress and pressure, lack of self-discipline, lack of time, budget constraints (Marquis et al., 2019), and limited food literacy (Malan et al., 2020). These habits include, but are not limited to, high consumption of sugar-sweetened drinks and saturated fats, higher fast food intake, lower fruit and vegetable intake and skipping breakfast (Alghamdi et al., 2018; Michels et al., 2019; Niemeier et al., 2006; Sharma et al., 2018).

During this transition, young adults develop a new sense of identity, autonomy, independence, social and physical habits (Arnett & Hughes, 2014; Gall et al., 2000). Therefore, this phase of life is critical as it is a transition phase that could shape and contribute to their future food choices and habits which in turn could have life-long health implications (Malan et al., 2019; Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008; Vaitkeviciute, Ball, & Harris, 2015). Within this population, promoting both healthy and sustainable eating behaviours requires a better understanding of specific characteristics and factors affecting young adults' food choices to create environments supportive of healthy and sustainable dietary practices. Insight about young-adult sustainable-eating behaviours is gained by answering the question what are the eater profiles of young Canadian adults, based on factors affecting food choices? To answer this question, we first, identify factors affecting food choices of young adults in Canada based on environmental perceptions, personal, and

behavioural factors as determinants of eating behaviours; and second, segment Canadian young adults based on the importance of the identified factors in their food choices.

A sample of young adults living in Canada was acquired to explore eating patterns and associated socio-demographic characteristics. Through this effort, new insights are gained about the drivers of healthy and sustainable eating, which can be used to inform the types of interventions that could contribute to dietary shifts that are healthy and sustainable. This study contributes to the growing field of research on sustainable eating patterns and behaviours with data from a North American context, with the ultimate goal of producing knowledge about specific characteristics of each segment, which can help with the planning and implementation of more effective marketing or educational activities.

2.3 Methods

A cross-sectional study was conducted using data collected with an online survey, followed by statistical analysis to define clusters for consumer segmentation. The study received ethics approval from the University of Waterloo (ORE 41458).

2.3.1 Survey design and sampling

To examine the factors affecting eating behaviours among Canadians, an online questionnaire was developed (See Section 2.2 for details) and administered across Canada using Qualtrics Survey Software, in both French (for province of Quebec residents) and English (for the rest of Canada). The survey was distributed through a survey service, Quest Mindshare (Quest Mindshare, n.d.) in November 2020. Quest Mindshare is a third-party survey service and a reliable source for survey distribution that uses an existing pool of participants who were contacted (by the provider) to fill out the survey. The number of participants needed were determined based on statistical data (for example province population or gender distribution), and this information about as provided to Quest Mindshare to ensure that solicited respondents were representative of the Canadian population. A remuneration was paid to participants based on the average time required to finish the survey and their previous participation in surveys administered by the service

provider. Participation in the study was voluntary and anonymous. Since the focus of this study was on the young adult population in Canada, only the responses from the age group of 18-24 was used for the current study (N=297).

2.3.2 Survey design: Factors and Variables

Food Attitudes and Behaviors: A theoretical framework, known as Social Cognitive Theory (Baranowski, Perry, & Parcel., 2002; Marquis et al., 2019; Renner et al., 2008), was used to identify and describe the determinants of behaviour as well as the interaction and relationships between environmental and personal factors affecting eating behaviours (Bandura, 1999). The questions were based on Social Cognitive Theory, and were related to personal, environmental and behavioural factors affecting eating behaviours. Food attitudes and behaviors questions were derived from the U.S. National Cancer Institute's (NCI) Food Attitudes and Behaviors (FAB) Survey (National Cancer Institute (NCI), 2020), and other similar studies investigating eating behaviours (Booth et al., 2001; Deliens et al., 2014; Erinosho et al., 2012; Glanz et al., 2005; Markovina et al., 2015). More specifically, 52 questions were included in the questionnaire which addressed personal preferences, health and wellbeing, convenience and familiarity, environmental impact considerations, weight control and body image, food neophobia, food involvement, price, food culture, food choice influencers and sociability. For each question, respondents were asked to provide their answers indicated on a 7-point Likert scale (1 = not important at all and 7 = very important) as to how important it was in their food choice. The study was piloted with 20 graduate students from the Faculty of Environment at the University of Waterloo, and feedback was used to improve the wording and delivery of the survey.

Socio-demographic Factors: Relevant socio-demographic data were collected, which included gender (male, female, other, prefer not to say), highest level of education (no certificate, secondary school diploma, apprenticeship or trades certificate or diploma, college or university certificate or diploma below or equal to bachelor level, University certificate or diploma above bachelor level), type of community (large urban center, small urban center and rural), immigration status (Canadian citizen, permanent resident), and province

(excluding territories). Income was also included in the questions; however, since many of the respondents declined to answer the question, it was eliminated from the analysis.

Best practices in survey design were reviewed and used for the design of the current survey (AAPOR, n.d.). To avoid survey fatigue, straightlining (non-differentiating in Likert scale ratings), and other issues that could lead to false results, several different methods of asking survey questions were used (e.g., avoiding too many matrix questions, using slider buttons, avoiding presenting too many questions on one page).

2.3.3 Statistical analysis

The 52 questions in our questionnaire were analyzed to identify factors affecting eating behaviours and group respondents into segments based on the strength of those factors in their food choice. However, we first interrogated the data visually and graphically to understand the distributions of responses and detect possible errors or outliers and removing questionnaires with missing data of which there were 12.

In order to determine the dominant and common factors affecting eating behaviours in young adults, an Exploratory Factor Analysis (EFA) was used. Factor analysis reduces a large number of the original variables (associated with each survey question) into latent variables, or factors, that summarize the original data. This is done by grouping the original variables based on strong inter-correlations. EFA is an investigatory process without any hypothesis underlying it, and assesses whether relationships exist between the initial variables, or statements, to reduce the number of variables for further analysis, thus simplifying otherwise complex models. The EFA was performed using a Varimax rotation. To ensure data were suitable for factor analysis, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used (Hair et al., 2010). If KMO>0.5, then data are acceptable for factor analysis, and for higher values, if KMO>0.7 data are middling, if KMO>0.8 data are meritorious, and if KMO>0.9 data are marvelous (Kaiser & Rice, 1974). Using the Bartlett test, data are acceptable for factor analysis if $\rho<0.05$ (Dziuban & Shirkey, 1974). A KMO test (KMO = 0.789) and Bartlett test ($\rho<0.000$) indicated data were suitable for factor

analysis. The inter-correlation matrix generated from the EFA method had no variables exhibiting correlations under 0.3 (Field, 2018).

The number of factors was determined based on a Scree plot and selecting eigen values greater than one. In order to interpret the factors, variables with factor loadings were ignored if their value was less than |0.3| (Santos et al., 2019). Cronbach's alpha was used to examine internal consistency of the survey items (i.e., the extent to which variables within a scale are associated with each other). In Likert-scale questionnaires, high reliability is demonstrated when Cronbach's alpha is higher than 0.7 (Field, 2013). Internal consistency reliability indicates the extent to which variables within a scale are associated with each other and gauges the consistency of the results when measuring the same construct.

Socio-demographic data was analyzed using chi-square to determine whether the distribution of population (based on socio-demographic factors) in each segment was statistically significantly different than or similar to the population. Once the six factors were extracted, interpreted and labelled based similar studies and the theoretical framework, all participants received a score for each factor. The extracted factors scores were used as standardized weights as input for the cluster analysis (Grunert et al., 2009). To assess the relationship between the extracted factors scores and socio-demographic data a non-parametric correlation test (Spearman rank correlation) was used for level of education, and chi-square test was used for gender, community type, legal status, and province, where a p-value smaller than 0.05 indicates statistical significance.

The extracted factors from the EFA were used to segment respondents using a cluster analysis, a commonly used method to segment consumers (Brečić et al., 2017; Espinoza-Ortega et al., 2016), by separating respondents into groups based on how similar they are to other subjects in that group. The clusters were determined using k-means clustering, which is suitable for clustering cases with similar characteristics (Hair et al., 2010). To choose the appropriate number of clusters, cluster count (k) was incremented from two to six. Testing different numbers confirmed that a six clusters solution is the suitable solution, and an ANOVA test demonstrated that all factors have significant impact on clustering (all $\rho <$

0.001). The clusters were named based on the scores obtained for each factor within each group, similar to the method used by Espinoza-Ortega et al. (2016). All statistical analyses were performed using IBM SPSS 27 (SPSS Inc., Chicago, IL).

2.4 Results

2.4.1 Sample Characteristics

A total of 297 (excluding the twelve incomplete responses) respondents between the age of 18-24 participated in our survey (Table 1). Among these respondents, 69% were female, 28.6% were male, 1.7% identified as other gender, and 0.7% chose "prefer not to answer". In terms of gender distribution, the female respondents are over represented in this study compared to the 20-24 years old Canadian population (Statistics Canada, 2020b). A total of 93.6% of the respondents were Canadian citizens and 6.4% were permanent residents of Canada. The majority of the respondents were living in urban centers (58.9%) of over 100,000 people, while 30.6% resided in small urban centers, and 10.4% in a rural area, which is representative of the Canadian population (Statistics Canada, 2011, 2016).

The highest level of education of survey respondents was similar to the education levels of 20-24 year-olds in 2016 across Canada (Statistics Canada, 2017c). The highest level of education was a university certificate or diploma above bachelor level (10.1%) followed by a college or university certificate or diploma below or equal to bachelor level (35.0%), apprenticeship or trades certificate or diploma (8.4%), secondary (high) school diploma (36.7%), and reported having no certificate, diploma or degree (9.8%).

Most of the respondents were from Ontario (45.8%), Quebec (18.2%) and British Columbia (12.5%). Because the survey sampling was targeted to be representative of the Canadian population, this aligns with the highest population provinces; however, in this age group the Ontario respondents are slightly overrepresented and Quebec is slightly underrepresented (Statistics Canada, 2020b).

Table 1- Socio-demographic characteristics of the respondents

Socio-demographic variable	Frequency in survey		Canadian population
	(n)	(%)	(%)
Gender			
Female	205	69.0	47.8
Male	85	28.6	52.2
Other	5	1.7	
Prefer not to say	2	0.7	
Total	297	100	
Legal status in Canada			
I am a Canadian citizen.	278	93.6	
I am a Permanent Resident of Canada.	19	6.4	
Total	297	100.0	
Type of community			
Large urban center (more than 100,000 people)	175	58.9	59.9
Small urban center	91	30.6	21.5
Rural area	31	10.4	18.9
Total	297	100.0	
Highest education			
No certificate, diploma or degree	29	9.8	11.5
Secondary (High) school diploma	109	36.7	23.7
Apprenticeship or trades certificate or diploma	25	8.4	10.8
College or university certificate or diploma below or equal to bachelor level	104	35.0	45.1
University certificate or diploma above bachelor level	30	10.1	
Total	297	100.0	
Province			
Alberta	34	11.4	11.1
British Columbia	37	12.5	13.7
Manitoba	9	3.0	3.9
New Brunswick	6	2.0	1.8
Newfoundland and Labrador	5	1.7	1.2
Nova Scotia	6	2.0	2.5
Ontario	136	45.8	41.8
Prince Edward Island	1	0.3	0.5
Quebec	54	18.2	20.1
Saskatchewan	9	3.0	3.0
Total	297	100.0	

2.4.2 Factors Guiding Food Choices

Our factor analysis, using a |0.3| threshold for factor loadings, revealed only two questions that did not load strongly onto any factors, which were subsequently eliminated (People share common food tastes regardless of their cultural backgrounds; I do not trust new food technologies (e.g., lab meat) (Appendix A)). Using factor analysis, we identified six factors guiding food choices for Canadians aged between 18-24 (Appendix A), and interpreted the factors as follows: (1) beliefs (ethical, environmental and personal (EEP)) (Cronbach's $\alpha = 0.852$), (2) familiarity and convenience (Cronbach's $\alpha = 0.742$), (3) joy and experience (Cronbach's $\alpha = 0.723$), (4) food influencers and Sociability (Cronbach's $\alpha = 0.701$), (5) cultural identity (Cronbach's $\alpha = 0.743$), and (6) body image (Cronbach's $\alpha = 0.702$).

The *Beliefs* factor (ethical, environmental and personal) is related to respondents' concerns about whether the food is produced locally, has low environmental impact, is fair trade, as well as more personal considerations, including their cultural and religious beliefs. The *Familiarity and Convenience* factor includes considerations of taste, health, price, availability and familiarity, easy preparation, and visual appeal. The *Joy and Experience* factor is related to how respondents perceive food-related activities, such as cooking, shopping or dining and whether it is a joyful, enjoyable and an overall positive experience. This factor also includes respondents' attitude towards trying novel food and new recipes. The *Food Influencers and Sociability* factor explores the impact of media, and nutritionists and other influencers on food choices. Furthermore, this factor includes the social aspect of eating behaviours, such as eating out or eating with other people. The *Cultural Identity* factor is related to ethnic and cultural background influences on food choices. Finally, the *Body Image* factor, includes diets and weight considerations as guiding food choices.

With respect to sociodemographic influences on factors, there was a statistically significant positive correlation (Spearman's rank correlation, $\rho < 0.001$, $r_s=0.212$) between education and the *Joy and Experience* factor, suggesting that respondents with higher education attributed a higher value to factors related to the pleasure of cooking, looking for new

recipes, and food experiences. This finding illustrates the significance of education and knowledge as a factor affecting enjoyment related to food which could be due to higher cooking skills, food literacy and more exposure to new food related experiences. Previous research has shown cooking skills and food literacy tend to be higher with higher levels of education (Gréa Krause et al., 2018; Kowalkowska et al., 2018). There was no significant association found between any other socio-demographic characteristic and the identified factors (based on chi-square tests).

2.4.3 Consumer segments

As consumer food choices demonstrate their eating behaviours (Romeo-Arroyo et al., 2020), the results of the factor analysis were used to segment consumers using cluster analysis. This yielded six segments (representing the respondent's eater profile characteristics presented in Figure 1). The segments and their eating behaviour characteristics are as follow:

1. The conventional consumer - This first cluster accounts for the largest segment, making up 20.5% of the population. This segment is highly sensitive to *Familiarity and Convenience* considerations. Therefore, they are highly concerned about factors related to price and affordability, fast and easy preparation, sensory appeal, and brand recognition. These consumers are not very sensitive to other factors particularly *Cultural Identity, Joy and Experience* and *EEP Beliefs*.

2. The concerned consumer - The second cluster accounts for 19.5% of the participants and is composed of consumers that are concerned about all factors to some extent. In this segment *Food influencers and Sociabilit*y is the highest consideration. Sensitivity to *Body Image*, *Joy and Experience* and *EEP Beliefs* are similar to, but much lower than, *Food influencers and Sociability*. The only factor that is not that important is *Familiarity and Convenience*.

3. The non-trend follower consumer - The third cluster accounts for 19.5% of the participants. Consumers in this segment are most sensitive to factors related to *Joy and*

Experience and *EEP Beliefs*, and they are least concerned about *Food influencers and Sociability*.

4. The tradition-follower consumer - The fourth cluster accounts for 14.5% of the respondents. Consumers in this cluster are most sensitive to factors related to their *Cultural Identity*. They are also concerned about *Familiarity and Convenience*. Consumers in this segment mostly choose their food based on their family's traditional food or their cultural background. Eating behaviours rooted in their ethnicity, culture and food consumed by their family is a major consideration in this group. These consumers consider *Food influencers and Sociability* and *EEP Beliefs* which also relates to sustainability consideration and choosing food with low environmental impact not that important in their food choices.

5. The indifferent consumer - The fifth cluster accounts for 13.5% of the population. Compared to the second cluster, this cluster is not really concerned about any of the factors, particularly with *Familiarity and Convenience*. The only factor that has a very small effect on their eating behaviour is *Food influencers and Sociability*.

6. The 'eat what you love' consumer - The sixth and final cluster accounts for 12.5% of participants and is the smallest segment in terms of population. Consumers in this segment are somewhat sensitive to factors related to *Food influencers and Sociability*, *Familiarity and Convenience* and *EEP Beliefs*. In this segment, one notable characteristic is that *Body Image* is not at all their concern.

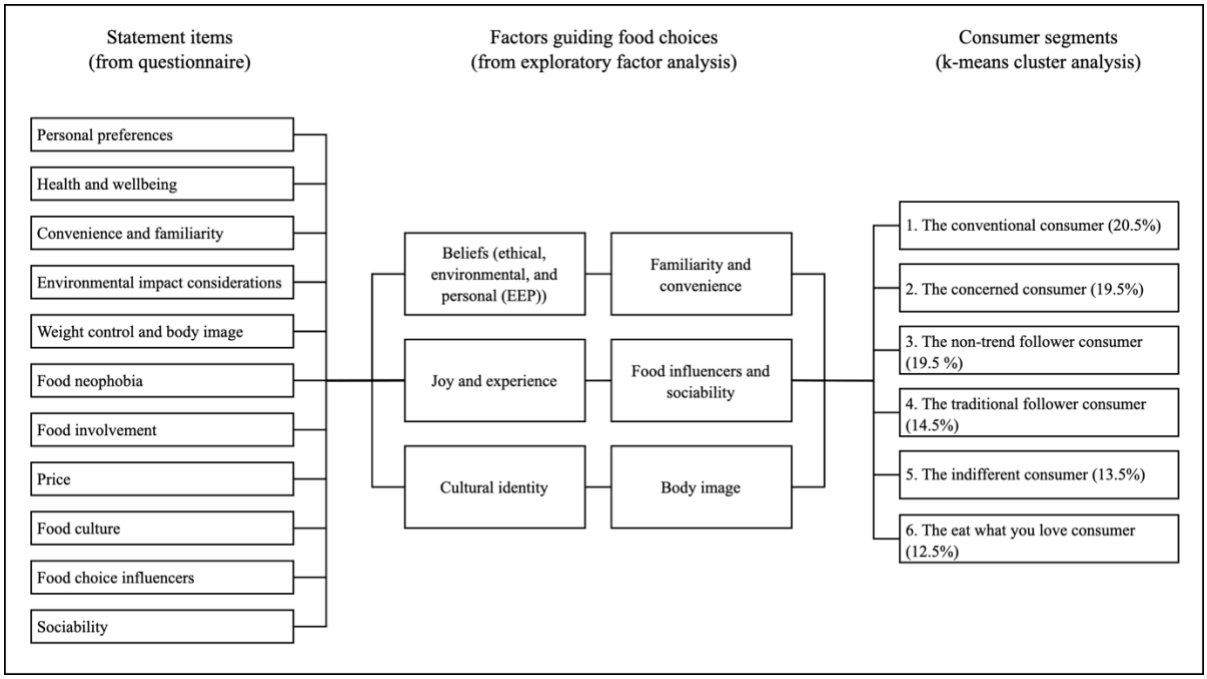

Figure 1 - Statements from questionnaire, representing 11 categories and 52 statements, which load onto six factors affecting food choices that were used to derive consumer segments describing eater profiles.

2.4.4 Segment demographics

In all segments gender distribution, composition based on legal status in Canada, type of community and province is very similar to the whole sample. There were also no significant differences in group composition by gender, province of residence, legal status in Canada, or type of community. Chi-square analyses indicated significant differences for the highest level of education among segments (p= 0.018). There were no participants with no certificate, diploma or degree in *the tradition-follower consumer* segment whereas in *the indifferent consumer* segment this population is much higher (15%) than the whole population (9.8%) and compared to the other segments. Within *The tradition-follower consumer* segment the population with a Secondary (High) school diploma is higher compared to the whole population (54% and 36.7% respectively). Finally, the number of participants with a university certificate or diploma above bachelor level is significantly higher in *the indifferent*

consumer (15%) and *the concerned consumer* segments (21%) compared to the other segments and the whole population (10%). Furthermore, although not identified as statistically significant through the tests, the number of participants from Quebec within *the concerned consumer* segment (5%) is lower compared to the other segments and the whole population (18.2%). The segment demographics are shown in Table 2.

Table 2 - Socio-demographic characteristics of segments

Socio-demographic characteristics	All Participants	The indifferent consumer	The conventional consumer	The concerned consumer	The non-trend follower consumer	The tradition-follower consumer	The eat what you love consumer
	N=297	n=40	n=61	n=58	n=58	n=43	n=37
Gender							
Female	69	60%	70%	60%	79%	74%	68%
Male	28.6	38%	28%	38%	21%	26%	22%
Other	1.7%	0%	2%	2%	0%	0%	8%
Prefer not to say	.7%	3%	0%	0%	0%	0%	3%
Legal status in Canada							
Canadian citizen.	93.6%	95%	97%	86%	93%	93%	100%
Permanent Resident of Canada.	6.4%	5%	3%	14%	7%	7%	0%
Type of community							
Large urban center (more than 100,000 people)	58.9%	60%	49%	71%	52%	65%	59%
Small urban center	30.6%	25%	38%	26%	33%	28%	32%
Rural area	10.4%	15%	13%	3%	16%	7%	8%
Highest education							
No certificate, diploma or degree	9.8%	15%	13%	10%	9%	0%	11%
Secondary (High) school diploma	36.7%	40%	36%	21%	31%	49%	54%
Apprenticeship or trades certificate or diploma	8.4%	10%	7%	5%	14%	9%	5%
College or university certificate or diploma below or equal to bachelor level	35.0%	20%	39%	43%	40%	35%	24%
University certificate or diploma above bachelor level	10.1%	15%	5%	21%	7%	7%	5%

Province							
Alberta	11.4%	10%	5%	9%	10%	16%	24%
British Columbia	12.5%	15%	13%	16%	14%	5%	11%
Manitoba	3.0%	3%	3%	5%	2%	2%	3%
New Brunswick	2.0%	3%	0%	3%	2%	2%	3%
Newfoundland and Labrador	1.7%	5%	3%	2%	0%	0%	0%
Nova Scotia	2.0%	0%	0%	3%	5%	0%	3%
Ontario	45.8%	45%	46%	57%	43%	44%	35%
Prince Edward Island	.3%	0%	2%	0%	0%	0%	0%
Quebec	18.2%	20%	21%	5%	21%	23%	22%
Saskatchewan	3.0%	0%	7%	0%	3%	7%	0%

2.5 Discussion

The presented research sought to answer the question, what are the eater profiles of young Canadian adults, based on factors affecting food choices? To answer this question, major personal, environmental and behavioural factors influencing eating behaviours of young adults in Canada were identified to better understand their attitudes towards adapting healthy and sustainable eating patterns. Three key finding emerged from this research. First, there were six major factors influencing eating behaviours among young adults in Canada. Second, the respondents were segmented into six groups based on the importance their attribute to each of the identified factors. Of these six segments, three were new consumer segments particularly identified for young adults in Canada. Third, more than half of the population in this study have specific considerations and criteria for their food choices which differentiates each segment from the others. Each of these findings is described in greater detail below.

The six factors identified as influencing eating behaviours among young adults in Canada include: (1) *Beliefs (ethical, environmental, and personal (EEP))*, (2) *Familiarity and Convenience*, (3) *Joy and Experience*, (4) *Food influencers and Sociability*, (5) *Cultural identity*, and (6) *Body image*. These factors align with and corroborate factors identified and used to segment populations in previous research. For example, Espinoza et al, used more general variables such as sensorial and economic aspects (Espinoza-Ortega et al., 2016) while Funk et al., considered variables specifically representing environmentally friendly food (Funk et al., 2021). Other factors include health, weight control, convenience, natural

content, familiarity, price and ethical concerns (Markovina et al., 2015), or more generally categorized internal (health and sensory characteristics, body weight and digestion) and external (price and availability, convenience) (Brečić et al., 2017).

Beyond the previously examined factors, the current study also included statements related to attitudes regarding environmental and ethical perceptions which were classified under *Beliefs (ethical, environmental, and personal (EEP))*. Furthermore, the *Food influencers and Sociability* factor included influencers such as family and friends, media and the social aspects of eating. Media and advertising has also been previously identified as determining eating behaviors generally, and especially among young adults (Deliens et al., 2014; Glanz et al., 2005). For young adults specifically, social media is an important vehicle of information dissemination including nutritional information (Lambert et al., 2019). Regardless of whether interventions are educational, marketing or policy related, attempts at promoting improved eating behaviours among young adults requires modified approaches that best leverages factors affecting their food choices.

The cluster analysis revealed that the respondents could be segmented into six groups: (1) *the conventional consumer,* (2) *the concerned consumer,* (3) *the non-trend follower consumer,* (4) *the tradition-follower consumer,* (5) *the indifferent consumer* and (6) *the 'eat what you love' consumer*. The consumer segments found in this study are similar to those found in other studies related to food choices. *The conventional consumer,* and *the concerned consumer* are two of the most common segments identified in previous studies and are often segments with the highest population (Brečić et al., 2017). For *the conventional consumer,* which also the largest segment, price and availability are the most important concerns. Price and availability have been reported as important variables in consumer food choice (Glanz et al., 2005; Mollaei, 2018). *The indifferent consumer,* from the current study, is comparable to the "indifferent consumer" in a study in Croatia (Brečić et al., 2017), the "careless" consumer in a study from Mexico (Espinoza-Ortega et al., 2016) and the "ambiguous food consumers" in the study from Switzerland (Funk et al., 2021). Consumers classified in these segments did not have high sensitivity to any of the factors. However, in the current study,

consumers in this segment slightly consider *Food influencers and Sociability* in their food choices which was expected for this age group. Consumer segmentation and understanding the similarities and differences between the segments enables more informed interventions aimed at changes in eating behaviours.

This study also identified three new consumer segments for young adults in Canada. First, *the tradition-follower consumer* who is mostly concerned about their *Cultural Identity*. In general, socio-cultural norms and ethnicity (Courtenay et al., 2002; Deliens et al., 2014) have been considered as important determinants of eating behaviours. Second, *the 'eat what you love' consumer* was not at all concerned about their *Body Image*. This segment has the lowest percentage of the population (12.5%), and they were least sensitive to factors related to choosing food that is low in calorie or fact or helps them lose/maintain weight. Given the particular age group (18-24) of the population under study, it was expected that body image would be a contributing factor to food choices (Deliens et al., 2014; Heiman & Olenik-Shemesh, 2019), hence the low number of respondents that are not concerned about their body image. Third, *the non-trend follower consumer* who was least concerned about *Food influencers and Sociability*. This segment was second smallest, representing 13.5% of the sample. This was expected considering the specific age group under study, as they are more likely to be following trends on social media (Rounsefell et al., 2020), or be more influenced by peer pressure and social norms within their network (Higgs, 2015; Munt et al., 2017; Salmon et al., 2014).

Finally, the current study reveals than more than half (59%) of the population have specific considerations and criteria for their food choices. This includes *the conventional consumer* (20.5%), *the concerned consumer* (19.5%) and *the non-trend follower consumer* (19.5%). *The conventional consumer*, which is the largest segment (20%), is highly concerned about factors related to price and affordability, fast and easy preparation, sensory appeal, and brand recognition. Similarly, previous research has shown that taste, cost and convenience are considered the top determinants of food choice (Glanz et al., 1998). This segment was also not considering ethical and environmental aspects of their food in their eating habits. Hence,

direct promotion of sustainability features of a food item might not be a successful approach in this case. Even in other segments, such as *the concerned consumer*, where consumers were concerned about the environmental impacts of their food choices, their eating behaviours might not be reflective of these concerns (Funk et al., 2021). Research shows there is an obvious disconnect between diets and their perceived environmental impact (Flynn et al., 2021), which calls for educational and promotional programs and planning. Education based interventions for sustainable eating have been previously implemented in university campuses and proven to be successful (Schroeter et al., 2021; Scourboutakos et al., 2017; Tallant, 2017). Furthermore, a review of the literature shows a lack of focus on interventions considering food health and sustainability jointly (Lee et al., 2021). Therefore, knowledge about specific characteristics of each segment in the young adult population can help with the planning and implementation of more effective marketing or educational activities (Jakubowska & Radzymińska, 2019) and future intervention design that consider planetary health as well as human health regarding food choices.

2.5.1 Strengths

The current study included factors related sustainability, in addition to health and other common determinants of food choices, which have not been included in previous food systems research. Sustainable food choices are gaining more attention from governments and dietitians (Carlsson et al., 2019; Health Canada, 2019). Therefore, the identified factors guiding food choices and in turn the consumer segments identified using sustainability factors present a more comprehensive analysis of eating behaviours among young adults in Canada. Findings such as the fact that 51.5% of the population includes sustainability factors in their food choices, provide empirical evidence that information, pricing, and other nudges that are sustainability focused can influence consumer choice and eating behaviour. Furthermore, the study was representative of Canadian young adults in categories such as province of residency, education and type of community (Statistics Canada, 2020a).

2.5.2 Limitations and further research

Similar to other survey-based research, self-reporting through questionnaire response is known to be biased as is social desirability. Furthermore, similar to other studies in specific countries, the results from this study might be unique to young adults in Canada and do not include a cross-cultural component (Renner et al., 2008). Given that the population under study were mostly university students, factors specific to students such as university characteristics or living arrangements (Deliens et al., 2014) were not analyzed. Additionally, many university students who study in Canada are international students (Frenette et al., 2020) and have a temporary status (study permit), and so were excluded from this study. Finally, this study had more female respondents compared to the gender distribution of young adults in Canada (Statistics Canada, 2020b). Furthermore, the data was gathered during the COVID-19 pandemic (WHO, 2019), when there were many lockdowns and food supply chain interruptions, which could have changed the eating behaviours and patterns of the respondents (Ammar et al., 2020; Huber et al., 2021; Poelman et al., 2020; Renzo et al., 2020). However, respondents were asked to choose their responses based on their behaviours and attitudes prior to the pandemic, so any change in their behaviour captured in the survey should be minimal.

For future research, a larger and more representative sample of Canadian young adults in terms of gender, and immigration status can be studied. Furthermore, the overall number of people that identified as “other” for their gender is not very high (5 people). The characteristics of this group can be further studied in future research as there is not much information currently available. As for factors identified, in the current study both statements related to price, which is an important determinant of food choices, loaded on to *Familiarity and Convenience.* Future research can include other statements related to food cost or perceptions around value to further explore price as a separate factor. *Food influencers and Sociability* is shown to be a generally important factor for young adults. Given that most segments are sensitive to this factor and even *the indifferent consumer* is slightly concerned about it, future research can focus specifically on the impact of social influencers on young

adults in Canada. Finally, using the identified consumer segments and their characteristics, attitudes towards interventions related to food choices can be examined in future studies.

2.6 Conclusion

While detailing a complete workflow from the presented results to policy interventions is beyond the scope of the presented research, it is clear that taking into consideration sustainability factors influencing consumer choice or using consumer segments that include sustainability factors can influence the eating behaviours of young adults. Furthermore, the characteristics of identified consumer segments can be used to more effectively target segments that require additional assistance to make healthier and more sustainable food choices.

The existence of multiple factors and their various combinations into consumer segments suggest that interventions and promotional activities should be group-specific, eliminating the "one size fits all" approach, increasing their effectiveness. Promotional activities related to better communication should create a synergy between environmental impact and food healthiness based on characteristics identified for each segment (Jakubowska & Radzymińska, 2019). Results from the current study identify major characteristics and factors affecting eating behaviours in different segments among young adult Canadians. These results could ultimately help with identifying perceived barriers and benefits of sustainable and healthy eating behaviours, and improve interventions aimed at this population.

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Chapter 3

Perceptions and determinants of adopting sustainable eating behaviours among university students in Canada: A qualitative study using focus group discussions.

The contents of this chapter are accepted for publication:

Mollaei, S., Minaker, L., Lynes, J. K., & Dias, G. M. (2023). Perceptions and determinants of adopting sustainable eating behaviours among university students in Canada: A qualitative study using focus group discussions. *International journal of sustainability in Higher Education (Accepted).*

3.1 Abstract

Purpose: University students are a unique population with great potential to adopt eating habits that promote positive human and planetary health outcomes. The goal of the current research is to illustrate the current perceptions of sustainable eating behaviours among the students and to examine the determinants of sustainable eating behaviours.

Design: Data were collected from December 2020 to May 2021, through focus group discussions among university students in Canada, facilitated through synchronous online sessions. There were 21 student participants during the course of five focus group sessions (4-5 participants per session) from various departments within the university. The discussions were transcribed and analyzed for main themes and concepts using open coding; deductive coding based on the framework by Deliens et al and as well as the literature; and inductive coding for emerging themes.

Results: The students had different perceptions about what a sustainable eating behaviour could look like which were not necessarily the correct assumptions. A variety of individual, environmental (macro, micro and social) and university characteristics were mentioned as factors influencing sustainable food choices, with “food literacy” and “campus food” being the top two factors mentioned.

Originality: This study presents a novel and holistic overview of how sustainable eating behaviours and sustainable foods are perceived among university students and identified the

perceived determinants of adopting sustainable eating behaviours. This study helps with identifying opportunities to promote sustainable eating behaviours among university students and the design/implementation of informed interventions and policies aimed at improving eating behaviours.

3.2 Introduction

Promoting healthy and sustainable eating behaviours is a valuable and impactful strategy for both human and planetary health (Willett et al., 2019). Current eating habits are associated with negative environmental impacts, such as climate change and water scarcity (Campbell et al., 2017; Garnett et al., 2015; Willett et al., 2019). Given the importance of food and eating habits on human (Ridgway et al., 2019) and planetary (Willett et al., 2019) health, dietary interventions are required to promote healthy and sustainable eating habits (Campbell-Arvai et al., 2014). However, interventions should be designed and implemented based on their target population, considering specific eating behaviour characteristics.

Young adults are in a critical stage of their lives in terms of developing long lasting eating habits (Arnett, 2000), particularly university students who are going through a transition, and are often known to have poor and unhealthy dietary habits (Alghamdi et al., 2018; Deforche et al., 2015; Michels et al., 2019; Niemeier et al., 2006; Sharma et al., 2018). The transition to university often disrupts young adults' regular eating patterns, resulting in less healthy diets (Maillet & Grouzet, 2021). The absence of adequate cooking skills and facilities, and the presence of tempting and unhealthy food options are barriers to healthy diets among university students in particular (Maillet & Grouzet, 2021). Furthermore, postsecondary institutions offer a distinct opportunity to implement and test interventions aimed at improving dietary behaviours, due to their unique food environment and population (Evans et al., 2015; Hansen, 2017).

A variety of factors influencing eating behaviours of university students have been identified. Deliens et al. present these factors in a framework used to categorize factors into five groups including: (1) individual factors, such as time availability and state of mind; (2) the social

environment, such as parental control; (3) the physical environment, such as appeal of food and prices; (4) the macro environment, such as media and social norms; (5) and university characteristics, such as residency (Deliens et al., 2014). Other important factors include food literacy (Malan et al., 2020), and specific habits, such as snacking (Marquis et al., 2019). Nevertheless, money, healthfulness, and taste are considered the major factors influencing eating behaviors among university students (Roy et al., 2019).

Sustainability has been linked to a variety of eating habits, including consuming: local and organic food; more fruits and vegetables; fewer meat products; more plant-based products; fewer processed and packaged products; more products that have small ecological footprints, as well as reducing food waste (Austgulen, 2014; Carlsson-Kanyama & González, 2009; FAO, 2019; Health Canada, 2019; Lobb & Mazzocchi, 2007; Pieniak et al., 2010; Redman & Redman, 2014; Schösler et al., 2012). Determinants of sustainable eating habits include sensory characteristics, traditions, meal-patterns, peer-pressure and personal values (Nasir & Karakaya, 2014; Perrea et al., 2014). Cheah et al.'s research framework identifies perceived benefits and barriers to reducing meat consumption as an example of a sustainable eating behaviour (Cheah et al., 2020). For example, barriers to eating a vegetarian diet include unpleasant taste (Lea & Worsley, 2003) and lack of knowledge regarding food (Salonen & Helne, 2012). Although sustainable eating may include a variety of eating habits, definitions of sustainable eating behaviours among the target population are important for designing interventions, particularly among young adults, among whom sustainable eating is becoming more mainstream (Kamenidou et al., 2019).

Most dietary interventions targeting young adults in postsecondary institutions focus on nutrition rather than environmental sustainability (Deliens et al., 2016; Lee et al., 2021). Among sustainability-related interventions, most focus on waste management/prevention strategies rather than dietary choices (Grech et al., 2020). Therefore, there is a lack of research on sustainable dietary interventions among this population, which is an important gap given that interventions should be tailored to specific groups (Cheah et al., 2020).

A Canada-wide survey of young adults found that more than half of the respondents had specific criteria (such as environmental perceptions, personal, and behavioral factors) for their food choices (Mollaei et al., 2022). Therefore, this research intends to take a closer look at Canadian university students, who are also classified as young adults, to further examine their eating behaviours through open-ended questions. Furthermore, studies on factors influencing eating behaviours (including dietary intervention research) among university students lacks a holistic and systematic approach that encompasses both human health and environmental sustainability (Lee et al., 2021). To address this gap, we conducted focus groups to gain insights into eating behaviours of Canadian university students to examine their attitudes towards adopting sustainable eating behaviours. Students studying at Canadian institutions come from diverse cultural backgrounds. Hence, insights gained from this sample population could contribute to future studies in a different geographic setting. Interventions promoting health or environmental sustainability require a level of knowledge about the target population's motivations that align with their eating goals to increase intervention effectiveness (Bauer & Reisch, 2019). Therefore, the goal of the current research is to illustrate the current perceptions of sustainable eating behaviours among the students and to examine the determinants of sustainable eating behaviours. Furthermore, this research took place during the COVID-19 pandemic, which drastically impacted eating habits (Huber et al., 2021). Therefore, results from this research can provide insights regarding the impacts of this change on the sustainability aspects of eating behaviours. The first objective of this study is to gain a better understanding of what sustainable food and eating behaviours means to the students. Therefore, the first question this research aims to answer is:

1. What is the perceived meaning of sustainable food and sustainable eating among university students?

Then, to connect current perceptions to sustainable eating behaviours, it is important to understand the determinants of sustainable eating habits. Therefore, the second research question of this study is:

2. What are the determinants of sustainable eating behaviours among university students?

3.3 Methodology

For this study a qualitative method was used where data were collected through focus group discussions among university students which is a method to collect experiential information (Morse, 1994). Focus groups have been established as being an effective tool to collect qualitative data in social sciences and are recognized for generating useful information (Onwuegbuzie et al., 2009). Particularly, online focus groups have characteristics that provide a more comfortable environment leading individuals to share more and reveal more of their thoughts and ideas which is an advantage for online focus groups (Stancanelli, 2010; Stewart & Williams, 2005; Wettergren et al., 2016). This study took place at the University of Waterloo, a large and diverse university in Waterloo, Canada. Participants were selected from undergraduate students in different programs studying at three colleges to ensure diversity of opinion. College students are a sample with a variety of ethnic and knowledge backgrounds. The aim was to recruit four to six students for each session (Stancanelli, 2010; Woodyatt et al., 2016) and the participants included students at each college who accepted email invitations to participate in the study. The "call for participation" email was sent by college administration on behalf of the researchers to all first-year students. Students who responded to the email invitation were contacted to set up a time for the online focus group session. The study received ethics approval from the University of Waterloo (ORE 42454). The focus groups were held from December 2020 through May 2021 (during the Covid-19 pandemic).

All focus groups were conducted online using MS Teams. Participants had the option to use a pseudonym and not use their real names. Participants were asked to keep their camera off during the sessions to increase anonymity. The link to the meeting was sent to the participants approximately one week prior to the session and a reminder email was sent one day before. The participants were sent an information and consent form prior to the session and at the beginning of each session the purpose of the study was explained. A brief

overview of the MS Teams platform and information about the focus group process was presented at the beginning of each session. Every participant had the option to leave the focus group at any point during the session. At the end of each session, the students were asked to fill out a survey gathering demographic information while ensuring anonymity by not collecting any personal information that could be linked back to the participant. A $10 gift card was sent to all participants after the session regardless of whether they stayed for the whole session or not. Each focus group lasted between 60 to 90 minutes and was facilitated by the lead author, who audio-recorded the session, asked the questions and took notes during the sessions. The number of focus groups was dependent on the point of saturation, as it is often not possible to pre-determine the number of sample size in a qualitative study (Morgan et al., 1998). One additional focus group was also held to confirm no new information was discussed and saturation was reached.

3.3.1 Focus Group Design Questions

A semi-structured interview guide (Appendix B) was developed based on the instructions by Harrell and Bradley, 2009 and Seale et al. 2003 (Harrell & Bradley, 2009; Seale et al., 2003) in order to answer the proposed research questions of this study. Using the literature, and after rounds of discussion with experts on the topic, the questions were developed and tested in one pilot session with five individuals. Participants for the pilot session were selected randomly from the students who responded to the call for participation email. Since there were no changes after the pilot session, data collected during that session were also included in the analysis, as this is a valid approach to using pilot data (Morgan et al., 1998). The questions consisted of one introductory question (icebreaker) to start the conversation and one transitional question more related to the topic of the study to guide group discussions towards the goal of the study. There were five key questions, and the majority of the time was spent on these questions. The key questions were regarding: the participants' eating habits before and after Covid-19 pandemic; their understanding of un/sustainable food and eating behaviours; differences between their eating habits at home and at the university; their food choices when they have a meal plan; and the impact social influencers, such as their

peers or parents, have on their food choices. The moderator followed the question guide during each session while asking follow-up questions where needed. The follow-up questions enabled the students to share their ideas and elaborate on them.

At the end of the focus groups the participants were asked to fill out a short survey gathering their demographic information. The survey was also anonymous, online (the link was provided at the end of the session) and conducted through Qualtrics. There were seven questions related to age, gender, employment, education, program of study, living arrangement and citizenship/immigration status. This information was used to better understand the sample and was not used for further analysis.

3.3.2 Data Analysis

Data obtained from the survey were analyzed by Microsoft excel to calculate descriptive statistics on participant characteristics. Data obtained from the audio recordings were transcribed verbatim using otter.ai (*Otter.Ai*, 2022) and then cleaned and checked for precision. To identify main themes and concepts related to each research question, there were three steps: open coding was used for each focus group; deductive coding based on the questions and the literature; and inductive coding for emerging themes. In deductive coding, codes are derived first, and data are fitted to the codes, whereas, in inductive coding codes are constructed based on information from the focus groups (McBey et al., 2019). The framework by Deliens et al. (2014) (Appendix C) was used as a guide for deductive coding. Data (quotes) from each focus group were examined and coded using the factors identified by Deliens et al. (deductive) or a coded as new factor (inductive) where applicable. Inductive coding, guided by the literature, particularly the conceptual model by Malan et al. (2020) and the framework by Cheah et al. (2020), was done for reoccurring instances of a theme (factor). A code book (Appendix D) was developed (Fereday & Muir-Cochrane, 2006; Seale et al., 2003) and the codes were systematically grouped together also based on the five main categories presented by Deliens et al. (2014) as follows: (1) individual factors, (2) the social environment, (3) the physical environment, (4) the macro environment, (5) and university characteristics. Before developing the codebook, one randomly selected focus group was

independently checked for coding consistency by the lead author and a research assistant (RA) to ensure reliability. All codes from the selected focus group were compared and discrepancies/disagreements were discussed until consensus was reached. Then, codes were finalized and the codebook was devised to make sure all themes and concepts were captured (Bradley et al., 2007). All focus groups were then coded thematically using Microsoft Excel based on the codebook. For each identified factor, supporting quote(s), and the number of unique times the theme was mentioned by the participants (m) is presented in the results section, and includes the number of times the factor was mentioned in a different context. This means that the same person could mention the same factor more than once, and therefore 'm' could be greater than the number of participants (n=21).

3.4 Results

The results are presented according to the study's research questions. The demographic characteristics of the participants are presented in the first section; the second section discusses the attributes of sustainable food and the perceptions of sustainable eating behaviours among university students, and the third section discusses the determinants of students' sustainable eating behaviours.

3.4.1 Participant Characteristics

In this study, five focus groups were conducted consisting of 4-5 participants in each session. The estimated point of saturation was observed and established in the fourth, and confirmed in the fifth session. The sample (n=21) consisted of 1 male, 19 female and 1 non-binary participant (Table 3).

All the participants were undergraduate students between the age of 16 to 23. They were mostly living with their families (42.9%) or in one of the campus residences (33.33%). As for their employment status, they were mostly unemployed (33.33%) or working part-time either on campus or off campus (28.6%, 23.8% respectively). The participants were also mostly Canadian citizens (90.4%).

All participants were undergraduate students. We also asked the participants to specify their faculty. There were eight students in the Faculty of Environment (38%), six students in the Faculty of Health (28%), three in the Faculty of Engineering (14%), three in the Faculty of Arts (14%) and one student in the Faculty of Science (4%).

Table 3 - Characteristics of focus group participants

Category	Count (N=21)	Percentage
Gender		
Female	19	90.4%
Male	1	4.8%
Queer	1	4.8%
Prefer not to say	0	0
Age		
18-20	18	85.7%
21-23	3	14.3%
Employment		
I work full-time, on campus	1	4.8%
I work full-time, off campus	2	9.5%
I work full-time, both on-campus and off campus	0	0
I work part-time, on campus	6	28.6%
I work part-time, off campus	5	23.8%
I work part-time, both on-campus and off campus	0	0
I am not employed	7	33.3%
Living arrangements		
UWaterloo residences	7	33.3%
Living with roommates	4	19%
Living alone	1	4.8%
Living with family	9	42.9%
Citizenship/Immigration status		
I am a Canadian citizen, Domestic student	19	90.4%

I am a permanent resident, Domestic student	1	4.8%
I am in Canada with a study permit, International student	1	4.8%
Total	21	100%

3.4.2 Perception of Sustainable Food and Eating Behaviours

Participants had different interpretations of sustainable food and sustainable eating behaviours, but overall, the participants seemed to have a basic understanding of the term. Two participants mentioned that because they were students in the Faculty of Environment, they were very familiar with the term due to the topics covered in their studies and information from their professors. In contrast, two of the participants mentioned that they have never thought about or heard the term "sustainable food". Nevertheless, participants associated sustainable food with a variety of concepts that have been categorized into eleven themes, discussed below. The identified themes are both related to the characteristics of food and food production (sustainable food); (1) environmental impact, (2) local and organic, (3) animal-based vs plant-based, (4) healthy and nutritious, (5) ethically produced, (6) production and agriculture, as well as behaviours related to food consumption (sustainable eating behaviours); (7) balance and mindfulness, (8) financial aspects, (9) temporal aspects, (10) food waste. A summary of results is provided in Figure 1.

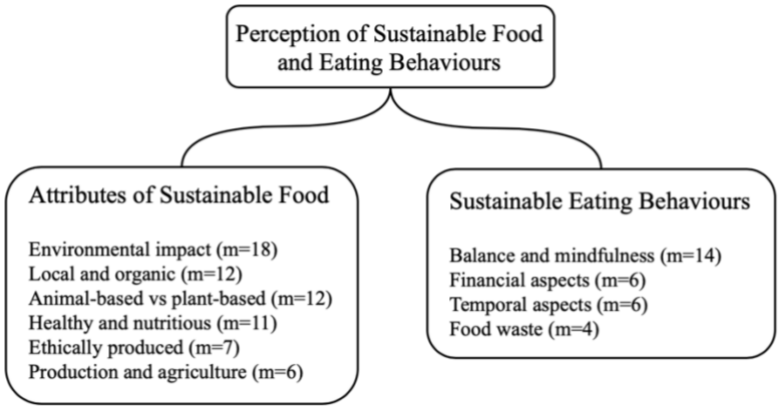

Figure 2 - Identified themes related to the perception of sustainable food and eating behaviours among university students. The number of mentions (m) of each determined is provided in brackets.

3.4.2.1 Attributes of sustainable food

Environmental impact (m=18) - "Environmental impact" was the theme that was most commonly associated with sustainable food. The participants mentioned whether the food is "good" for the environment, had lower carbon emissions, and impact on climate change, as a deciding factor for them to label it sustainable:

> *I also think about the relation to the environment. So, thinking about your carbon footprint, what are the things that you're eating? And what impact does it have.*

They also mentioned packaging and resource use (i.e., water consumption) as factors contributing to overall environmental impact, which in turn can impact whether a food is sustainable or not. In order to identify food items with low environmental impact, participants discussed taking company reputation into consideration. Therefore, if certain big companies had a reputation of harming the environment, their product would be perceived as unsustainable.

Local and organic (m=12) - Many of the students (12 out of 21) perceived there was a connection between sustainable food, and "local and organic" food. Therefore, buying

groceries from local markets was seen as more sustainable and it would also support the community and local economy:

> *Also, a local diet. So, eating foods that come from your local area, maybe like a local market, just choosing the foods that are grown around you rather than having to transport them from further locations.*

One participant mentioned sustainability was going beyond the individual level to a more societal level and supporting the community, local farmers and businesses. Furthermore, they equated local with organic and mentioned buying produce from local markets is a better choice compared to buying from larger grocery stores. Participants also mentioned using labels, particularly organic, as indicators of sustainability. However, there was a disagreement among the participants on whether labels should be trusted or not. For many of the participants sustainable, organic and local had similar meanings when it came to food choices:

> *Sustainable food is like the organic, true food, food from local markets.*

Animal-based vs plant-based (m=12) - Another theme identified during the discussions was the difference between eating "animal-based vs plant-based' products. The participants associated plant-based products with sustainability and lower environmental impact:

> *I find that eating less animal products or meat, is more sustainable.*
>
> *[to be sustainable] We should reduce. If you ate it [animal products] less, I would call it sustainable.*

Some participants mentioned they were trying to eat less meat and dairy or had completely switched to products such as non-dairy milk in order to eat more sustainably. However, one participant, who was a vegetarian trying to become vegan during the pandemic, mentioned that although non-dairy milk is more sustainable, if she were given coffee with cow's milk by mistake, she would drink it as wasting food was probably more harmful in this case.

Healthy and nutritious (m=11) - The participants also discussed the importance of eating healthy and nutritious food in order to have a sustainable diet. They believed there was an

association between health and sustainability, and sustainable food could be translated into healthy food.

> *I guess just the mix between eating predominantly healthy… making sure that you are getting all the nutrition that you need.*

Although, "Health and nutrition" were referred to as an important aspect of sustainable food, some participants mentioned sustainability goes beyond just health:

> *[Sustainability in food] it's about a lot besides just eating healthy.*

Furthermore, most participants mentioned they did not consider frozen or canned fruits and vegetables healthy enough:

> *I would consider the fresh, non-frozen version of the food to be healthier, because I guess it hasn't been processed, than frozen food.*

Ethically produced (m=7) - The "Ethics" behind food production was also discussed in the conversations. Most of the discussion was regarding cruelty towards animals and how they were raised. The participants also mentioned equality and working conditions of the people involved in the process of food production. One participant noted that although they have thought about ethical consideration of food production, they prioritized environmental impact over ethics and another participant mentioned that ultimately ethics were not a deciding factor in what they choose to eat:

> *I've definitely thought about the ethical considerations behind eating animal products; specifically, a lot of unsustainable food production does harm a lot of animals. But I wouldn't say that it's a deciding factor in what I choose to eat.*

Production and agriculture (m=6) - Circumstances related to food production and agriculture was another theme identified as a factor related to how the participants perceived sustainable food:

> *I do think that sustainable food has to do with how it is grown and how it is raised if you're talking about livestock agriculture.*

They mentioned sustainable food was food that was produced within a self-sustaining system without much human intervention. Furthermore, the use of pesticides and Genetically Modified Organisms (GMOs) were perceived as unsustainable agricultural practices. The participants also mentioned certain products such as palm oil and soy as examples of products that required extensive resources and their production harmed the environment. One participant mentioned sustainable food was when the natural system had the ability to reproduce the food without environmental degradation:

> *Sustainable food, I just think of the ability of natural systems to keep producing that food.*

3.4.2.2 Sustainable eating behaviours

Balance and mindfulness (m=14) - A major identified theme related to sustainable eating behaviours, was "balance and mindfulness". Many of the participants perceived sustainable eating behaviours as being related to eating a "balanced" diet and being "mindful" of what and when you eat. This could be eating a balanced meal, in terms of the amount that is eaten, consuming all food groups (such as fruits, vegetables, grains and others), or having an overall balanced diet, which they saw as a diet where they had multiple meals per day, snacks and enough water. They also mentioned mindfulness and listening to your body when choosing what food to eat:

> *When I think about sustainable eating habits, I think about eating mindfully. Just doing what you can with the given circumstances, and then making more mindful choices.*

Some mentioned intuitive eating (rather than having a meal because it is the time to have a meal such as lunch) and being mindful of your mental health given the circumstances (i.e., being a university student during a global pandemic) were characteristics of sustainable eating behaviours:

> *[sustainability is] making it so each meal we have the amount of food we need the balance we need. It's important to watch what you're eating. So, it's not just about eating consistently. And you also have to make sure*

> *you're getting everything from all the food groups, like make sure you're eating your fruits and vegetables and dairy, things like that.*

Financial aspects (m=6) - The participants discussed that sustainable eating behaviors have to be financially feasible. They mentioned since they were university students, they had budget constraints and healthy food (which was associated with sustainable food as mentioned in section 3.2.1) tended to be more expensive. Hence, it was often a challenge for them to eat sustainably due to the financial burden. One participant said:

> *I think about sustainable eating, as a university student, a big part of it is the financial aspect.*

Temporal aspects (m=6) - Students discussed being able to maintain a habit for a long period of time without any constraints (such as financial constraints) was a characteristic of sustainable eating behaviour, which could also be related to the actual meaning of the word sustainable.

> *…it's about what you can kind of continue to do over a long period of time.*

Food waste (m=4) - Another aspect of sustainable eating behaviour mentioned by the students was reducing "food waste". When asked about what food related behaviour they think was sustainable, one participant said:

> *When I think about sustainable eating, it is also looking at the waste aspect, like how much waste you're producing in terms of food waste. [To] make sure that I'm not being wasteful.*

They pointed out that university students were likely to forget about the food they had, or did not have access to the required facilities (such as a fridge or a stove) which in turn would result in food waste. Therefore, being aware of their food waste and striving to reduce it contributed to eating sustainably.

3.4.3 Determinants of Sustainable Eating Behaviours

The framework by Deliens et al., is used to structure the results section below related to participants' perceptions about determinants of sustainable eating behaviors. The five

categories from the framework are: (1) individual factors, (2) social environment, (3) physical environment, (4) macro environment, and (5) university characteristics. A summary of results is provided in Figure 3.

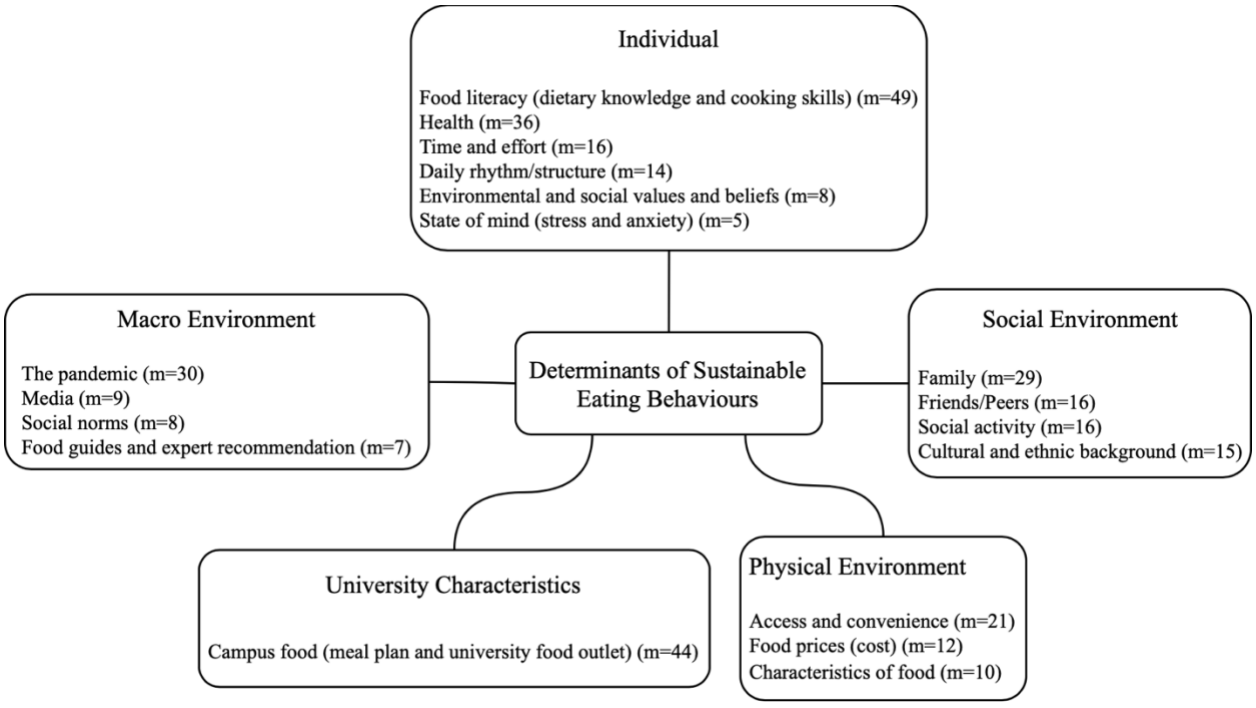

Figure 3 - Determinants of sustainable eating behaviours among participants.

3.4.3.1 Individual factors

Food literacy (dietary knowledge and cooking skills) (m=49) **–** Many of the participants (18 out of 21) suggested their cooking skills, and knowledge about the ingredients such as nutritional value or health benefits (referred to as food literacy in general) were among the main factors influencing their food choices. Lack of cooking skills was mentioned as a barrier to eating healthy and sustainable food even if they had access to cooking facilities and a kitchen. They also mentioned using the same ingredients almost all the time since they did not know many recipes or how to use new ingredients which showed lack of food literacy:

> *I don't think I have sufficient cooking skills to make healthy meals for myself.*

However, participants who believed they had adequate cooking skills, demonstrated higher motivation to eat healthy and sustainably. Whether they cooked for themselves or had a partner, friend or family member who cooked, or just being involved in the process of cooking, motivated them to prepare healthy dishes with higher nutritional value:

> *I feel like I've actually been eating healthier ever since I've been able to cook.*

Furthermore, the effort they put into their cooking helped them value their food and hindered them from ordering takeout or eating prepackaged food such as frozen pizza. For some participants, they had to learn some basic cooking skills when moving away from their family which resulted in healthier food choices once they learned how to cook.

Health (m=36) - Physical and mental health was one of the major determinants of healthy and sustainable eating discussed by the students. In order to stay healthy, the participants mentioned trying to choose healthier food options such as fruits, vegetables and salads while avoiding fried food or takeout. They also discussed including all food groups in their meals as an approach to healthy eating:

> *[On a meal plan] I'm choosing what I want to try to eat healthy stuff. Make sure I have at least one vegetable with each of my meals.*

For some participants, focusing on the health aspects of their food was due to their workout plans or health concerns (such as avoiding gluten or sugar). In addition to physical health, mindfulness and mental health were also discussed as motivators to eat healthy. Particularly, when living on campus, the students had to be more mindful of what goes into their body and maintain balance. As mentioned in the previous section, for many of the participants, health and sustainability were closely related and had similar implications.

Time and effort (m=16) - The participants mentioned during school they did not have enough time to plan for or prepare meals that were healthy and sustainable or go grocery shopping often. Therefore, they sometimes ended up having only one meal on the day. They

also mentioned preparing and cooking a meal required a lot of effort, and they would rather spend their time and energy on other activities such as studying.:

> *When I'm busier, I feel like I have a lot less time to prep and eat healthy, and to take care of myself.*

The participants who were on meal plans pointed out the convenience of not spending time preparing food and having readily available meals. However, they still had the previously mentioned issues about meal plans.

Daily rhythm/structure (m=14) - Not having a unique daily schedule or structure was also identified by the participants as an influencing factor. For some participants being at home with their family resulted in having a better schedule as they had specific mealtimes with their family and would not skip a meal (their family would remind them to eat), and food was available to them any time of day when they were at home:

> *Although I do eat breakfast, lunch and dinner, it really depends on the day. I wouldn't say that it's the same time that I eat those meals every day, because of school.*

Others mentioned they had a better structure on campus as they could decide what and when to eat and schedule their meals around their work and study times. Participants also mentioned the impact of online classes on their schedule and in turn their eating habits due to the pandemic. For some, online classes meant more time to prepare food and therefore having healthier meals, snacks, and more regular eating habits. For others, the stress of online classes and lack of a schedule resulted in skipping meals, particularly breakfast and eating more unhealthy food such as takeout. They mentioned, most online courses did not have a scheduled lecture time and it is up to the student to manage their time. Therefore, as noted by the participant, particularly for first-year students, time management, in terms of whether to study or to eat, was an issue.

Environmental and social values and beliefs (m=8) **-** Environmental consciousness and knowing you were making more ethical choices impacted their choice of healthy and sustainable food. By choosing more plant-based options, reducing waste, and supporting

local businesses, especially during the pandemic, participants felt they are making more sustainable decisions regarding their food and the positive impact from these choices motivated them to continue. Participants mentioned they might not be able to fully change their diet, but they could and were willing to make some modification. One participant said:

> *I gave myself two days in the week that I do so to be more conscious of the meat that I was consuming.*

State of mind (stress and anxiety) (m=5) - Stress and anxiety due to exams, homework, courses or life in general were also mentioned as factors impacting eating behaviours. For some participants it resulted in eating less and for others it meant stress eating which were both considered unhealthy and unsustainable. The stress would also inhibit them from planning for food or putting in the effort to try to eat healthy:

> *As stressful university students, it can be hard to put that much time and effort into making sure you can go and seek healthy food.*

3.4.3.2 Social environment

Family (m=29) - Another major factor influencing eating behaviours and eating decisions discussed by the participants was their family. Parents, partners and siblings were the main influencers identified within their family. Parental control can have a significant role in food decisions. For many of the participants, growing up their parents had the most impact on their eating behaviours. Their parents did most of the grocery shopping and cooking, and the students did not have much say. Therefore, they would have to eat what was prepared, which was sometimes not the healthiest option in their opinion. Furthermore, if their family were mostly carnivores or tended to eat a lot of meat, it was difficult to be a vegetarian or vegan (which were perceived to be healthier and more sustainable diets). One participant said:

> *I never believed that I could ever go vegetarian. I'm in a house full of carnivores and my boyfriend loves to hunt and all that fun stuff.*

They also mentioned even when they were on campus, their parents checked to make sure they were having decent meals and enough healthy food (i.e., fruits and vegetables).

Therefore, their family eating habits were still an important influence on their eating and many of their choices aligned with what their parents taught them:

> *Even on campus, my parents definitely influenced me as well with the calls asking me what I was eating, and encouraging me to try something new.*

Furthermore, if they had a family member that was vegan or vegetarian, it motivated them to try those diets or make moderate changes in their diets.

Friends/Peers (m=16) **-** After family, friends were also identified as eating behaviour influencers. When living on campus, participants mentioned many of their food decisions were impacted by their friend group. If they had friends who ate healthfully, they tended to eat healthier, and if their friends were more into takeout and unhealthy options their food choices would also be similar:

> *What I eat really depends on who I was hanging out with at the time. It really depended on my friends.*

Students' house/roommates also influenced their eating habits. For example, some participants mentioned they shared food with their house/roommates or if their friend mentioned they were cooking, it reminded them to also eat and not skip meals. The final aspect discussed was how friends made suggestions about trying new food as well as keeping each other in check:

> *Beyond just the healthy versus unhealthy, I think, friends do a good job of exposing you to new types of food that you wouldn't have necessarily tried beforehand.*

Therefore, they could make sure they were eating healthfully and consume all necessary nutrients, similar to how parents check-in is mentioned in the "family" section.

Social activity (m=16) **-** For the majority of participants, eating was more enjoyable with others and as a social activity. Eating in a social setting, rather than alone, was also a reminder to be mindful of their eating habits. Therefore, they discussed they might skip a

meal or eat just to fuel themselves (without paying attention to what they are actually eating) if they had to eat alone.

> *At home, I would usually eat just with my family. When I was cooking, it was usually either with friends or family, because it was just a kind of a social activity.*

Cultural and ethnic background (m=15) **-** Ethnic and cultural food consumed at home and by their families was also a factor influencing eating habits.

> *Growing up, I only ever really ate Chinese food because my parents, my mom only really knew how to cook Chinese food and wasn't too open to foods from other cultures.*

Some participants mentioned their cultural food is well balanced and had an item from every food group which was considered healthy. For others, their cultural food had no meat or very little meat which was considered a sustainable diet:

> *Most of our [ethnic] food is pretty balanced. In one dish, there's always a vegetable there's always meat, and you get a lot of the stuff in the food groups already.*

Some of the participants mentioned leaning towards more cultural food when on campus and others mentioned eating other types of food to either try new food or due to their diets:

> *I changed a lot of my diet in the recent months, …because I came from a cultural background, recently I started to eat less of cultural foods.*

3.4.3.3 Physical environment

Access and convenience (m=21) - Access to cooking facilities such as a kitchen or a fridge was mentioned as a determinant of sustainable and healthy eating by the participants. Not being able to stock up on food, not having the required ingredients, and not having the equipment to cook, were all reasons that made it difficult for the students to eat how they would prefer.:

> *I don't have the opportunity to go to a fridge full of food, …it's also harder just because I can't stock up.*

Another aspect of lack of access mentioned in the conversations was not being able to go grocery shopping and transportation restrictions. Some students mentioned they did not have a car or a bus pass; therefore, they would have to limit their trips to the store, and this would result in missing some ingredients at certain points of the week. This would also mean they would have to buy non-perishable food with longer shelf life, such as packaged and frozen food (if they had a fridge), and opt-out of purchasing fresh fruits and vegetables (which they saw as healthier options).

Convenience was also mentioned as a contributing factor. Depending on the living situation of the students, healthy eating choices could be a convenient choice or a challenge. For some participants, living on campus meant easier and faster access to food, or if they were on a meal plan, the food was already prepared. Therefore, they could choose what they would like to eat:

> *The residence I was at was buffet style .... It just felt easier to [choose healthy food] and more convenient.*

Others mentioned they might forget to eat, skip a meal or just snack when they were on campus. Therefore, living at home and having healthy food options or a kitchen at their disposal helped them make better food choices. Therefore, when healthy and sustainable food options were the convenient choice, the participants mentioned being more motivated to choose those options.

Food prices (Cost) (m=12) **-** The higher cost of healthy and sustainable food was another factor mentioned by the participants as a determinant of their food choices. In general, they talked about how students did not usually have a bountiful budget and may not be able to afford healthy and organic (which they perceived as sustainable) food. They also had to be mindful of how much they pay for each meal which would result in eating the same meals. With regards to cost being a barrier, one participant mentioned:

> *So as someone who liked trying new food, I didn't explore that much just because of how much money I have, and I can't go over.*

Some participants mentioned they collected coupons or tried to do their shopping on certain days to get discounts. However, making the "financially smart decision", as mentioned by the participants, was not always easy, particularly given the price increase during the pandemic. Many of the participants mentioned that although they would prefer eating healthy and sustainable food and purchasing eco-friendly products, they were not willing to spend more money especially since the product was the same. However, one participant mentioned that they understood sustainable food was more expensive, however, it was a good investment for their health and the environment.

Characteristics of food (m=10) **-** The participants discussed how specific characteristics of food, particularly healthy food, could impact their choice. This could be regarding characteristics such as taste or durability. They mentioned sometimes healthy food (i.e., vegetables) did not taste good or was not properly cleaned when served in their meal plans. Therefore, they preferred eating another type of food:

> *This [taste and not being cleaned properly] deters you from eating the vegetables, and you just want something that tastes good.*

They also mentioned fruits and vegetables had a shorter shelf-life and were more perishable compared to other food such as cereals or pasta.

3.4.3.4 Macro environment

The pandemic (m=30) **-** One of the main influencers of eating behaviours discussed in the focus groups was the Covid-19 pandemic and the challenges related to it. For most of the participants, at the beginning of the pandemic, they experienced major changes in their eating habits due to the uncertainty of the situation and all the changes:

> *At the beginning of the pandemic, however, I felt like my eating habits were worse because there was no structure to the day.*

Some challenges related to the beginning of the pandemic were lack of motivation, boredom and uncertainty. As a result of these challenges participants discussed baking more, trying new recipes, gaining weight, and being less active:

> *In the beginning of the pandemic, when lockdown started, I gained so much weight just because I was baking a lot.*

However, many participants mentioned reaching stability and a balance after a while. As for their eating behaviours, it meant they either went back to their pre-pandemic eating habits or developed new habits. For some participants, the pandemic had a positive influence on their eating habits such as learning to cook and eating more home-made dishes, having all their meals (not skipping meals) since all their courses and work were online, starting to support local restaurants and businesses, eating out less since most restaurants were closed at the beginning, and overall developing healthier eating habits:

> *Compared to the start of the pandemic to now I've definitely improved my eating habits for sure.*

Media (m=9) **-** The internet and social media were also identified as influencers of sustainable eating behaviours. However, they had different types of impacts. For vegan and vegetarian participants or participants that were planning to reduce meat consumption, media was seen as a good resource for finding new recipes, watching documentaries about food production and overall, a good source of information. As for social media, the participants discussed that it might have negative impacts such as promoting diet culture or displaying unrealistic versions of healthy and sustainable eating:

> *Also, I think social media influences us a lot. Because we are always looking that some people make some diet and eat vegetables in this way to get this body.*

Some participants mentioned they were often skeptical of information provided on social media and tended to do their own research to fact check.

Social norms (m=8) **-** For many participants, their eating habits were also impacted by the social norms in their community. They mentioned what they chose to eat often depended on the circumstances and the social group they were dining with. For example, when dining in the dining halls and most people were having a healthy food, they would also be more intrigued to make healthier food choices:

> *I feel like when I went to meals in residence, I would see other people get healthy foods, and that would kind of pressure me to be like I probably felt needed a salad or something on this plate*

For some it would be due to their insecurities and more related to peer pressure, and for others it was a reminder to eat healthy and more of a positive impact.

Food guides and expert recommendation (m=7) **-** The participants also discussed referring to food guides, nutritionists and other experts regarding food recommendations. Many of the participants discussed Canada's Food Guide as a reference for their eating:

> *Right now, my eating habits are mostly influenced by the recommendations in the food guide, kind of vaguely at the back of my head.*

Therefore, they would try to have at least one item from each food group and keep the serving size in line with the food guide recommendations. They also mentioned they would rather do their own research about their food choices and listen to recommendations from doctors and nutritionists:

> *For myself the most reliable people that I go off of, are doctors or nutritionists or registered dieticians, because they're the people that have done their research about food and nutrition and what we actually need to eat.*

3.4.3.5 University characteristics

Campus food (Meal plan and university food outlet) (m=44) - Campus food characteristics, particularly meal plans and available food outlets were the most frequently mentioned factor impacting healthy and sustainable eating. Almost all the participants had been on a type of meal plan at some point in their time as a university student. Depending on the type of meal plan, they mentioned the *portions* were either too small or too large for them. Particularly, in the case where they had to swipe for each meal (and pay for each meal separately from their overall meal plan balance) if the portions were too small, they would have to stay hungry and keep their swipe for the next meal. Another aspect was lack of *variety*. The participants mentioned although there was an obvious effort to provide healthier

food options, such as fruits and vegetables for each meal, there were the same options almost every day. Furthermore, due to financial reasons or not liking alternate food items with which they were presented, some students mentioned eating the same meal every day for a long period of time. For vegan and vegetarian participants, it was particularly challenging to have a balanced diet. Whereas, at home they had the option of preparing a balanced and healthy dish for each meal, living in residence constrained their options for balanced meals. A few participants also discussed that the food might be balanced and include every food group, however, it did not match the cultural food (discussed more in section 3.3.4, cultural and ethnic background) they were used to eating and had more of a "North American diet" style. Another topic discussed regarding the meal plans and food outlets, was the *time restrictions* in the residence's cafeteria:

> *Being at university and being on a meal plan has led me to eat fewer portions because they have those structured mealtimes.*

Due to the pandemic, the cafeterias in the college residences had constrained mealtimes. Therefore, students on a meal plan had a set block of time for breakfast, lunch, and dinner, and if they missed those time blocks, they would have to purchase food from elsewhere. However, before the pandemic these cafeterias served food all day, so the students could match their eating times to their own schedule. Finally, some participants mentioned being on a meal plan or eating at the cafeteria gave them the feeling that they were dining at a restaurant. Therefore, they would indulge more and lean towards unhealthy options. Several students noted that the ice cream and soda vending machines made it very convenient for them to indulge in unhealthy food:

> *When you go to the cafeteria, it almost feels like you're going to a restaurant every day. when you go out to a restaurant, you obviously don't make the healthiest choices.*

3.5 Discussion

The aim of this study was to present the current perceived attributes of sustainable food and sustainable eating behaviours, and to understand the determinants of sustainable eating

behaviours among Canadian university students. This knowledge is important for informing interventions aimed at promoting sustainable eating behaviours that can moderate the transition to sustainable eating habits (Bauer & Reisch, 2019). There were three key findings for this study. First, university students had a wide range of perceptions of the attributes of sustainable food, and the aspects of sustainable eating behaviours. Second, in addition to the factors previously presented in the framework by Deliens et al., this study identified additional determinants of sustainable eating behaviours, specifically 'environmental and social values and beliefs' (categorised under individual factors), 'campus food' (categorised under university characteristics), 'the pandemic' and 'food guides and expert recommendation' (categorised under macro environment). Among all factors affecting eating behaviours, the top two themes mentioned by the participants were food literacy, and campus food (meal plan and university food outlet). Third, identified personal and environmental factors can motivate or act as a barrier for sustainable and healthy behaviors of university students. Each of these key findings is discussed in the context of existing literature below.

3.5.1 Perceptions of Sustainable Food and Eating Behaviours

This research showed that the three main perceived characteristics of sustainable food were environmental impact, the food being organic/local, and animal-based vs plant-based. In the literature, university students mostly related sustainable food to environmental consideration and contribution to community, and to having less meat (Cheah et al., 2020; Massaglia et al., 2022). Contribution to community also came up as an implied theme in the current research, as the participants mentioned one of the reasons why local food was more sustainable is due to its positive impact on the local economy and community. The current study shows that overall there is limited understanding of what is sustainable food, because some of the perceived characteristics are not necessarily aspects of sustainable food. For example, results from the current research and the literature (Pradhan et al., 2015; Stein & Santini, 2022) suggest that local food is perceived to be sustainable, which is not necessarily the case.

The top theme of the characteristics of sustainable eating behaviours was 'balance and mindfulness.' This theme was mentioned substantially more than the other characteristics,

and this is a novel finding within the literature. Particularly, in the literature reducing food waste is one of the main instances of sustainable eating behaviours (Monroe et al., 2015; Pinto et al., 2018) which was the least mentioned characteristics in the current study. The current research goes beyond the previously discussed aspects of sustainable eating behaviours, such as only focusing on food waste reduction, and provides a holistic and more comprehensive list of themes related to sustainable eating behaviours.

These existing misinterpretations regarding sustainable food and eating behaviours among university students presents an opportunity to increase their knowledge and reinforce existing sustainable eating behaviours through interventions such as educational programs or messaging (Cheah et al., 2020) or through courses related to food and sustainability (Jay et al., 2019).

3.5.2 Determinants of Sustainable Eating Behaviours

Participants mentioned a variety of personal and environmental factors (social, physical and university) as determinants of sustainable eating behaviours. For individual factors, this research found that food literacy (referred to as dietary knowledge in the framework by Deliens et al.) followed by health, were the greatest individual factors affecting students' eating behaviours, and were mentioned two to three times more often than the other determinants (i.e., time and effort, daily rhythm/structure, values/beliefs, and state of mind). In the current research, food literacy was the most frequently mentioned factor by the participants (as an individual factor and among all other categories) which has also been identified as an important factor shaping eating habits of university students (Malan et al., 2020). Furthermore, given that this study was focused on sustainable eating behaviours, environmental and social values were the main values and beliefs mentioned by participants, similar to results from the study by Lund et al. (2021) which found personal beliefs and values particularly concerns regarding animal welfare and ethics impact dietary choices (Lund et al., 2021).

Within the students' social environment, family, particularly parents, were the most important determinants of sustainable eating behaviors, followed by friends/peers, as students spend most of their time with their friends/peers when they are on campus. This has been highlighted in others studies, where it was found that parents impact diet trajectory patterns of young adults (Appannah et al., 2021) and friends have major influences on the food choices due to time spent together and the need to be accepted by the social group (Malan et al., 2020; Mensah & Oyebode, 2022). Furthermore, eating was considered a social activity for many of the participants, which influenced their food choices based on their social group. Mensah & Oyebode (2022) also found that social gatherings and relations served as a guide for what and where young people eat. Eating habits were also impacted by culture and ethnicity. Particularly, if their cultural food was perceived to be sustainable (for example less or no meat), they would likely follow the same diet.

Characteristics of the physical environment that determined participants' sustainable eating behaviours included access and convenience, food prices (cost), and characteristics of food (referred to as 'appeal of food' by Deliens et al.). Their main two concerns regarding access were: having a kitchen and cooking facilities (i.e., fridge and stove); and access to means of transportation (personal vehicle or public transportation). These factors were also concerns mentioned in other studies (cooking facilities in Mensah & Oyebode (2022), transportation in Bivoltsis et al. (2020) and Shannon & Christian (2017)). Food cost was also a critical factor in whether participants purchased healthy and sustainable food items as they had budget constraints. Cost is widely known to be one of the major determinants of food choices (Glanz et al., 2005), and this is particularly true concerning healthy, organic or local food, which are perceived to have higher prices (Collier et al., 2021). The current research also found that food characteristics including taste, cleanliness, and perishability were all factors that mostly deterred the students from having the healthy and sustainable food option. Collier et al. (2021) also mentions that sensory experience including taste (for example when substituting meat) is one of the main factors impacting food choices.

In the macro environment, the participants mentioned the pandemic as a major influencer where lockdowns, food outlets closures and changes in schedules all impacted eating behaviours, which was expected (Ammar et al., 2020; Huber et al., 2021). However, certain changes, such as baking more, were temporary, while others resulted in a permanent behaviour change. Particularly for students, results from the current study suggest that positive changes occurring due to the pandemic, such as eating healthier or preparing homemade dishes, can be sustained over time and become a regular habit.

Media, social norms, and expert recommendations were also mentioned as determinants of sustainable and healthy eating behaviours from the macro environment. However, these factors had far less mentions (one-third) compared to the pandemic. Canada's Food Guide was mentioned as an important reference for dietary guidelines. The provincial curriculum for primary and secondary schools requires that students are taught Canada's Food Guide, so this is a positive intervention that seems to carry into adulthood. Therefore, promoting food guides and recommendations by experts such as dietitians can provide an opportunity to help increase food literacy and in turn improve eating behaviours among university students.

In terms of university characteristics, campus food was the main factor influencing participants' food choices, and the second most commonly mentioned factor among all categories of determinants. Particularly meal plans and university food outlets where the major themes mentioned by the participants in this category. This is consistent with findings from recent studies where university food and food environment characteristics were identified as important factors for enabling healthy and sustainable eating behaviours (Lee et al., 2019; Mensah & Oyebode, 2022). Marquis et al. also concluded that action to increase food variety and convenient meals is required in the residence halls in university campuses (Marquis et al., 2019). Therefore, meal plans and university food environments in general can provide an opportunity for the students to improve their eating habits by offering easy access and sufficient variety of sustainable foods and healthy food options.

3.5.3 Barriers/Motivators

In line with previous research by Sogari et al. (2018), the current study also recognised that factors influencing sustainable eating behaviours can act as a barrier or a motivator depending on the circumstances. For example, pre-paid meal plans could act as a constraint for the students due to the limitations in variety and offering times (barrier). However, it could also be a convenient way of accessing food without the additional cost or effort which can motivate healthy and sustainable eating (motivator). Another example would be living arrangements. Results from the current research showed that for some participants their living arrangements (living alone and away from their family), a factor also identified by Sexton-Dhamu et al. (2021), was a chance to learn new cooking skills (motivator), while for others resulted in an increased consumption of unhealthy and fast-food options (barrier). This could be due to lack of knowledge and skills to cook healthy foods (closely related to food literacy also identified by Malan et al. (2020)), easy access to unhealthy food (due to environmental characteristics also identified by Munt et al. (2017)), and personal emotions such as stress. The current research also indicated that the impact of social influencers is not necessarily positive and depends on the circumstances. Peers and parents can have both negative or positive impact on eating behaviors (Maillet & Grouzet, 2021).

Factors identified in the current research, extend beyond general or solely health related behaviours and include sustainable eating (i.e., environmental and social considerations), providing a more comprehensive overview of existing opportunities for eating habit improvements. This could guide food related interventions and policies by providing a better understating of how to eliminate barriers and emphasize on motivators.

3.5.4 Strengths, Limitations, and Future Direction

In terms of strengths, this study was conducted with the participation of students from various colleges and various faculties. Therefore, it covered different point of views, backgrounds, and levels of knowledge regarding the discussed topics. Furthermore, to provide a comprehensive overview, this study did not focus on one specific eating behaviour

related to sustainable eating. The focus groups guided the participants to discuss their perception of sustainable eating and what they believe would motivate or demotivate them to eat sustainably.

In terms of limitations, although the goal of the study was to have a representative gender distribution, there were more female students in the sample compared to other genders. The reason behind this could be due to the fact that females are more likely to participate in online research and surveys (Smith, 2008). This biased sample could in turn impact the results and skew towards representing a more female-focused point of view. However, women are more likely to be food purchasers/providers in families, so this sample could be useful in understanding food choices. Additionally, all students were from Canadian colleges and in the city of Waterloo, Ontario and the results may not be generalizable to other higher education institutions in other provinces or countries. Furthermore, this study was done during the COVID-19 pandemic; hence, results might have been affected by circumstances surrounding the pandemic. For example, students' living arrangements, class schedules and social events where different than regular times. Other inherent limitations of focus groups, such as group thinking, might have also impacted the results.

In future research, these focus groups could be conducted for a larger and more representative sample in terms of gender or samples that account for student ethnicity as they may have different eating behaviours. Moreover, further surveys could be conducted based on the current exploratory research to reach a wider audience. Furthermore, current results can be used to design interventions aimed at promoting sustainable eating behaviours which can then be tested at a university setting. A number of universities, such as the University of British Columbia (UBC) and University of Cambridge, have implemented different initiatives or programs to promote sustainable eating behaviours (Buchheister et al., 2020; Jay et al., 2019; University of Cambridge, 2019). Results from the current research helps with the design implementation of such programs in the Canadian context.

3.6 Conclusion

This study presents a novel and holistic overview of how sustainable eating behaviours and sustainable foods are perceived among university students and identified the perceived determinants of adopting sustainable eating behaviours. This study used a previous framework of the factors influencing eating behaviours among university students as a reference and identified new factors including 'environmental and social values and beliefs' by focusing on sustainability aspects. Results from the current study also demonstrated that 'food literacy' and 'campus food' are the top factors mentioned by the participants. Furthermore, the students had different perceptions about what a sustainable eating behaviour could look like which were not necessarily the correct assumptions. Therefore, comprehensive and broad interventions are required to be designed and implemented in order to fill this knowledge gap and successfully move eating habits towards a more sustainable eating trajectory. Results from the current study help with understanding this trajectory and identifying opportunities to promote sustainable eating behaviours among university students such as improving knowledge and understanding of the association between food, human health and planetary health.

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Chapter 4

An analysis of diet trends and associated carbon footprint of young adults in Canada between 2004 to 2015

The contents of this chapter are under review:

Mollaei, S.& Dias, G. M. (2023). An analysis of diet trends and associated carbon footprint of young adults in Canada between 2004 to 2015. *Cleaner Environmental Systems (under review).*

4.1 Abstract

Activities within the food system, particularly dietary choices, are one of the major contributors to global environmental change. Therefore, transitioning to sustainable and healthy diets will help avoid or mitigate a variety of environmental challenges as well as contribute to the health and well-being of society. Furthermore, a particular focus on the eating behaviours of youth and young adults is required as they comprise a critical segment of the population and are in a transitional phase of acquiring dietary habits.

The overall goal of the current research was to understand the dietary trends and dietary environmental impact, particularly carbon footprint (CF) of young adults (aged between 18 to 24) in Canada between 2004 and 2015.

To address the goals of this research; first, using the Canadian Community Health Survey (CCHS)-Nutrition from 2004 and 2015 the average diet (based on the type and amounts of food consumed) by the target population was presented; and second, the carbon footprint associated with dietary changes were calculated using two life cycle inventories (LCI). A total of 3022 and 1113 participants, aged 18 to 24 were included in the analysis from the 2004 and 2015 surveys.

There were three main trends observed. First, there was a shift towards Canada's Food guide intake recommendations. Second, there was a shift towards the consumption of food that is considered to have a lower carbon footprint. Third, protein intake increased in 2015 compared to 2004 and was mainly from animal-based sources for both years with almost identical ratio for animal-based to plant-based. Finally, the overall CF of self-reported diets decreased only slightly (4%) in 2015. The identified trends demonstrated that although diets of Canadian young adults are moving towards the right direction (healthy and with lower environmental impact), the shift is not significant and needs major interventions, particularly regarding reducing CF. Thus, substantial changes in diets of young Canadian adults as well as dietary interventions are needed towards higher consumption of foods with lower environmental impact.

This study contributes to research regarding linking human health to planetary health, which is still a relatively new field of study. Furthermore, public health initiatives aimed at the eating habits of young adults can benefit from current results in order to effectively meet health and climate goals.

4.2 Introduction

Food production is one of the major contributors to global environmental change, particularly climate change (Willett et al., 2019). The food system accounts for 25-30% of total greenhouse gas emissions (IPCC, 2019). The environmental impact of food systems is also affected by dietary choices (Heller & Keoleian, 2015), having a large influence on food production and environmental impacts associated with food systems (M. Springmann et al., 2016). Therefore, transitioning to sustainable and healthy diets will help avoid or mitigate a variety of environmental challenges as well as contribute to the health and well-being of society (Grech et al., 2020).

The necessity for a transition to healthy and sustainable diets has been outlined in international agreements and initiatives including the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement (United Nations, 2015a). Therefore, in

order to meet climate targets, food demand is becoming more important and has presented itself as an opportunity for meeting these targets (Springmann et al., 2018). Particularly, the goal of 1.5 C limit in temperature increase set in The Paris Agreement (United Nations, 2015a) requires drastic reductions in greenhouse gas emissions (GHGE) (IPCC, 2018a). Given the significant environmental impact of food production, which is linked to food demand and consumption, understanding the relationship between diets and GHGEs becomes essential.

In recent years dietitians have become more aware of how food choices influence dietary environmental impacts (Carlsson et al., 2019). Furthermore, governments are also beginning to incorporate environmental considerations into food guides, such the food guides from Brazil and Sweden (Behrens et al., 2017; Livsmedelsverket, 2015; Ministry of health of Brazil, 2014). In 2019, Canada became one of the countries to present a modified food guide to include suggestions on how to make food choices with lower environmental impacts (Health Canada, 2019). In addition to providing knowledge of food impacts, other interventions, such as taxation, physical environment interventions (also known as choice architecture) or use of incentives, are used by different organizations such as governments or health professionals in order to promote dietary changes (Bauer & Reisch, 2019; Belogianni & Baldwin, 2019). These interventions are often mostly focused on health aspects, therefore sustainability related concerns, such as carbon footprint (CF) of diets, still require more attention (Lee et al., 2021).

Previous studies have looked at dietary trends in Canada, including studies that only focused on the consumption of specific food groups/items: fruits and vegetables (Polsky & Garriguet, 2020); red and processed meat (Frank et al., 2021); ultra-processed meat (Polsky et al., 2020); and beverages (Jones et al., 2019). However, studies that only focus on certain food groups result in a partial demonstration of the overall dietary trends in Canada. There are studies that looked at the overall diet quality among adults in Canada using Healthy Eating Index–2015 (HEI-2015) scores with a specific focus on socioeconomic inequities (Olstad, Nejatinamini, Victorino, Kirkpatrick, Minaker, & McLaren, 2021), or Health Canada's

Surveillance Tool, Tier System (HCST) (where Tier 1 (fruits and vegetables) and Tier 2 (grains) are recommended food, Tier 3 (milk and meat and their alternatives) is food that should be chosen less often and Tier 4 represents other food (food with high fat/sugar, sugar-sweetened beverages, and alcohol)) (Hack et al., 2020) and found there is a slight shift towards healthier diets. These studies only looked at the consumption data with a particular focus on health and the environmental impact associated with diets is missing. A previous study by Topcu et. al (2022) has looked at dietary trends and CF associated with those trends. However, this study was done only for the province of Ontario, across the entire population. Therefore, a more comprehensive study including other provinces is required to further increase our knowledge of Canadian dietary changes so as to inform food policies and planning. Despite the growing public awareness and advances in attempts to promote diets with lower environmental impact (McMahon, 2019), there is still a need to quantify the environmental impacts (e.g. CF) of diets in order to better understand which foods drive environmental impact.

Moreover, a particular focus on changes in eating behaviours of young adults is required as they comprise a critical segment of the population. Young adults are in a transitional phase and dietary habits acquired at this time can persist over time and impact their overall food choices in the future (Malan et al., 2019; Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008; Vaitkeviciute, Ball, & Harris, 2015). Therefore, understanding the dietary trends and diet CF of young adults and recognizing how it has changed over the years provides valuable insights on whether food consumption patterns are becoming healthier and reducing impacts.

The current study aims at filling the gap within the literature linking human health to planetary health by connecting dietary trends (including all food groups) and their environmental impacts through a comprehensive nation-wide analysis focused on young adults in Canada. The overall goal of the current research is to understand the dietary trends and dietary environmental impact, particularly CF of young adults (aged between 18 to 24) in Canada. Therefore, the research questions for this study are as follows:

1. How have dietary trends (food item and amount consumed) of young Canadian adults changed between 2004 and 2015?
2. What is the CF associated with dietary changes among Canadian young adults between 2004 and 2015?

This study contributes to the growing area of research on diets and their impact on human and planetary health, specifically by focusing on young adults, whose dietary habits are still in transition. The results of this study can guide researchers and policy makers in designing incentives and interventions that can be used to promote diets which are healthy with low environmental impacts.

4.3 Methods

To address the goals of this research two types of data were required. First, we required an average diet, based on the type and amounts of food consumed by the target population and second, the carbon footprint associated with a kilogram of each food in the average diet. The following sections explain how this data were obtained.

4.3.1 Study design and participants

Secondary data from the Canadian Community Health Survey (CCHS)-Nutrition from 2004 and 2015 were used for this study (Health Canada, 2006; Statistics Canada, 2017b, 2017a) to indicate the type and amount of foods consumed as well as the demographic characteristics of the target population. The Canadian Community Health Survey (CCHS) – Nutrition is a survey administered nationally in Canada collecting detailed data regarding Canadians' dietary intake as well as demographic data. This survey also includes a 24-h dietary recall where the participants report consumed food items and amounts. For the purpose of this study data for the participants aged between 18-24 from the 24h recall were used. Within this age criteria all participants were included in the study. Furthermore, demographic characteristics included in the current study obtained from the CCHS-Nutrition survey included gender, marital status, education, province of residency, and population size group. Participants in this survey report all food and beverages consumed during the recall period as

well as the amount (gram per day). Food items both from meals and snacks were reported by the respondents. More than 2500 food items are recorded in the survey.

4.3.2 Statistical analysis

Descriptive statistics to demonstrate demographic characteristics of the sample was performed using IBM SPSS 27 (SPSS Inc., Chicago, IL).

4.3.3 Foods in dietary patterns

In order to group food items, initially 19 high-level food groups (HLFG) were used to classify all food and beverage items based on food groups suggestions by Canada's most recent food guide (Health Canada, 2019) and previous literature (Topcu et al., 2022; Veeramani et al., 2017). Moreover, to group the reported food items, the Bureau of Nutritional Sciences (BNS) food group codes were used as a reference. Modifications were made to food classified under certain groups (according to BNS) to better differentiate between animal-based and plant-based food items. For example, items in groups such as soup, or gravy were broken down and categorized into other groups similar to the methodology used by Topcu *et al.* (2022). To classify food items from each HLFG the most frequently consumed items (in terms of mass) were selected. Other food items that made up less than one percent of the mass in their HLFG were classified as 'Other'.

The 19 HLFG identified were as follows: "beverages", "dairy and egg", "fruits" (including fresh, frozen, canned, dried and excluding fruit juice), "vegetables" (including fresh, frozen, canned, dried and juice), "grains", "cereal", "baked goods", "beef and processed beef products" (including sausages and deli meat and a small proportion of lamb and veal), "poultry", "pork", "fish and shellfish", "sugar and sweets", "fats and oils", "sauce", "snacks", "nuts and seeds", "pulses", "spices and herbs", and "miscellaneous".

The average amount of food consumed per day was calculated for 2004 and 2015. To calculate the average amount (in grams) consumed per capita per day, the total amount of food reported in each food group (gram per day) was divided by the total population in the sample. Given that the method used in both years was consistent and designed to be

comparable, the average amount calculated for each year was used to assess dietary changes (Statistics Canada, 2017a).

Self-reported dietary intake is often subject to misreporting (i.e., over or under reporting of how much of a food is consumed). If the magnitude and the direction (under/over reporting) of misreporting was similar in 2004 and 2015 it would cancel itself out as it would have been a similar systemic bias. However, there is evidence that misreporting changed due to a change in the survey administered in each year, and in 2015 there were more under-reporters and less over-reporters (Garriguet, 2018), resulting in lower energy intake in 2015 compared to 2004 by an average of 250 kcal (Garriguet, 2007; Statistics Canada, 2017d). According to the study by Garriguet (2018), reported average energy intake in 2015 was significantly lower (~300 kcal lower) for female respondents aged between 19-30 (which is the closest age group to the current study's target population) (Garriguet, 2018). Furthermore, misreporting is not equal across all food groups and under reporting tends to be higher for energy intake compared to protein or for fruit and vegetable intake (Polsky & Garriguet, 2020; Topcu et al., 2022). Due to these differences, food amounts were normalized based on an average daily intake of 2500 kcal, which is the average recommended calorie intake for a moderately active person aged between 18-24 (USDA, 2011). Normalizing the data also ensures that the comparison of impacts of the average diet in 2004 and 2015 is based on the type and amount of foods consumed and not due to consumption of more calories. Data were normalized by calories using a previously published methodology (Topcu et al., 2022).

To normalize the amounts, caloric data of food items were obtained from the FoodData Central database by the U.S. Department of Agriculture (USDA) (USDA, 2022). For each food category, the item with the highest weight was selected to represent the category. For example, the *cheese* category (within the "dairy and egg" HLFG) included a variety of cheeses, such as cheddar and mozzarella. Since cheddar cheese had the highest weight (51% in 2004 and 44% in 2015) in this category, it was selected to represent the *cheese* category. Then the food weight was converted to calories, i.e. the caloric value by weight of cheddar

cheese was multiplied by the total weight of the cheese category. For the *other* category in each HLFG, two methods were used:

1) If there was an item making up more than 20% of the *other* category, the calorie of that item was used for the whole group. For example, maple syrup made up 51% (>20%) of the *other sugar and sweets* category (within the "sugar and sweets" HLFG). Therefore, the calories associated with maple syrup was used to represent all the foods in the *other sugar and sweets* category.
2) If no item within the other category accounted for at least 20% of the total weight, the *other* category was equally added to all other items in the HLFG. For example, in the *other vegetables* category (within the "vegetables" HLFG) no item made up at least 20% of the overall weight. Hence, the weight of *other vegetables* was divided by the number of categories in the "vegetables" HLFG (18 categories) and equally added to the weight of all other categories within the "vegetables" HLFG.

Additionally, daily protein intake was calculated by converting weights of all food items to their corresponding protein-gram using protein content data derived from FoodData Central database (USDA, 2022). The protein intake on a daily basis was calculated by summing the protein content of each food. For this calculation all food items that had protein content were included regardless of whether or not they are considered major protein sources (according to Canada's Food Guide). Then the proportion of protein from three different sources was calculated. The three categories were defined as (1) animal-based, including all items in poultry, pork, beef excluding meat alternatives, fish and shellfish, (2) animal derived, including cheese, cream, egg, milk, yogurt, and butter and (3) plant-based.

4.3.4 Carbon Footprint

To calculate the CF of self-reported diets in each year, the CF associated with 1 kg of each food/beverage was derived from two databases. The main source of CF was a Canadianized cradle-to-consumption gate (farm-to-fork) life cycle inventory (LCI) database previously used for two Ontario studies (i.e. Topcu *et al.*, 2022; Veeramani *et al.*, 2017). This LCI database includes the following activities: farm production, processing and packaging, household activities (such as storage and cooking), and transportation across all stages.

In cases where data for the food items were not available in the Canadianized database (including milk substitute (soymilk), turkey, fruit juice (pineapple juice), beans, lentils,

chocolate, corn, wheat, blackberry, grapefruit, lime and lemon juice, mango, peach, celery, mushroom, spinach, squash, sweet potato, and sunflower seed – also available in Appendix A), a secondary data based called dataFIELD published by Heller et al. (2018) was used. The dataFIELD is a database of CF associated with various food items. The food items included in this database were based on the foods reported in the National Health and Nutrition Examination Survey (NHANES) dietary intake data. The system boundary for this database was cradle-to-farm gate. This database used data from the United States, which is a good proxy for Canadian food as food production activities are similar. Nevertheless, all other activities are not included, so it would underestimate the actual farm-to-fork CF. However, since this study compares data on the same foods consumed from two different years, it would not greatly affect the interpretation of the study.

Similar to the approach utilized for calorie calculation, CF of items that made up 20% or more of the weight in the group were used to represent the group. For example, for "spices and herbs" salt made up 51% of the food group's weight, so the CF of salt was used for the remainder of the mass of food items in this category.

4.4 Results

The results are presented as follows: sample characteristics, dietary trends and CF associated with dietary trends.

4.4.1 Sample characteristics

A total of 3022 and 1113 participants, aged 18 to 24 were included in the analysis from the 2004 and 2015 surveys, respectively. In terms of gender within the sample, the male population was 49.1% in 2004 and 49.9% in 2015, and the female population was 59.9% in 2004 and 50.1% in 2015. Compared to the Canadian population aged 20-24 years old in 2004 and 2015, there were 51% male and 49% female in 2004 and 52% male and 48% female in 2015. The marital status of the participants was mostly single with 87.2% and 84.5% for 2004 and 2015 respectively. From the data available by Statistics Canada, this number was 81% for 2004 and 85% for 2015 for the population aged between 20 to 24. The sample is

also representative with regards to population size group (urban vs. rural) where the distribution of the sample was 13.4% rural and 86.6% urban for 2004, and 18.3% rural and 81.7% urban for 2015. As for province of residency, the sample is to some extent representative of the Canadian population, with Ontario and Quebec being underrepresented (by around 10%) and Newfoundland and Labrador, Nova Scotia and Prince Edward Island being overrepresented (by 3-7%). For highest level of education, the majority of participants (58.1%) in 2014 reported having a high school diploma with no post-secondary education. For 2004, the majority of participants (62%) reported having a high school diploma (30.5%) or some post-secondary education including trades certificate or diploma (31.5%). However, this is not consistent with data provided by Statistics Canada in which the majority of the population aged between 20 to 24 (63.6% for 2004 and 66.1% for 2015) reported having a university degree (below or above a bachelor's degree). Detailed socio-demographic characteristics and a comparison with existing data from Statistics Canada is provided in Table 4.

Table 4 - Socio-demographic characteristics of the respondents

Socio-demographic variable	2004 N=3022 (%)	2015 N=1113 (%)	Canadian Population in 2004 (%)	Canadian Population in 2015 (%)
Gender				
Male	49.1	49.9	51	52
Female	50.9	50.1	49	48
Marital Status				
Married	3.9	3.8	6	4
Common-law	8.3	11.1	12	11
other	0.5	0.7	1	1
Single, never married	87.3	84.5	81	85
Population size group				
Rural area	13.4	18.3	19.9	18.7

Urban area: less than 30,000 people	18.5	12.3	80.0	81.2
Urban area: 30,000 to 99,999 people	13.8	11.3		
Urban area: 100,000 to 499,999 people	25.2	22.1		
Urban area: 500,000 people or more	29.1	35.9		
Province				
Newfoundland and Labrador	5.2	4.9	2	1.2
Prince Edward Island	3.8	6.1	0.4	0.4
Nova Scotia	4.6	9.3	2.8	2.5
New Brunswick	4.5	5.2	2.3	1.9
Quebec	14.5	15.7	23.2	21.9
Ontario	27.1	19.9	38.1	39.5
Manitoba	12.3	7.4	3.7	3.8
Saskatchewan	6.3	7.7	3.3	3.2
Alberta	10.7	12.8	11.3	11.9
British Columbia	11	11.1	13	13.3
Highest Level of Education				
Less than high school diploma or its equivalent (Grade 13 or lower)	20.9	13.8		
High school diploma or a high school equivalency certificate, No post-secondary	30.5	58.1	0.1	0.2
Trades certificate or diploma or some post-secondary	31.5	4.4	18.6	25
College diploma or certificate	10.3	13.5		
University certificate below bachelor's level	1.6	2.6	63.6	66.1
Bachelor's degree or university degree or certificate above bachelor’s level	4.7	7.5		
Not stated	0.5	0		

4.4.2 Dietary Trends

Results showed the average energy intake for the sample was 3311 kcal/person/day and 2804 kcal/person/day for 2004 and 2015, respectively. However, to make a fair comparison, the

results are presented based on 2500 kcal consumed by one person over a day. For dietary trends, results are provided in two sections: first, a comparison between high-level food groups (HLFGs) for both years and second, a detailed look into each food group for both years.

4.4.2.1 Comparison between high-level food groups

Changes in consumption ranked in the order of amount consumed are provided in Table 5. The HLFGs showing the largest increase in consumption (in mass) between 2004 and 2015 were “fruits” with 29.2g (+24%), “baked goods” 15.3g (+16%) and “grains” 11.1g (+8%). The HLFGs showing the largest decrease in consumption (in mass) between 2004 and 2015 were “beverages” 102.5g (-5%), “dairy and egg” 37.4g (-10%) and “beef and processed beef products” 8.5g (-12%). The HLFGs with smallest increase in consumption (in terms of amount consumed) between 2004 and 2015 were “fats and oils” 0.5g (+2%), “miscellaneous” 1.6g (49%) and “nuts and seeds” 2.7g (+31%). The HLFGs with smallest decrease in consumption (in terms of amount consumed) between 2004 and 2015 were “sauces” 0.2g (-1%), “cereals” 0.6g (-3%) and “vegetables” 0.9g (-0.4%).

Table 5 - Normalized amounts of HLFGs and differences between 2004 and 2015

High-level Food Group	Normalized Amount 2004 (g)	Normalized Amount 2015 (g)	Percentage Difference (%)	Amount Difference (g)
HLFGs with increased consumption				
Fruits	107	136	24	29.2
Baked goods	91	106	16	15.3
Grains	125	136	8	11.1
Poultry	74	84	13	10.7
Fish and shellfish	13	21	47	8.0
Pork	27	30	12	3.3

High-level Food Group	Normalized Amount 2004 (g)	Normalized Amount 2015 (g)	Percentage Difference (%)	Amount Difference (g)
Pulses	6	9	44	3.2
Snacks	15	18	18	2.9
Nuts and seeds	7	10	31	2.7
Miscellaneous	3	4	49	1.6
Fats and oils	31	32	2	0.5
HLFGs with decreased consumption				
Beverages	2343	2241	-5	-102.5
Dairy and egg	401	363	-10	-37.4
Beef and processed beef products	77	69	-12	-8.5
Sugar and sweets	45	40	-12	-5.3
Spices and herbs	4	4	-22	-0.9
Vegetables	222	221	-0.4	-0.9
Cereals	22	21	-3	-0.6
Sauces	18	18	-1	-0.2

4.4.2.2 Changes by food group

This section is organized according to Canada's Food Guide (CFG) healthy plate food guide food groups including fruits and vegetables, protein foods, grains and beverages (Health Canada, 2019). All remaining HLFGs are discussed at the end of this section.

Fruits and vegetables

Young adults consumed 29.2g more "fruit" in 2015 compared to 2004 (24% increase). The highest increase in consumption was for apples (10.4g (+36%)) and bananas (10g (+47%)). The highest decrease in consumption was for *melon and watermelon* category 4.5g (-34%).

Most fruits were consumed raw in both years compared to canned, frozen and dried fruits. However, both the amount (121g to 100g) and proportion (79% to 59%) of raw fruits intake decreased from 2004 to 2015.

For “vegetables”, intake did not change much between the two years (decreased by 0.9g or +0.4%). The highest increase in consumption was for peppers 5g (57%) and the highest decrease was for potato 16.8g (-29%). Raw vegetables were the main source of vegetables in both years. The consumption of raw vegetables increased both in amount (86g to 93g) and proportion of total vegetable intake (39% to 42%) from 2004 to 2015. Frozen and canned vegetable had lower intake in 2015 both in terms of amount and proportion. The proportion of vegetables consumed cooked (27%) and as vegetable juice (3%) stayed the same for both years.

Grains

For “baked goods”, consumption increased by15.5g (+16%) on average, where *bread and bagel* had the highest increase at 11.7g (+15%) and *biscuit and cookies* were the only category that decreased by 0.5g (-9%). For “grains”, there was an 11.1g increase (+8%) where the consumption of rice (18.9g, 46%) and wheat (7.1g, 24%) increased, and pasta (13.7g, -26%) and corn (1.2g. -19%) decreased. For “cereals”, there was a slight decrease by 0.6g (+3%) where the consumption of multigrain (1.5g, +70%) and corn (4g, +20%) cereal increased, and wheat (1.5g, -36%) and oat (1.1g, -8%) cereal decreased.

Protein foods

Average consumption of “dairy and egg” decreased by 3.7g (-10%), but this was due to an overall decreased consumption of milk by 62.9 g (-23%). Consumption of all other food items in this category increased as follows: eggs, 10.5g (+42%); yogurt, 6.4g (+27%), and milk substitutes by 4.2g (+62%).

Overall, the consumption of “beef and processed beef products” decreased by 8.5g (-12%) from 2004 to 2015. The consumption of beef and sausages (all processed meat excluding pork sausages) decreased by 8.5g (-15%) and 3.3g (-36%), respectively. Consumption of

other meat (veal and lamb) increased by 0.8g (+28%). In contrast, consumption of "poultry" and "pork" increased by 10.7g (+13%) and 3.3g (+12%), respectively. For "poultry", the consumption of chicken increased by 14g (19%), while turkey consumption decreased by 3.5g (-56%). For "pork" (excluding pork sausage), there was a 3.8g (-18%) decrease while consumption of pork sausage increased by 7.1g (103%).

For "fish and shellfish", consumption had increased by 8g (+47%) with salmon having the highest increase with 4.6g (+119%). All items in this category had an increased consumption.

For plant-based proteins, the consumption of processed products, such as tofu and soy patty, increased by 2.5g (+95%). There was also increased consumption of "pulses" (by 3.2g (+44%)). This increase was primarily driven by higher intake of peas (1.9g, +155%) which was the food item with the highest increase in consumption. For "nuts and seeds", there was an overall shift towards higher intakes by 2.7g (+31%). In this food group, consumption of all items increased, except for peanuts, which slightly decreased by 0.1g (-0.6%). The food item with the highest increase was the "other nuts" category with 1.1g (+70%) increase, followed by "peanut butter" with 0.9g increase (+25%).

Beverages and Other HFLG

In "beverages", there was an overall decrease in consumption of 102.5g (-5%). In this category, the consumption of water (130.5g, +9%), tea (15.5g, +16%) and coffee (20.3g, +13%) increased, but the consumption of carbonated drinks (144.5g, -58%), alcoholic beverages (55.7g, -37%), fruit juice (42.5g, -35%) and "other drinks" (26.1g, -22%) decreased.

For "fats and oils", there was a slight increase in consumption (0.5g, +2%). All items in this category had a slight shift towards higher intakes except for margarine which decreased by 0.6g (-10%).

For "sugar and sweets", consumption decreased by 5.3 g (-12%), with all food items showing decreased consumption, except sugar and *other sweets* category that increased by 0.8g (+6%) and 0.9g (15%), respectively. The highest decrease in this food category was for desserts

(reduced by 5.8g (-65%)). In contrast, for “snacks” (salty snacks), there was an overall increase of 2.9g (+18%), with all items showing increased consumption, except potato chips which decreased by 1.6g (-23%).

For the remaining HLFGs, “sauces” had 0.2g (-1%) decrease, “spices and herbs” had 0.9g (-22%) decrease and “miscellaneous” had 1.6g (+49%) increase.

4.4.2.3 Protein intake

The overall protein intake was 102 g/capita/day in 2004 and 107 g/capita/day in 2015. In terms of protein sources in 2004, 45% were animal-based (including all items in poultry, pork, meat excluding meat alternatives, fish and shellfish), 23% were animal-derived proteins (including cheese, cream, egg, milk, yogurt, and butter), and 32% were plant-based proteins. In 2015, 46% were animal-based, 22% were animal-derived proteins and 32% were plant-based sources of protein. Thus, there were no shifts in protein intake from animal to plant-based. Detailed information regarding the assumptions, calorie and protein calculations and normalization is provided in the Appendix E.

4.4.3 Environmental Impact – Carbon Footprint

The carbon footprint associated with food consumption was 5.92 and 5.71 kg CO_2eq per 2500 calories consumed by one person based on a daily food intake in 2004 and 2015, respectively. This represents a very minor change due to the changes in food consumption noted in the previous section (i.e., -4 % or -0.2 kg CO_2eq). The following outlines changes in HLFGs’ CF based on changes in amount consumed (Table 6).

All HLFGs had more or almost similar CF in 2015 compared to 2004 except for "beverages”, “dairy and egg” and “beef and processed beef products”. These three HLFGs had the highest decrease in consumption and collectively contributed to 0.47 kg CO_2eq decrease in the overall CF. For other HLFGs there was a small increase (less than 0.08 kg CO_2eq) in their CF. For “vegetable”, although consumption decreased, CF increased by 0.03 kg CO_2eq. This increase was mostly due to the increased consumption of tomatoes and peppers (0.02 kg CO_2eq more CF for each category).

4.4.3.1 Foods Contributing to Most of CF

For both years, the top four HLFGs that made up more than 70% of the overall CF were "beef and processed beef products", "dairy and egg", "vegetables", and "beverages". The contribution of "beef and processed beef products" and "beverages" to the overall CF decreased by 3% each in 2015 compared to 2004 and all other HLFGs had minor shifts in their contribution to the overall CF (less that 1%).

In terms of specific items that had the highest CF contribution to their HLFG, for "beef and processed beef products", almost all emissions were from beef in both years (2004: 96%, 2015: 94%), for "dairy and egg", milk (2004: 56%, 2015: 46%), cheese (2004: 27%, 2015: 29%) and egg (2004: 10%, 2015: 16%) were the top three contributors, for "vegetables" tomatoes (including raw tomatoes, tomato juice and canned tomato puree) had the highest CF contribution (2004: 47%, 2015: 49%), and for "beverages" more than half of the CF was from alcoholic beverages (beer) (2004: 28%, 2015: 26%), carbonated drinks (2004: 26%, 2015: 20%) and fruit juice (2004: 18%, 2015: 17%).

Detailed information regarding the assumptions and calculations of CF is provided in Appendix F.

Table 6 - CF of HLFGs and differences between 2004 and 2015. Negative numbers denote decreased consumption in 2015 relative to 2004.

Item	Amount Difference (g)	CF 2004 (kg CO_2eq)	CF 2015 (kg CO_2eq)	Percentage Difference in CF (%)	Amount Difference in CF (kg CO_2eq)	% of total CF in 2004	% of total CF in 2015
Beef and processed beef products	-8.5	2.512	2.213	13	-0.30	42%	39%
Beverages	-102.5	0.510	0.370	32	-0.14	9%	6%
Dairy and egg	-37.4	0.942	0.911	3	-0.03	16%	16%

Sugar and sweets	-5.3	0.098	0.094	4	0.00	2%	2%
Spices and herbs	-0.9	0.002	0.002	22	0.00	0%	0%
Vegetables	-0.9	0.537	0.563	5	0.03	9%	10%
Cereals	-0.6	0.009	0.009	2	0.00	0%	0%
Sauces	-0.2	0.090	0.089	1	0.00	2%	2%
Fats and oils	0.5	0.109	0.109	0	0.00	2%	2%
Miscellaneous	1.6	0.002	0.004	49	0.00	0%	0%
Nuts and seeds	2.7	0.021	0.032	43	0.01	0%	1%
Snacks	2.9	0.043	0.051	18	0.01	1%	1%
Pulses	3.2	0.003	0.005	66	0.00	0%	0%
Pork	3.3	0.173	0.195	12	0.02	3%	3%
Fish and shellfish	8.0	0.112	0.187	50	0.08	2%	3%
Poultry	10.7	0.362	0.426	16	0.06	6%	7%
Grains	11.1	0.156	0.171	9	0.01	3%	3%
Baked goods	15.3	0.143	0.165	14	0.02	2%	3%
Fruits	29.2	0.091	0.115	23	0.02	2%	2%

4.5 Discussion

This study used data from two large, nationally representative samples from 2004 and 2015 to explore trends and changes in the quantity and composition of Canadian young adults' diets and to examine the carbon footprint associated with these dietary changes. The first objective of this study was to identify changes in dietary trends among young adults in Canada. There were three main trends observed. First, there was a shift towards Canada's Food guide intake recommendations (Trend 1). Second, there was a shift towards the consumption of food that is considered to have lower carbon footprint (Trend 2). Third,

protein intake increased in 2015 compared to 2004 and was mainly from animal-based sources for both years with almost identical ratio for animal-based to plant-based (Trend 3). The second goal of this study was to determine the CF associated with dietary changes, which showed that the overall CF of self-reported diets decreased only slightly in 2015.

4.5.1 A shift towards Canada's Food Guide intake recommendations (Trend 1)

A comparison between diets in 2004 and 2015 of Canadian young adults showed that there was a slight shift towards higher intake of food that that is heavily recommended by CFG and a lower intake of food that is recommended to be consumed less. Specifically, there were higher intakes of: fruits which are great sources of vitamins, minerals and fiber and may lower the risk of heart disease (Health Canada, 2019); whole grain cereals and bread, which are the preferred choice of grains in CFG (Health Canada, 2019); "poultry" and "fish and shellfish", which are considered healthier alternatives to red meat (Hallström et al., 2019; Harvard Health Publishing, 2020); nuts and seed which are a healthy source of fat (Neale & Tapsell, 2020); and "pulses" which are considered healthy alternatives to animal-based protein sources (Harvard School of Public Health, 2023). In general, across the entire Canadian population, the percentage consuming "pulses" has increased by 4% from 2004 to 2015 (Ahmadi, 2021). Overall, this trend was also observed in a study among all Canadians (aged over 1) where the consumption of CFG recommended food (such as legumes, certain vegetables, nuts and seeds) had increased and the consumption of food that is suggested (by CFG) to be consumed less (such as fruit juices and sugar-sweetened beverages (SBB)) had decreased from 2004 to 2015 (Tugault-Lafleur & Black, 2019).

In Canada, studies measured diet quality among Canadians adults as well as Canadian children (aged 2-17) using HEI-2015 and found the mean HEI-2015 total scores improved slightly (became healthier) from 2004 to 2015 (Olstad, Nejatinamini, Victorino, Kirkpatrick, Minaker, & Mclaren, 2021; Olstad, Nejatinamini, Victorino, Kirkpatrick, Minaker, & McLaren, 2021). Similarly, trends towards healthier diets were observed in Belgium, where the quality of diet among young adults improved (as measured with a dietary index) from 2004 to 2014 (Desbouys et al., 2021), and diets of US adults improved from 1999 to 2016 in

terms of macronutrient composition, higher consumption of whole grains and plant-protein, and lower consumption of added sugar (Shan et al., 2019).

In terms of reduced intakes of food that are suggested to be consumed less or in moderation by CFG, beef consumption, particularly processed beef products had reduced which was similar to the consumption patterns of Ontarians (Topcu et al., 2022). Given that meat is associated with health issues such as obesity (Rouhani et al., 2014), type 2 diabetes (Pan et al., 2011) and cancer (Wang et al., 2015) and processed meat has been classified as carcinogenic to humans (World Health Organization, 2015), this reduced consumption is a positive trend that could have positive health outcomes. A study by Frank et. al (2021) showed that adults in Canada (based on CCHS-Nutrition 2015) are consuming less red and processed meat compared to adults in the US (based on NHANES 2013-2016). Furthermore, intake of food with high sugar content (such as candies, chocolates and dessert) was generally reduced which is recommended by CFG (Health Canada, 2019). Particularly, industrialized sweets and dessert are considered ultra-processed food with low nutritional quality and are associated with higher risks of obesity and other health issues (Moubarac, 2017).

Finally, there was lower intake of "beverages" that are considered unhealthy such as alcoholic beverages, carbonated drinks, and fruit juice/drinks. Fruit juices are great sources of nutrients, but they have higher sugar content (Khan et al., 2019) and should be limited (Health Canada, 2019). A health report by Statistics Canada looking at all Canadians 2 years and older showed that there was a shift toward lower intakes of fruit juice in 2015 compared with 2004 (Polsky et al., 2020). This trend was also observed among young adults. Overall, lower intake of SBB among young adults is in line with national trends. However, young Canadian adults are consuming less alcohol, which is in contrast with trends observed from a study on all Canadians (Jones et al., 2019). A US study found that there is greater awareness of health risks associated with drinking alcohol particularly for Gen Z (Selcho, 2022), and this awareness may also be growing in young adults in Canada.

4.5.2 A shift towards foods with lower environmental impact (Trend 2)

Young Canadian adults had increased consumption of meat alternatives (such as tofu and soy patty), milk substitutes (particularly soy milk), and nuts, seeds and pulses, which have lower environmental impact compared to animal-based sources of protein (Poore & Nemecek, 2018). Islam et al. (2021) also found that more Canadians (aged over 2) are consuming plant-based beverages (PBBs) in 2015 compared to 2004. Although these changes are positive in terms of reducing impacts, for the most part, there were only small changes in consumption of plant-based proteins. In terms of animal protein, there was higher consumption of poultry in 2015, which has lower environmental impacts than milk and beef (Poore & Nemecek, 2018).

4.5.3 No change in ratio of animal-based to plant-based proteins (Trend 3)

The current ratio of animal to plant-based proteins for both years was 68:32 which is also in line with results from Topcu et al. (2022) (70:30) for the general population in Ontario, Canada and results from Fabek et al. (2021) (63:37) for Canadian adults over 19 (both studies used CCHS-N data). These ratios are considered as high animal-protein (de Boer & Aiking, 2019; Willett et al., 2019). Furthermore, the current study showed that the protein intake of Canadian young adults is similar to the average daily protein intake by Ontarians older than 2 years old (Topcu et al., 2022) which are both much higher than the recommended daily protein intake.

4.5.4 Little change in Carbon Footprint

Although looking at the composition of diets showed a shift towards foods with lower environmental impacts (Trend 2), the current study showed that the CF of diets of young adults in Canada only slightly decreased from 2004 to 2015 (-4%). However, this amount equals to approximately 168 million kg CO_2eq per year for the overall young adult population (approximately 2.3 million based on Statistics Canada data (Statistics Canada, 2020c)) which is the equivalent of 1,133 acres of forests preserved from conversion to cropland in one year (EPA, 2022). According to a study by Heller *et al.* (2018), the mean

CF of US adult (age>18) diets was found to be 2.21 kg CO_2eq per 1000 kcal based on one person's intake (Heller et al., 2018). For Ontarians (2 years and older) the average daily CF across six different diets was 5.69 kg CO_2eq per person per day in 2004 and 5.57 kg CO_2eq per person per day for based on an average daily intake of 2700 kcal (Topcu et al., 2022). When these results are scaled to the average daily caloric intake of 2500 kcal consumed by one Canadian young adult on a daily basis, the CF is 5.53 kg CO_2eq for US adults on a daily basis, and 5.27 and 5.16 kg CO_2eq for adults in Ontario in 2004 and 2015, respectively. The results for young adults in the current study are slightly higher than for the general population at 5.92 and 5.71 kg CO_2eq in 2004 and 2015, respectively.

"Beef and processed beef products" and "dairy and egg" accounted for more than half of the overall CF for both years. Beef, is the single most carbon intensive food item (Hallström et al., 2015), so reducing beef consumption made the biggest contribution to reducing the overall CF of diets in 2015 compared to 2004; however, there was no significant decrease in CF. Although, consuming other alternatives such as chicken or fish instead of beef has been shown to reduce impacts (Aleksandrowicz et al., 2016b; Willits-Smith et al., 2020), in this study, decreased beef consumption (by 8.5 g), was replaced with higher consumption of fish and poultry (by 8.0 and 10.7 g), respectively. Additionally, there is a wide range of values for the life cycle CF of fish depending on the type and source of fish (farmed vs. wild) (Nijdam et al., 2012; Parker & Tyedmers, 2015; Seafoodco2, 2022).

4.5.5 Implications of trends

The identified trends demonstrated that although diets of Canadian young adults are moving towards the right direction (healthy and with lower environmental impact), the shift is not significant and needs major interventions, particularly regarding reducing CF. For example, the ratio of animal-based to plant-based protein has not changed between 2004 and 2015 and dietary shifts did not translate to a significant reduction in CF yet. Thus, it is not enough to switch from one to another animal-based protein sources, but absolute reductions in all animal-based protein are needed. Substantial changes in diets of young Canadian adults are

needed towards higher consumption of plant-based protein foods because of their lower impact (Willett et al., 2019).

Research indicates that dietary shifts towards more plant-based food and less animal products has benefits related to reducing GHG emissions and lowering diet-related health concerns (Springmann et al., 2016). A study looking at google trends found that there is a large public interest for vegan and vegetarian diets globally (Kamiński et al., 2020). However, in Canada only 5% of the overall population reported plant-based dietary practices in 2015 (Valdes et al., 2021). Studies from countries including Canada, Germany and Finland suggests that there is an association between veganism/vegetarianism and younger age (Charlebois, 2018; Charlebois et al., 2018; Mensink et al., 2016; Vinnari et al., 2009). However, even if younger adults are moving towards these diets, they are too few and further dietary modification is required for meaningful impact. Furthermore, given that the contribution of different food categories is not the same, meaningful modifications in high impact and high intake categories or items such as beef or milk, can result in diets with an overall lower environmental impact.

Furthermore, there are also opportunities to enhance diets to be healthier. For example, vegetable and fruit intake is still below recommended amounts, and given that the current study showed that most people consumed fresh fruits and vegetables, it could be challenging to increase consumption as Canada imports most of its fruits and many of its vegetables. Canada's Food Guide suggests frozen fruits and vegetables as an alternative to fresh produce for a variety of reasons, such as reducing food waste, being less perishable, more convenient, and providing year-round access (Canada's Food Guide, 2022), as well as having equivalent nutritious value. However, Connell et al (2018) found that there is a negative association with frozen compared to fresh fruits and vegetables among undergraduate students in the USA, which could be true for Canadian young adults as well. In a study of university students in Ontario, Canada, students mentioned that a lack of food literacy (cooking skills and knowledge of ingredients) was a barrier to eating healthy and sustainable food (Mollaei et al., 2023). Therefore, there are opportunities to increase the consumption of fruits and vegetables

by increasing food literacy, including reducing misperceptions regarding frozen or canned alternatives. This approach has proven to be successful for example in the case of reduced intake of SSB among young adults in Canada which could be the result of educational and policy interventions such as the school nutrition policy (SNP) implemented in Canadian schools in an attempt to improve the quality of food and beverage intake and choices which resulted in positive changes in health outcomes (Critch et al., 2020).

Therefore, dietary shifts to align protein intake with nutritional needs, and a shift to more plant-based proteins, which are also known to have higher health benefits, are required for a healthier and more sustainable diet. Dietary shifts are not necessarily due to environmental concerns and could be related to price increases and budget constraints (Statistics Canada, 2022), even though they might have environmental or health benefits. Affordability is major concern and contributor to food decisions particularly for young adults (Mollaei et al., 2022). Therefore, successful interventions should address barriers such as high costs, and access, improve food literacy (Mollaei et al., 2023), use appropriate message framing for marketing of food and drinks, and also aim to improve social and cultural acceptability and relevance (Evans, 2020).

4.5.6 Strengths, limitations, and future work

To our knowledge, this is the first study to use CCHS-N data to examine dietary trends of young adults in Canada and determine the carbon footprint of these diets. Previous research was focused on specific provinces such as Ontario (Topcu et al., 2022) or particular food groups such as fruits and vegetables (Polsky & Garriguet, 2020), processed food (Polsky et al., 2020), beverages (Jones et al., 2019), or inequalities in diet quality of adults (Olstad, Nejatinamini, Victorino, Kirkpatrick, Minaker, & Mclaren, 2021). However, given that there is a lack of assessment of dietary trajectories among young adults (Christoph et al., 2019), an overall diet analysis focused on Canadian young adults was missing from the literature. This helps with the implementation of novel policies to support healthy food choices focused on a population sub-group which is proven to be a critical in terms of establishing dietary patterns that last and guides future generations (Arnett & Hughes, 2014; D. Hammond et al., 2022; M.

C. Nelson et al., 2008). Furthermore, this study links current diet trends with their CF demonstrating the environmental impact of food choices. Hence, providing a more comprehensive overview of diet characteristics which could guide future policy and decision-making regarding diet shifts.

The main limitation of the current study is the effect of misreporting. As suggested by Garriguet in order to eliminate this issue calculations should be limited to the analyses of plausible energy reporters, using a previously published methodology (Garriguet, 2018). According to this study, for plausible reporters, only female respondents aged between 19-30 had a significantly lower estimated energy intake in 2015 compared to 2004 by 164 kcal. There was no significant difference between estimated energy intake for under-reporters and over-reporters for respondents aged 19 to 30 in 2004 and 2015 (Garriguet, 2018). Therefore, for future research changes due to adjusted intake by female respondents in the plausible reporter category can be accounted for. Moreover, this study did not include inferential statistical analysis as the goal of the research was to focus on dietary changes and CF, and future research can include this analysis.

Another limitation of this study is the use of two data bases to derive the CF of foods. First, the dataFIELD data base is non-Canadianized and this is particularly important due to impacts related to electricity grids. Furthermore, the system boundary defined for the two databases is not the same which could result in variations in CF particularly if the food item had major changes between the two time points. Moreover, how different foods are grown/produced impacts the CF of the food. For example, in the Canadian data based used for this study, CF associated with 1kg of tomato is calculated using data from greenhouse tomatoes grown in Ontario which is 10 times higher than the CF of field tomatoes. Furthermore, there were assumptions made while grouping food items, calculating calories and CFs which impact results. Future research can use a more extensive and detailed approach for further precision.

For this study only CF is used as the determinant of sustainability. Future research can include other aspects related to sustainable diets such as land-use change or water

consumption since certain food items such as pork have lower CF compared to beef but have higher levels of other environmental impacts (such as acidification) (Poore & Nemecek, 2018).

Finally, although results from the current research show a reduced consumption of unhealthy food and a decreased intake of healthier food, whether the diets are in fact shifting to be healthier cannot be determined. Brassard et al. showed that Canadians' eating patterns had a low degree of adherence to dietary guidelines based on the Healthy Eating Food Index (HEFI) 2019 and 2007 (Brassard et al., 2022). Therefore, future research can measure the extent to which changes in diets of young adults translate into a healthier diet using indicators such as the HEFI.

4.6 Conclusion

The goal of this study was to examine dietary trends and CF among young adults in Canada in 2015 compared to 2004. Results showed that young adults in Canada are moving towards healthier more environmentally friendly diets. However, this transition is at its early stages and minimal particularly while considering the CF of diets. Furthermore, animal-based proteins still account for most protein intake. By providing an overview of dietary trends among young adults which are a critical population in terms of eating behaviours, this study contributes to future progress in shifting diets.

This study contributes to research regarding linking human health to planetary health, which is still a relatively new field of study. Furthermore, public health initiatives aimed at the eating habits of young adults can benefit from current results in order to effectively meet health and climate goals. Alteration of nutrition environments, taxation policies and price increases, informational interventions and knowledge-based activities are all different approaches than can be utilized to promote sustainable and healthy dietary patterns. In order to successfully implement such strategies, it is required to know how and why certain populations have changed their diets, as well as the environmental impact associated with these changes. Given that demand for food impacts the food system and creates opportunities

to a sustainable transition, understating areas of development in food choices becomes significantly important.

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Chapter 5

The current mixed method research examined the eating behaviours of young adults in Canada and has several conceptual, methodological, and practical contributions. The overarching goal of this dissertation was to take an interdisciplinary approach, through the lens of sustainability management, and provide an overview of young adults' eating behaviours by exploring and drawing connections from concepts within the field of environmental studies, marketing, and public health.

5.1 Summary of findings

The quantitative research depicted in Chapter 2, examined the eater profiles of young Canadian adults based on factors affecting food choices. Three key finding emerged from this research. First, there were six major factors influencing eating behaviours among young adults in Canada including: (1) beliefs (ethical, environmental and personal), (2) familiarity and convenience, (3) joy and experience, (4) food influencers and Sociability, (5) cultural identity, and (6) body image. Second, the respondents were segmented into six groups based on the importance they attributed to each of the identified factors as follows: (1) the conventional consumer, (2) the concerned consumer, (3) the non-trend follower consumer, (4) the tradition-follower consumer, (5) the indifferent consumer and (6) the 'eat what you love' consumer. Third, more than half of the population in this study have specific considerations and criteria for their food choices, which distinctly differentiates each segment.

The qualitative research in chapter 3, further explored the factors affecting sustainable eating behaviours of young adults particularly university students. This study also presented the current perceived attributes of sustainable food and sustainable eating behaviours Canadian university students. There were three key findings for this study. First, university students had a wide range of perceptions regarding defining the attributes of sustainable food, and the aspects of sustainable eating behaviours. Second, in addition to the factors previously presented in the framework by Deliens et al., this study identified 'environmental and social

values and beliefs' (categorized under individual factors), 'campus food' (categorized under university characteristics), 'the pandemic' and 'food guides and expert recommendation' (categorized under macro environment) as determinants of sustainable eating behaviours. Among all categories, the top two themes mentioned by the participants were food literacy, and campus food (meal plan and university food outlet). Third, identified personal and environmental factors can motivate or act as a barrier for sustainable and healthy behaviors of university students.

Finally, results from Chapter 4 identified three dietary trends among young adults in Canada between 2004 and 2015; first, there was a shift towards the consumption of food that is heavily recommended by Canada's Food guide (Trend 1); second, there was a shift towards the consumption of food that is considered to have lower carbon footprint (Trend 2); and third, protein intake increased and was mainly from animal-based sources for both years with almost identical ratio for animal-based to plant-based (Trend 3). The study also identified the overall CF of self-reported diets decreased only slightly in 2015. The identified trends demonstrated that although diets of Canadian young adults are moving towards the right direction (healthy and with lower environmental impact), the shift is not significant and needs major interventions, particularly regarding reducing CF.

5.2 Research contributions

How food systems function has direct and indirect impacts on human health and the eco-system health of our planet through different channels and impacts the outcomes of food security (IPES-Food, 2017). Within the food system, consumer demand can be a positive force to encourage the production of food that is both nutritious and has lower environmental footprint. Hence, real-world evidence that informs strategies related to dietary shifts is key to a successful design and implementation. To this end, an analysis of individual and environmental drivers of dietary shifts is required to better understand the trade-offs between different interventions, and their outcomes on the natural environment, human health, food systems and food security.

Diet quality is at the intersection between food security and nutrition (FAO et al., 2022). Current global food consumption patterns are placing significant and broad burdens on society and the natural environment. Poor diets are the leading cause for mortality and non-communicable diseases (NCDs) which means financial costs for the healthcare system while also having environmental impacts and associated costs (FAO et al., 2021, 2022). Therefore, by taking a look at the eating behaviours of young adults, which are a population with generally poor diets, this research contributes to knowledge and practice related to interventions and decision-making aimed at improved (healthy and low environmental impact) food choices.

The research presented in this dissertation has contributed to knowledge and the scholarly literature regarding eating behaviours that support both human health and planetary health. Literature regarding eating behaviours and dietary patterns highlights that a variety of environmental, individual, social and policy factors contribute to forming these behaviours (Deliens et al., 2014; Glanz et al., 2005). The current research contributes to this literature by emphasizing sustainability outcomes and including factors that consider the environmental impacts of eating behaviours such as environmental and ethical perceptions. This research also contributes to a previously developed framework by Deliens et al. (2014) by highlighting the importance of campus food environments, particularly meal plans and food literacy, as determinants of eating behaviours among young adults. Furthermore, to our knowledge this study was among the first studies (the only other study was by Marquis et al. (2019)) that presented consumer segments for Canadian young adults based on determinants of their eating behaviours. Our study included factors related sustainability, in addition to health and other common determinants of food choices, which were not included in previous studies segmenting young adults. Furthermore, this research examined current dietary trends among young adults in Canada and highlighted that diets were moving towards healthier and more sustainable food choices; however, changes in the carbon footprint in the past 10 years have been very minimal. Although similar studies have looked at Canadian dietary trends at a national (Auclair & Burgos, 2021) or provincial (Topcu et al., 2022) scale, or with a focus on

certain food groups such as fruits and vegetables (Polsky & Garriguet, 2020), our study is the first to look at dietary trends of Canadian young adults and examine the carbon footprint associated with these dietary changes.

For practical implications, results from this study help with the design and implementation of food-choice interventions, as follows:

- First, the current research underscores the need for population-specific interventions. For example, results from Chapter 2 showed that although the majority of the population under study had specific considerations for their food choices, the largest segment did not consider ethical and environmental impacts in their choices. Therefore, interventions with a direct promotion of sustainability might not be the most suitable approach. Instead, there should be a focus on improving food literacy and eliminating barriers such as access to healthy food with low environmental impact or required facilities.
- Second, interventions might need to place a greater emphasis on knowledge translation and highlighting the link between food choices and their environmental impacts such as carbon footprint. For example, within our sample, the students had a superficial understanding of sustainable food and eating behaviors. Furthermore, food literacy, or lack thereof, was the top mentioned factor limiting the consumption of healthy and sustainable food choices. Therefore, future interventions could include knowledge-based interventions in order to fill in this gap.
- Third, for young adults, particularly students, interventions at the campus food environment level present a significant opportunity. According to this study, given the importance of campus food environment for students' food choices, focus and funding can be channeled towards making sure university food outlets have affordable, nutritious and sustainable food readily available including offering meat-less or vegetarian food options. Moreover, the positionality and physical food environment, such as availability of vending machines with sugar sweetened

beverages or ice cream machines, can be modified to promote and facilitate healthier more sustainable food choices.

5.3 Research limitations and Future research

This study provides several contributions to the literature regarding sustainable eating behaviours and discuses limitations regarding each section and suggestions for improvements for future research separately in each chapter.

The current study focuses on young adults in Canada, who might have unique socio-cultural characteristics and results from this study might not be applicable for other groups or countries. However, it could be a starting point and a guide for future research aimed at studying eating behaviours among particular groups. Future research can go beyond Canada, or look at specific regions within Canada, and how eating behaviours might vary across different regions. Food environments in various regions in Canada, such as provinces, urban/rural regions or remote areas, may affect different aspects of food security, such as access, and in turn eating behaviours (Glanz et al., 2005; Mollaei et al., 2021; Skinner et al., 2016). A population-specific study can go beyond the geographical location or gender and focus on marginalized populations or groups that are historically shown to have poor dietary habits such as low-income households.

Furthermore, within the context of food security, affordability (which translates to price and budget) has always been a major deciding factor for food choices. This study has also highlighted the importance of cost and the fact that young adults' dietary choices are potentially more affected by price changes, rather than intentional diet modification to address health or sustainability considerations and knowledge. Therefore, future research can focus on the extent to which recent price increases as a result of various events (Evans, 2022) have impacted food choices and the feasibility and required trade-offs of choosing healthy and sustainable food.

Future research can utilize results from the current study such as the identified consumer segments or factors affecting sustainable eating behaviours, to design, pilot and evaluate

interventions in a real-world setting, particularly in post-secondary campus settings. Real-world evidence can offer insight into the feasibility and scalability of food and nutrition interventions.

There is also an opportunity to perform a longitudinal study, to assess how the dietary habit change over the years. For example, using the CCHS-N there is an opportunity to look at dietary trends of the population aged 18-24 in 2004 and aged 28-34 in 2015. Although the two populations are not the same group of people, the study will present an average of how dietary trends have/have not changed over the years within the same generation which will help inform whether various initiatives or policies were successful or not.

Moreover, results from the current study can be used for developing models that demonstrate how people navigate their food choices within an environment and examine the impacts of interventions aimed at shifting diets. Agent based modeling (ABM) is a common method of modeling used by researchers in the field of eating behaviors (Hammond & Dubé, 2012; Nianogo & Arah, 2015) which captures how individuals make their decisions regarding food (based on their individual characteristics), and how they interact with the environment and each other (Giabbanelli & Crutzen, 2017; Warren & Louis, 2013). Our results can be used for future ABM studies in order to define the relationships among different components of the model.

Finally, through a more theoretical lens, a key concept of Social Cognitive Theory is self-efficacy. Self-efficacy determines how we think and feel about ourselves and ultimately how we behave. If we believe in our ability to effectively adapt a behaviour, we will put effort, persevere, and be resilient in the face of adversity. Therefore, future research can focus on utilizing the concept of self-efficacy and factors that influence it such as experiences, social persuasion and physical/emotional state as a leverage to promote or facilitate sustainable eating behaviours.

5.4 Conclusion

The current research studied the eating behaviours of young Canadian adults by looking at factors impacting their food choices through two different methodologies (quantitative and qualitative), segmenting them, understanding their perception regard sustainable food and eating behaviours and examining their dietary trends and the carbon footprint associated with their diets over the past 10 years. Therefore, this study provides a holistic overview of the eating behaviours of young Canadian adults. Taking an interdisciplinary approach enables systems-thinking which is required when studying multi-faceted concepts such as eating behaviours. Through the lens of sustainability management, this study utilizes and links concepts from public health, environmental studies and marketing to examine the connections and interdependencies between individual and environmental factors, and eating behaviours. Figure 4 demonstrates how the different findings of the current study connects with each of the mentioned disciplines. All findings contribute to the general goal of informing food and nutrition policies and interventions towards healthier and more sustainable food consumption. Furthermore, drawing upon results from holistic studies, such as the current study, can also serve as a blueprint for future research and achieving goals such as food security, which impact both human and planetary health.

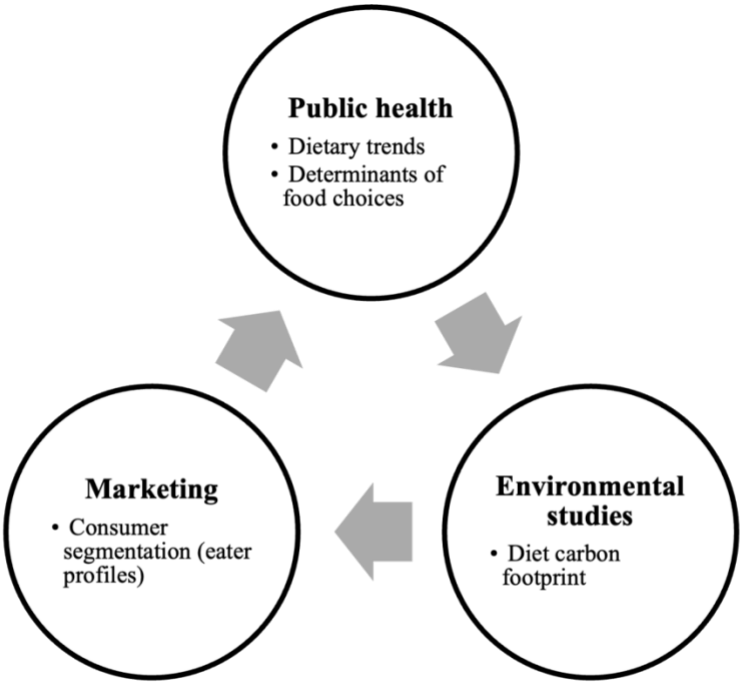

Figure 4 - Disciplines used in the study and the link to research findings

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Appendix A

The factor loading matrix and Cronbach's alpha

Factor and associated concepts	Factor Loading	Mean	Std. Deviation
Beliefs (EEP)			
Has a low impact on climate change.	0.715	4.87	1.741
Is prepared and packaged in an environmentally friendly material.	0.709	4.95	1.659
Is produced in a way that respects animals' rights.	0.677	5.08	1.722
Is fair trade.	0.635	4.68	1.619
Is organic.	0.604	4.07	1.785
Is low in animal products.	0.603	4.15	1.847
Is produced and processed locally.	0.540	4.48	1.587
Claims to contain no additives or GMOs.	0.482	4.36	1.721
Aligns with my cultural background (e.g., nation, country, region).	0.454	3.57	1.843
Aligns with my religious views (e.g., Halal, Kosher).	0.397	3.35	2.116
Is seasonal.	0.348	3.90	1.589
Cronbach's alpha = 0.852			
Familiarity and convenience			
Tastes good.	0.660	6.07	1.292
Is a good value for the money.	0.652	5.76	1.437
Is easily available in shops and supermarkets.	0.611	5.52	1.423
Makes me feel good.	0.596	5.48	1.485
Is easy to prepare (in terms of necessary skills, ingredients and, equipment).	0.565	5.10	1.559
Is fast to prepare.	0.471	4.79	1.480
Keeps me healthy.	0.461	5.59	1.410
I prefer food from brands I'm familiar with.	0.446	5.29	1.291
Is not highly processed.	0.408	4.79	1.569
I am willing to try insect protein.	-0.404	3.20	2.044
Is on sale.	0.388	5.14	1.473
Has an appealing presentation (e.g., visual presentation or packaging).	0.341	4.43	1.708
Cronbach's alpha = 0.742			
Joy and Experience			
I consider myself to be a skilled cook.	0.596	4.23	1.778
I am constantly sampling new and different foods.	0.592	4.77	1.551

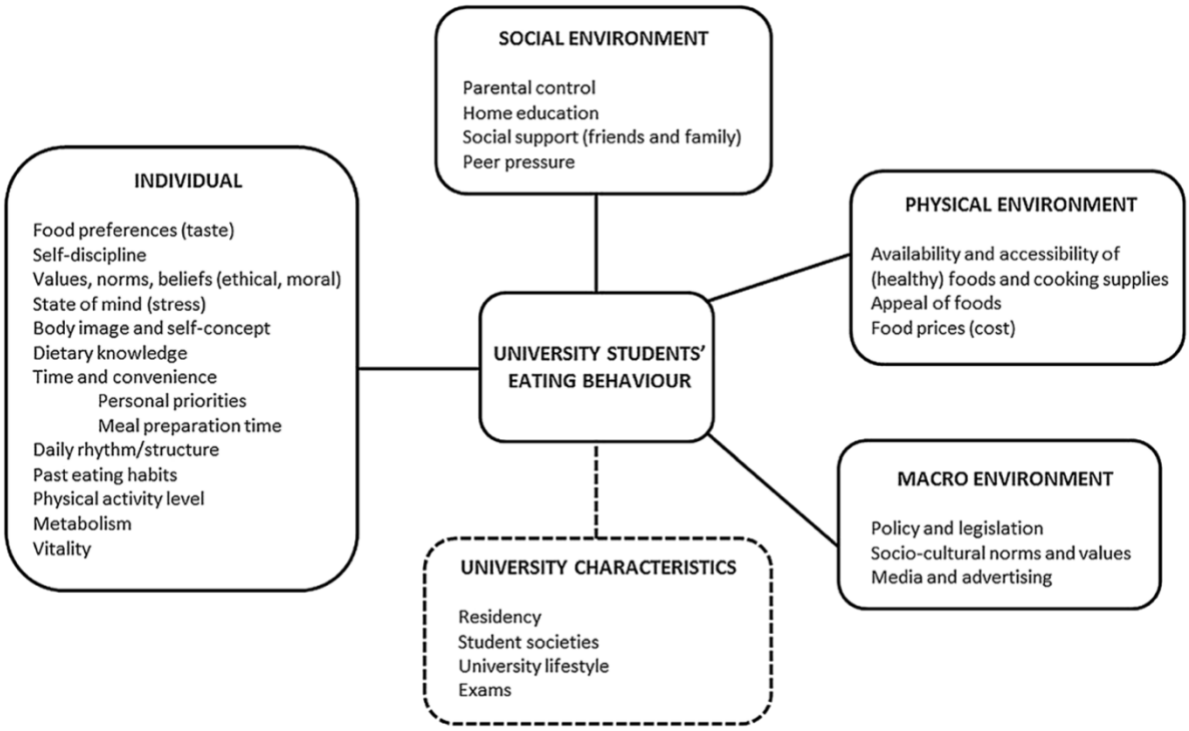
Factor and associated concepts	Factor Loading	Mean	Std. Deviation
I enjoy cooking for others and myself.	0.569	5.16	1.689
I enjoy looking through recipes on websites and social media.	0.549	5.09	1.651
Eating is a good way of spending time with other people.	0.506	5.54	1.349
I do most or all of my own food shopping.	0.469	4.76	1.861
I often eat food from various cultures.	0.455	5.19	1.488
Food makes social gatherings more enjoyable.	0.440	5.62	1.390
I eat food which is recommended by friends.	0.428	5.04	1.421
I am hesitant to eat things I have never had before.	-0.406	4.07	1.825
I eat for pleasure.	0.396	5.28	1.407
I am willing to try plant-based protein foods.	0.347	5.38	1.575
I prepare my shopping list before going to the grocery store.	0.337	4.97	1.719
Cronbach's alpha = 0.723			
Food influencer and sociability			
I often eat out or ready-to-eat meals (more than 3 times a week).	0.675	3.81	1.934
I eat food which is advertised in various media (e.g. Television, Online).	0.598	4.06	1.731
I eat food which is recommended by social media influencers.	0.573	3.55	1.776
I follow food trends.	0.465	4.05	1.702
When I am around others, I eat better quality food.	0.429	4.47	1.608
I eat just as a means of satisfying hunger.	0.356	4.05	1.719
I eat food which is recommended by nutrition experts.	0.331	4.50	1.580
I make most of my purchasing decisions inside the grocery store.	0.331	4.70	1.695
Cronbach's alpha = 0.701			
Cultural identity			
I often eat my ethnic/traditional food.	0.715	4.53	1.754
I often eat my family's traditional dishes.	0.674	5.01	1.628
Food is an expression of cultural identity.	0.385	5.18	1.433
Cronbach's alpha = 0.743			
Body Image			
Is in line with my diet to maintain or reduce my weight.	0.477	4.63	1.757
Is low in calories and fat.	0.430	4.34	1.633
Cronbach's alpha = 0.702			
People share common food tastes regardless of their cultural backgrounds.	Did not load to any factor	4.83	1.630
I do not trust new food technologies (e.g. lab meat).	Did not load to any factor	4.28	1.771

Appendix B

Opening (and warm up)	After welcoming the participants an introduction of the topic will be provided: *The purpose of the study is to find out more about students' food choices, the reasoning behind those choices, and the changes in eating behaviors due to the COVID-19 pandemic. This study is being undertaken as part of my (Sadaf Mollaei) PhD research.* Then we will go through general information regarding the topic: *This focus group will be confidential so what you share in this session will be used anonymously. This session will be audio-recorded for the purpose of recording accurate notes.* *You have the option of not using your real names and you can keep your Camera off. If you wish to speak you can use the "hand raise" feature. The focus group will take between 60-90 minutes. Data from this focus group will be analyzed and anonymous quotations might be used in the reporting of the data, with the consent of the participant. Even if names of participants are revealed during the actual focus groups, the data from the session will be anonymized and not associated with their names. Also, you are asked to complete a very brief survey at the end of this session collecting demographic data. I will provide you with the link. No personal information, such as your names, will be collected.*
Introduction (and ice breaker)	As part of participant introductions, we will go around the (virtual) room and ask the participants to list 2 things they are missing from being on campus.
Transition	Thinking of 'sustainable eating behaviours in university students', what comes to your mind?
Main questions	1. What different eating behaviors do you have between eating at home and eating at the university? 2. What are the meanings of the word "sustainable" and "unsustainable" food for you?

	3. Has the covid-19 pandemic changed your eating habits? If so, how have your eating habits changed? 4. When you have a prepaid meal plan (or in a buffet style restaurant when you don't have to pay for each item), how do you choose what to eat? 5. Who influences your eating? How can parents, peers or professors positively/negatively influence your eating behavior?
Projective techniques (showing images)	In this step the students will be shown examples of possible signs (aimed at nudging them towards choosing more sustainable food options). The images are provided in the Projective techniques (showing images) section. The goal is to see how they feel and what they think about the options, in order to choose the most effective ones for the actual implementation of the interventions.
Survey	Provide the survey link and ask them to complete it.
Ending	Are there any other opinions related to the topic? Is there anything else you would like to share? Final remarks

Appendix C



Factors influencing eating behaviours of university students by Deliens et. al, 2014

Appendix D

Code Book

Category	Theme	Quote
Attributes of sustainable food	Animal based vs plant based	it's not really about labels again, it's about just trying to get less meat or dairy products or animal products on your plate.
Attributes of sustainable food	Animal based vs plant based	I also try to make it sustainable. So say I'm at Starbucks, and they put milk in my drink. I'll never just throw it out, because it's already there. So when it comes to dairy and animal products that aren't meat, I'll just kind of eat it anyway.
Attributes of sustainable food	Animal based vs plant based	eating plant based, or a lot of meat, different options like that
Attributes of sustainable food	Animal based vs plant based	plant-based foods or fruits and vegetables. I think that it would be more sustainable than if we have animals
Attributes of sustainable food	Animal based vs plant based	when I think of a sustainable eating habit, I immediately think of either like a pescatarian or vegetarian or a plant based diet.
Attributes of sustainable food	Animal based vs plant based	I found that once I was on campus, I did start eating a lot less meat, because I separated those two days. I felt like I was eating more sustainably.
Attributes of sustainable food	Animal based vs plant based	I find that eating less animal products, or meat is more sustainable.
Attributes of sustainable food	Animal based vs plant based	eating things that are plant based. I'm just sick of meat and I would lean more towards the vegetable side and tofu.
Attributes of sustainable food	Animal based vs plant based	[to be sustainable] We should reduce. If you ate it [animal products] less, I would call it sustainable.
Attributes of sustainable food	Animal based vs plant based	I've switched to non-dairy products from dairy products.
Attributes of sustainable food	Animal based vs plant based	would also say, the vegan piece that I have been influenced by various sources, over a number of years on environmental or ethical and personal decisions.
Attributes of sustainable food	Animal based vs plant based	I am currently a vegetarian. So I would not be choosing the beef one, even if it was labeled as ethical meat or sustainably grown meat, I still would not eat that.
Attributes of sustainable food	Environmental Impact	it's about trying to do things that are sustainable for the environment
Attributes of sustainable food	Environmental Impact	I also think about the relation to the environment. So thinking about your carbon footprint, what are the things that you're eating? And what impact does it have
Attributes of sustainable food	Environmental Impact	The first thing that came to mind was the environment

Attributes of sustainable food	Environmental Impact	whether or not that food is eco friendly or well sourced is kind of another part of it
Attributes of sustainable food	Environmental Impact	I think about the environment
Attributes of sustainable food	Environmental Impact	I think that is much more sustainable for the environment.
Attributes of sustainable food	Environmental Impact	the first thing that comes to mind is food that is good for the environment
Attributes of sustainable food	Environmental Impact	but then also on a global level with climate change.
Attributes of sustainable food	Environmental Impact	But based on how animals are raised, they do contribute to carbon emissions which leads to greenhouse gases and doesn't necessarily prevent global warming.
Attributes of sustainable food	Environmental Impact	I look at the ingredients, for example. So for example, with almonds, that uses like a lot of water and usually there is controversy around how sustainable that is. So as an example, just maybe choosing an item that doesn't have that ingredient in it
Attributes of sustainable food	Environmental Impact	a diet that can be produced for the world, for a stainable future.
Attributes of sustainable food	Environmental Impact	[I prioritize] their environmental impact over the ethics behind it.
Attributes of sustainable food	Environmental Impact	[how it is] packaged is we are going environmentally
Attributes of sustainable food	Environmental Impact	but also packaging as well
Attributes of sustainable food	Environmental Impact	we can maintain an environment by using it. and unsustainable are the ones that when we take it, we're depleting the environment and natural resources.
Attributes of sustainable food	Environmental Impact	because different foods have different land requirements or water requirements.
Attributes of sustainable food	Environmental Impact	I know that a lot of food does take a lot to produce it just like milk needs a lot of water.
Attributes of sustainable food	Environmental Impact	probably not health is really because of excessive resources they use
Attributes of sustainable food	Ethically produced	lot of unsustainable food production does harm a lot of animals,
Attributes of sustainable food	Ethically produced	and Cruel ways that they tend to get them
Attributes of sustainable food	Ethically produced	I definitely think about [ethics behind their food], like chicken farming. And that's terrible. They're all stuck in a cage, and they all are in their own feces.
Attributes of sustainable food	Ethically produced	when I eat meat and same with cows and beef. How inhumane they're treated.
Attributes of sustainable food	Ethically produced	I've definitely thought about the ethical considerations behind eating animal products specifically, but I

		wouldn't say that it's a deciding factor in what I choose to eat.
Attributes of sustainable food	Ethically produced	a system that we can continue to use, that gives us food, that works for everybody. So not just us people here in the Western world, but also people in developing countries.
Attributes of sustainable food	Ethically produced	People still do work in extreme conditions just to get those foods
Attributes of sustainable food	Healthy and nutritious	I guess just the mix between eating predominantly healthy, making sure that you are getting all the nutrition that you need
Attributes of sustainable food	Healthy and nutritious	those combined into just a better form of eating, whether it's healthier
Attributes of sustainable food	Healthy and nutritious	it's a lot about just besides just eating healthy
Attributes of sustainable food	Healthy and nutritious	So I would have to say that a lot of the unsustainable foods are the foods that actually cause reactions for me internally
Attributes of sustainable food	Healthy and nutritious	I think just sustainable for me is considering how I feel internally and if I'm like this actually is filling me and I've read the nutritional value and I'm actually fine.
Attributes of sustainable food	Healthy and nutritious	sustainable is more healthier food that the environment can create for us.
Attributes of sustainable food	Healthy and nutritious	I guess not only the environment for our bodies and ourselves,
Attributes of sustainable food	Healthy and nutritious	I'm eating more unfortunately, whether that is healthy or unhealthy, I will probably see anything and grab it just because I can.
Attributes of sustainable food	Healthy and nutritious	we have to take into account all these things and just not think about our economy. Think about also our health.
Attributes of sustainable food	Healthy and nutritious	try and eat healthier
Attributes of sustainable food	Healthy and nutritious	eating more and eating more portions of healthy food
Attributes of sustainable food	local and organic	eating things that are… local
Attributes of sustainable food	local and organic	I think I just think of locally sourced.
Attributes of sustainable food	local and organic	Also, a local diet. So eating foods that come from your local area, maybe like a local market, just choosing the foods that are grown around you rather than having to transport them from further locations.
Attributes of sustainable food	local and organic	sustainability, sometimes it's so hard to do in terms of food because you know, you want to buy locally, or you want to know where your food is coming from

Attributes of sustainable food	local and organic	one of the main ways that people can do that is going to local farmers markets. And rather than just buying from the produce section of a grocery store,
Attributes of sustainable food	local and organic	it's a local, as much as you can, like bulk food would be more sustainable
Attributes of sustainable food	local and organic	sustainable food is like the organic, true food, food from local markets.
Attributes of sustainable food	local and organic	sustainable food to eat organic food, like fruits, vegetables, from local markets.
Attributes of sustainable food	local and organic	I also agree about choosing local foods
Attributes of sustainable food	local and organic	if you're talking about it on a more economic or environmental level it's just about trying to shop locally, or trying to support just businesses in the area,
Attributes of sustainable food	local and organic	so just getting food from sources that are good for the environment, good for the people who are making it such as supporting farmers or small businesses
Attributes of sustainable food	local and organic	I don't think about sustainable just on an individual level, but also on a societal level, how you're helping local farmers or local businesses,
Attributes of sustainable food	Production and agriculture	I do think that sustainable food has to do with how it is grown and how it is raised if you're talking about livestock agriculture.
Attributes of sustainable food	Production and agriculture	I just think back to farming and foods with products and pesticides and stuff.
Attributes of sustainable food	Production and agriculture	other aspect of it would be like palm oil and soy. I know some foods are not harvested properly
Attributes of sustainable food	Production and agriculture	the actual ingredients of various products, the process of those products being created.
Attributes of sustainable food	Production and agriculture	the amount of GMOs, and the way it was produced.
Attributes of sustainable food	Production and agriculture	sustainable food, I just think of the ability of natural systems to keep producing that food
Sustainable eating behaviours	Balance and mindfulness	balanced diet
Sustainable eating behaviours	Balance and mindfulness	I think unsustainable is not getting that balance.
Sustainable eating behaviours	Balance and mindfulness	sustainability is just the balance of it
Sustainable eating behaviours	Balance and mindfulness	[sustainability is] making it so each meal we have the amount of food we need the balance we need
Sustainable eating behaviours	Balance and mindfulness	and a lot more balanced.
Sustainable eating behaviours	Balance and mindfulness	it's important to keep your mental health good

Sustainable eating behaviours	Balance and mindfulness	when I think about sustainable eating habits, I think about eating mindfully
Sustainable eating behaviours	Balance and mindfulness	considering what you're consuming, if you're over or under consuming and I think sometimes that can be hard for university students
Sustainable eating behaviours	Balance and mindfulness	I think, just doing what you can with the given circumstances, and then making more mindful choices
Sustainable eating behaviours	Balance and mindfulness	just being a little more mindful in that sense, which I know has become a little bit harder with the pandemic and people are scared to go out and do things
Sustainable eating behaviours	Balance and mindfulness	listening to your body. listening to if your body's telling you, you're hungry to go off of that
Sustainable eating behaviours	Balance and mindfulness	I think intuitive eating is what I would think of, rather than what you should be doing.
Sustainable eating behaviours	Balance and mindfulness	it's important to watch what you're eating. So it's not just about eating consistently. And you also have to make sure you're getting everything from all the food groups, like make sure you're eating your fruits and vegetables and dairy, things like that.
Sustainable eating behaviours	balance and mindfulness	someone who is more so mindful of what they're putting into their body based on their own health.
Sustainable eating behaviours	Financial aspects	more financially sustainable.
Sustainable eating behaviours	Financial aspects	it doesn't become overwhelming both to yourself or financially.
Sustainable eating behaviours	Financial aspects	I think about sustainable eating, as a university student, a big part of it is the financial aspect.
Sustainable eating behaviours	Financial aspects	comes with compromises of maybe I'm buying things that are less environmentally sustainable. So there's some pros and cons, depending on if you're willing to spend more money to buy something more eco friendly
Sustainable eating behaviours	Financial aspects	healthy options are more expensive. So I think for students, it's really hard to have that fine balance of, are they eating stuff that is good for the environment, or is that within their budget as a student
Sustainable eating behaviours	Financial aspects	I can understand that it is more expensive. But I think that is a good investment for our health
Sustainable eating behaviours	Food waste	A big thing I think about is food waste
Sustainable eating behaviours	Food waste	I feel like at the end of each week quite a few university students end up throwing out certain things that they didn't get to use, or forgot about. So I feel like that's a huge part of unsustainable food practices.
Sustainable eating behaviours	Food waste	when I think about sustainable eating is also looking at the waste aspect, like how much waste you're producing

		in terms of food waste, make sure that I'm not being wasteful.
Sustainable eating behaviours	Food waste	I tend to think a lot about the food waste
Sustainable eating behaviours	Temporal aspects	the long term [you're more drawn towards the sustainable one]
Sustainable eating behaviours	Temporal aspects	sustainable, just so that you can continue over a period of time without either breaking the bank or still being healthy at the same time,
Sustainable eating behaviours	Temporal aspects	for an individual, it's about what you can kind of continue to do over a long period of time,
Sustainable eating behaviours	Temporal aspects	this will work for me through a long term perspective.
Sustainable eating behaviours	Temporal aspects	I try to think of foods that can sustain themselves without much human intervention.
Sustainable eating behaviours	Temporal aspects	it should be a long term thing, changes in your diet that you can actually make And withhold for a long time.
University	campus food	I'm on residents, I'm kind of restrained to the specific mealtimes of the residents
University	campus food	there are scheduled blocks for breakfast, lunch and dinner, which is like pretty restrictive as well.
University	campus food	we have cafeteria times. And like, if you don't go during the caf time, you don't get that food
University	campus food	being at university and being on a meal plan has led me to eat fewer portions because they have those structured meal times
University	campus food	when I went outside on campus, I made more of an effort to find healthier options.
University	campus food	I was living in residence. And I don't know sometimes they were huge challenges for me when it came to eating in residence, just trying to find time to meet up with friends and making sure I'm still eating healthy.
University	campus food	So I feel like having a meal plan where everything is kind of separated, like, here's a plate of vegetables or whatever. If they're not mixed in a certain way, I don't want to eat it.
University	campus food	I think having a meal plan, in that kitchen, it didn't really help
University	campus food	when you go to the cafeteria, it almost feels like you're going to a restaurant every day. when you go out to a restaurant, you obviously don't make the healthiest choices
University	campus food	they're also bigger portions that give you a lot of food generally at mealtimes

University	campus food	it's kind of sometimes we have big portions and sometimes where we'll have really small meals, or they'll give us really tiny portions.
University	campus food	another time where it could be three plates worth of food that they could give us.
University	campus food	and we'd have really big portions because we're all working,
University	campus food	since I've come to Res, I find that the portions they give you for food are actually really small.
University	campus food	sometimes the portions are just really small and I have to save my swipes up for the next meal coming up
University	campus food	[in terms of portion] I feel like breakfast is okay. It's moderate. When it comes down to dinner, they give you a smaller portions I find.
University	campus food	I'm not back at home. But one thing that I do find is it's always the same few meals. When you're buying groceries, it's easier to buy the same thing in bulk and then just make that over and over again.
University	campus food	with the types of food that I'm eating, typically a lot of it tends to repeat, I am eating the same stuff over and over, instead of trying new things or making different things.
University	campus food	I was eating a lot of the same meal every day until I got tired of it and then I'd pick a new meal and then I'd eat that every day until I got tired of it
University	campus food	At school, most times, I will choose pretty much the same meal every day
University	campus food	I did like the buffet style and how you kind of knew what was coming every week. And there were some things that were different,
University	campus food	they made an effort to try and make it with more variety and with the different food groups,
University	campus food	But it's never a guarantee that at every buffet style serving, all the food groups are available.
University	campus food	we don't get that much fruit
University	campus food	[cooking at home] allowed me to have much more of a variety of food
University	campus food	[as a vegetarian] I have the same number of options. Generally there will be one main meal option that has meat and then one without meat.
University	campus food	It's not like a ton of options for either of us, but it's equal.
University	campus food	the kind of have only had apples for a while, which were good, but that's kind of the only fruit there is.

University	campus food	normally the same options of hash browns, sausage, eggs, and bacon or waffles [for breakfast]
University	campus food	A lot of food is repetitive
University	campus food	You can't always eat super healthy if their main meals are pizza or something like that. So it's kind of just about working with what they have and also trying to balance it out with what you're eating as well
University	campus food	sometimes they don't serve vegetables for breakfast. So I guess I don't always get the opportunity to have a completely balanced meal.
University	campus food	I would say being vegetarian or vegan, sometimes the meals weren't always balanced, but I tried to compensate with hummus for protein or different things
University	campus food	But if they don't offer those options, I know that my next meal, I can always fall back on that and so it doesn't stress me out, it doesn't really have an impact on how I feel because I know that I can always do that in in my future meals.
University	campus food	It's I'm never really the kind to indulge too much in food and spending. So for me coming to Waterloo and all of a sudden having this meal plan, you know, tapping your money and kind of not even looking at the price of what you're paying anymore.
University	campus food	the meal plan was a buffet style. And I found that I typically ate a lot more than I was used to at home.
University	campus food	eating home cooked meals is more sustainable today because you get to choose the food you eat.
University	campus food	on campus...there's a cafeteria…I am lucky enough to have access to a kitchen as well
University	campus food	this partly reflects in my residence experience because I was like, Oh my goodness, so much vegetarian food exists, and I never knew this
University	campus food	When I was at school, I was living off campus. So I would always be responsible for my own meals, and typically eat around the same time.
University	campus food	when I lived on campus, I found that I ate a lot more, just because everything was more convenient.
University	campus food	at home, usually, I eat all three meals because my parents want me to, and they usually do the cooking.
University	campus food	When I'm on campus, I cook my own food
University	campus food	I'm able to choose when I want to eat because I'm at home right now.
Macro environment	Food guides and expert recommendation	for myself the most reliable people that I go off of, are doctors or nutritionists or registered dieticians, because

		they're the people that have done their research about food and nutrition and what we actually need to eat.
Macro environment	Food guides and expert recommendation	I don't usually go to people that haven't done their research about recommendations on what I should eat personally.
Macro environment	Food guides and expert recommendation	I still look at actual governmental information and doctors
Macro environment	Food guides and expert recommendation	I say that how I plan what I'm going to put on my plate is just by following Canada's health guidelines that shows filling my plate half with vegetables, a quarter with starches and carbohydrates and a quarter with protein
Macro environment	Food guides and expert recommendation	I just try to follow similar to half a plate for veggies and I just try to follow the standard as similar as possible.
Macro environment	Food guides and expert recommendation	it's pretty rooted in me for the standard Canada's Food Guide type information so that's kind of in the back of my head mostly if we're talking about the way to balance meals.
Macro environment	Food guides and expert recommendation	right now my eating habits are mostly influenced by the recommendations in the food guide, kind of vaguely at the back of my head.
Macro environment	Media	then once I moved out on my own is kind of when I started to venture out on my own in my eating decisions. So I definitely watch a lot of food documentaries
Macro environment	Media	I think that with the internet and books and reading, I've learned the value of true nutrition and that you have to fuel your body with good stuff.
Macro environment	Media	I resonate with some influence of diet culture.
Macro environment	Media	recipes such as vegan recipes, stuff like that. For vegan recipes, I look up those. I think definitely the access to the internet, I use Pinterest a lot for getting different recipes that I wouldn't get just from my family background or my personal life experience.
Macro environment	Media	I don't listen to social media, social media influencers, or people that are just maybe saying false information.
Macro environment	Media	Also, I think social media influences us a lot. Because we are always looking that some people make some diet and eat vegetables in this way to get this body.
Macro environment	Media	I usually look at social media influencers. And it makes me a little bit insecure, like, oh how did they get that body or whatever. So I kind of copy if they have a YouTube video or something.

Macro environment	Media	I do my fact based research after watching, social media influencers.
Macro environment	Media	feel like it kind of got me away from my cultural background a little bit from watching these social media influencers who are telling you to just eat broccoli.
Macro environment	social norm and peer effect	I feel like when I went to meals in residence, I would see other people get healthy foods, and that would kind of pressure me to be like I probably felt needed a salad or something on this plate
Macro environment	social norm and peer effect	I would say that depending on my circumstances, I feel a lot of my eating habits change
Macro environment	social norm and peer effect	my older sister is getting into more healthy eating, watching what she's eating, trying to do healthy substitutes. That kind of influences me. Kind of like peer pressure, like she is eating healthy.
Macro environment	social norm and peer effect	when I'm around certain people, I definitely noticed that my eating habits change.
Macro environment	social norm and peer effect	When you eat out with them for the first time or when you go out with them and you don't know them very well. You kind of get insecure about your eating, especially if you're hyper aware of your body as well. So you might feel the need to kind of eat something you wouldn't necessarily eat before
Macro environment	social norm and peer effect	So peer pressure. I'm like, okay want to eat a salad. Versus when I'm at home, I kind of just eat whatever is given to me or leftovers, anything that's available.
Macro environment	social norm and peer effect	with my friends, I'm a little bit more self-conscious about what I'm eating. because I know that some of my friends are really healthy.
Macro environment	social norm and peer effect	I guess when I went to university... my friends … would influence me a lot to eat healthy
Macro environment	The pandemic	after the pandemic hit, I wasn't getting the ingredients I really wanted
Macro environment	The pandemic	once we had the time to kind of sit down and plan our meals out and get through COVID
Macro environment	The pandemic	once COVID hit, I felt everything kind of just lost that structure
Macro environment	The pandemic	I'm definitely eating out less because nothing is open
Macro environment	The pandemic	now I find when I wake up, because there's no rush to get to campus, I have the time to make sure I have a decent breakfast,
Macro environment	The pandemic	COVID had a bigger impact on my eating habits before I moved into residence
Macro environment	The pandemic	to consider the covid 19 pandemic, just because I feel a little bit more obligated to eat in a more local stance

Macro environment	The pandemic	for me, personally, I don't think the COVID affected my eating habits as much compared to other people, I guess
Macro environment	The pandemic	But now that it's the pandemic, and pretty much all my lectures are asynchronous. I can get up and eat whenever I want.
Macro environment	The pandemic	since the pandemic has started, my eating habits have become more regular.
Macro environment	The pandemic	I think the pandemic kind of opened up, a time for me to plan and to learn all those kind of skills.
Macro environment	The pandemic	I did become vegan during the pandemic, but I was vegetarian eight years before.
Macro environment	The pandemic	since the pandemic started last March, I moved back home, and I'm with my family. So we typically take turns cooking meals on different days, which really has a variety of when we eat.
Macro environment	The pandemic	At the beginning of the pandemic, however, I felt like my eating habits were worse because there was no structure to the day.
Macro environment	The pandemic	at the beginning of the pandemic...I worked with my friend...we're going to work out we're gonna eat super healthy so that I was really motivated back then
Macro environment	The pandemic	in the beginning of the pandemic, when lockdown started, I gained so much weight just because I was trying out different baking
Macro environment	The pandemic	during like the first wave of the pandemic. I was the same, trying all these little recipes for baking and cookies and things like that, which definitely didn't help my case
Macro environment	The pandemic	after the first wave, and the first lockdown, I think things kind of went back to normal
Macro environment	The pandemic	When lockdown first started, I baked a lot, I cooked a lot, I tried a lot of different new things.
Macro environment	The pandemic	at the start of the pandemic, the baking was a lot
Macro environment	The pandemic	compared to the start of the pandemic to now I've definitely improved my eating habits for sure.
Macro environment	The pandemic	At the beginning of the pandemic, especially my family started cooking more
Macro environment	The pandemic	Before the pandemic, my family would have a home cooked meal every single night
Macro environment	The pandemic	before the pandemic, I was cooking a lot
Macro environment	The pandemic	feel like if it weren't for COVID 19, I would be eating with people more often. Because right now, in my residents, there's a rule that only one person can sit at

		each table. And I feel like that discourages most people from like eating at the caf.
Macro environment	The pandemic	I haven't eaten with friends or people other than my family since the pandemic started
Macro environment	The pandemic	with the situation of the COVID. I know that we don't go out to get fast food or that kind of food.
Macro environment	The pandemic	I think I order a little bit more considering the pandemic, just because I feel like the little milestones are something huge to celebrate
Macro environment	The pandemic	[during the pandemic] I've cut out dairy for the most part, switching milk entirely focused more on baking and more healthy things, more healthy meals.
Macro environment	The pandemic	in the pandemic, I don't find that I'm going out as often So I feel like eating is just a pastime. Sometimes I'm just snacking.
Physical environment	Access and convenience	also find that because of convenience. If I'm at home and I want a snack
Physical environment	Access and convenience	I'm just kind of being more mindful of when I eat, and obviously my kitchen is right at my hands. So if I am hungry, I can just grab something.
Physical environment	Access and convenience	But sometimes that's [knowing where your food comes from] not always possible.
Physical environment	Access and convenience	I live in an apartment on campus. So I do have access to a kitchen. I'm able to do home cooked meals.
Physical environment	Access and convenience	while I was in Res, I had a suite style, so I did have a kitchen.
Physical environment	Access and convenience	I don't have the opportunity to go to a fridge full of food...it's also harder just because I can't stock up
Physical environment	Access and convenience	so I think that I did eat unhealthy on campus, because of restrictions with transportation
Physical environment	Access and convenience	I didn't have a bus pass, and I didn't have a car. So I would literally eat the less I could, so that I could have enough food at the end of the week.
Physical environment	Access and convenience	it doesn't help that there was an entire wall dedicated to drinks and an ice cream machine on the side and the vending machines
Physical environment	Access and convenience	Whenever I'm at home, I am eating more than when I'm on campus, I guess, I don't know, maybe school makes me forget about eating, and I'll often miss meals or just forget to eat for a long period of time.
Physical environment	Access and convenience	At home, you can't really be entirely mindful of the food because at least in my case, it's not me making the food all the time. So you kind of just have to please the crowd and eat what's there

Physical environment	Access and convenience	I wasn't cutting out meat completely, because I knew that was unrealistic, especially on campus, when you can just eat what you can get.
Physical environment	Access and convenience	now I've also moved away from family. And I thought that would make a difference, but it really hasn't, I still don't really snack as much anymore.
Physical environment	Access and convenience	would always kind of be running out the door and not being the most prepared in terms of food, there'd be a lot of times where I'd go to campus and be really hungry, so that I either buy something on campus, or then just starved to get home and then eat a big meal.
Physical environment	Access and convenience	I after I come home from work, I'm kind of tired. And then even though I'm not necessarily that hungry, just because I'm tired. I just want to eat something. And grab a bite.
Physical environment	Access and convenience	So I felt my eating habits then were a little less sustainable. Just because it was kind of sporadic, and because I hadn't lived on my own, I didn't really know how to go about it.
Physical environment	Access and convenience	I think that healthy food is harder to keep around you can have a box of crackers or a box of cookies in your drawer for a month.
Physical environment	Access and convenience	I definitely think more about food that will last longer in my fridge, fresh food goes bad pretty quickly.
Physical environment	Access and convenience	I definitely do keep some canned vegetables in the fridge or things like that. When maybe I would go more regularly for getting fruit or something like that if I wasn't trying to keep my groceries down.
Physical environment	Access and convenience	The residence I was at was buffet style .... It just felt easier to and more convenient
Physical environment	Access and convenience	There is not ever a shortage of food in my house or things I can eat if I need to.
Physical environment	characteristics of food	I would consider the fresh, non-frozen version of the food to be healthier because I guess it hasn't been processed than frozen food.
Physical environment	characteristics of food	You have the choice to opt out of the deep fried stuff, but then you don't have that much of a selection to fully fill you up
Physical environment	characteristics of food	This deters you from eating the vegetables, and you just want something that tastes good.
Physical environment	characteristics of food	I think it's just basically the food that makes me feel good and kind of sustains me throughout the day, gives me the energy I need to get through daily life, get through my daily tasks and kind of keep me going.
Physical environment	characteristics of food	I also eat with them and the food that they make is more fulfilling for me

Physical environment	characteristics of food	So then I choose whatever I think is going to be the most fulfilling
Physical environment	characteristics of food	I think I would definitely want to take consideration like the calories
Physical environment	characteristics of food	I think for me honestly just comes down to what the food is, it is taste
Physical environment	characteristics of food	taste is also a big decision maker for me when there is a variety of food
Physical environment	characteristics of food	what looks good, It's really based on visual stuff.
Physical environment	Food prices	I was always really nervous. If I were to go to residence and I'm afraid that I would spend too much on one meals and l would just be super mindful that every meal
Physical environment	Food prices	I think that's a part of it just having a less bountiful budget as a student.
Physical environment	Food prices	if I had a meal plan, that was my money that was coming out of my account, I would be a little more methodical about it saying, Is this something that I really want
Physical environment	Food prices	think it's kind of hard to decide, picking between foods when the other one is cheaper. And the other one isn't, I know that most organic foods are more expensive.
Physical environment	Food prices	in terms of looking at prices at the shop it goes up and down. So I try to shop at a certain day or I always look at coupons
Physical environment	Food prices	especially being a university student trying to save money, it's not always the most financially smart option.
Physical environment	Food prices	You can go out and purchase stuff. It's just it's not a part of the meal plan. So you have to pay extra.
Physical environment	Food prices	I would rather not pay [for fruits] when I'm already on a meal plan
Physical environment	Food prices	I never ordered takeout in first year, maybe once….think that was more of a financial thin
Physical environment	Food prices	[for my meal plan] money wise, just because I still had so much money left over. I feel like I was almost careless with it.
Physical environment	Food prices	there's definitely the incentive to eat more since it's prepaid.
Physical environment	Food prices	So as someone who liked trying new food, I didn't explore that much just because of how much money I have, and I can't go over.
Social environment	Cultural and ethnic background	I don't like about getting a meal plan is that I know, they cook like pretty balanced stuff, but a lot of this stuff that they cook are more like, I don't know how to

		say this in a better way. But well, for me, I'm Filipino and I want to stick to cultural foods.
Social environment	Cultural and ethnic background	In my house, I'm more likely to eat kind of more traditional, cultural foods from my background, though, it's not always that because just my mom's always been kind of an adventurous cook.
Social environment	Cultural and ethnic background	a lot of my friends were just white. A lot of my friends at school, just a lot of the kids at school were white and me coming from a different background. I think there were some differences obviously, in terms of what I might be eating at home and what my friends might be eating at home, but I don't think it necessarily influenced me,
Social environment	Cultural and ethnic background	I think I was just eating very culturally different food.
Social environment	Cultural and ethnic background	was eating more ethnic food at home, versus at university, you just kind of eat what you can get. And that's not usually what's culturally specific to you, which is fine.
Social environment	Cultural and ethnic background	That changed a lot of my diet in the recent months. And in terms of other influences. because I came from a cultural background, recently I started to eat less of cultural foods.
Social environment	Cultural and ethnic background	I would say growing up, I ate a lot of Indian food
Social environment	Cultural and ethnic background	growing up, I only ever really ate Chinese food because my parents, my mom only really knew how to cook Chinese food and wasn't too open to foods from other cultures.
Social environment	Cultural and ethnic background	most of our food are pretty balanced. In one dish, there's always a vegetable there's always meat, and you get a lot of the stuff in the food groups already.
Social environment	Cultural and ethnic background	I'm in a house surrounded by carnivores. So it makes it a little bit challenging to pursue those vegetarian options that I'd be more interested in
Social environment	Cultural and ethnic background	our parents are the biggest influence, because my mom is doing the home cooked meals.
Social environment	Cultural and ethnic background	I think that my parents had a big impact on influencing me and my food choices based on the types of foods and the types of flavors that they expose me to when I was a kid and what I grew up being familiar with.
Social environment	Cultural and ethnic background	My family has traditionally eaten little meat and fish. But once I moved to university, I decided that I'd only consume meat or fish twice a week.
Social environment	Cultural and ethnic background	Growing up learned kind of not to be a picky eater, I think with my parents they always they kind of just

		taught me and my sister as well just to be open to trying new foods and be able to eat everything.
Social environment	Cultural and ethnic background	my mom would always cook ethnic home cooked meals with grains and vegetables and proteins.
Social environment	Family	I never believed that I could ever go vegetarian. I'm in a house full of carnivores and my boyfriend loves to hunt and all that fun stuff. But once I realized I actually could do it and get creative with some of my recipes. I'm like, you know what, maybe I can stick to this
Social environment	Family	that can be hard for university students because it's the first time away from home and for a lot of people and you don't really have your parents to kind of guide you in that sense.
Social environment	Family	because my parents always cooked meat and all that kind of stuff. And I don't really like meat, even though I'm not vegetarian, but I kind of don't like meat.
Social environment	Family	If my mom's preparing something, I know that has probably a lot of oil in it and I am trying to stop eating those foods.
Social environment	Family	when I was growing up, my family were huge steak people. We would have steak for dinner all the time.
Social environment	Family	And I think that now I am eating differently than my family. I cut out carbs, I cut out dairy.
Social environment	Family	it's later lunches, later dinners. And I think that's just more out of habit of my family. That's just kind of the schedule we've always had
Social environment	Family	now I'm at home with my family. And I would say that now I'm more back to a regular schedule. we all collectively eat at a certain time
Social environment	Family	think in terms of just the influences around me, I think obviously, my family is a pretty big influence in what I choose to eat and just how I eat as well.
Social environment	Family	I guess for majority of my life, it was my parents because I was living with them for such a long time.
Social environment	Family	my family definitely influences what I eat for my whole life growing up at home
Social environment	Family	I also currently live with my boyfriend. So he influences what I eat a lot, because we eat together all the time.
Social environment	Family	my family would always be like, you got to eat this because you have to grow
Social environment	Family	I think yes, my parents also definitely influenced what I was eating. And surprisingly, they also influenced what I was eating on campus, because they would call me and ask What did you eat today

Social environment	Family	even on campus, my parents definitely influenced me as well with the calls asking me what I was eating, and encouraging me to try something new
Social environment	Family	I would say growing up, my parents had the biggest influence on what kind of food I eat
Social environment	Family	for who would influence my eating, it's really my parents.
Social environment	Family	they [parents] would decide what restaurants we'd be going out to, or what style of food we'd be eating.
Social environment	Family	I feel like I still follow. Relatively, they align with the same choices that my parents raised me with, the same food choices,
Social environment	Family	I think that the impact of what your parents have brought you up eating has had some enduring impact
Social environment	Family	I would just eat whenever I wanted, like late night, but when I'm at home like my family, they all sleep at eight. So I kind of get into the groove of that I'm not going to eat at night
Social environment	Family	The only period that I did live with my family was during that first initial lockdown, which was when I saw all those changes because, like we said previously, my family was cooking for me.
Social environment	Family	Usually eating my parents cooking, which is always good. And I think with my parents, they are always trying to make sure that I eating well
Social environment	Family	I find that, it definitely is a lot of home stuff. So while I live alone, I'm very close with my uncle, and their family. And my cousin definitely, when I'm with her, it's really easy to eat vegan. it's really easy to stay on track
Social environment	Family	My mom would make sure that I'm getting like iron and all the necessary stuff that I wouldn't normally get if I was left on my own
Social environment	Family	Whereas when I'm at home, my parents cook my meals for me. And it's a more regular time.
Social environment	Family	she's always saying that you have to take your breakfast, you have to take your dinner. And you have to take food, always healthy food
Social environment	Family	I'm sure they would love to have a steak, but I'm not making them steak. I'm making them baked vegetarian cheese pasta type of thing. So I think it might be in a way, I'm influencing them.
Social environment	Family	we typically take turns cooking supper. So whatever is made, we typically eat it
Social environment	friends	I mean I've never really felt that my friends have had much of an influence on me I think

Social environment	friends	When I'm at school with my friends. And they go out to get food or anywhere, I'm more likely to slip up,
Social environment	friends	I feel like because a lot my friends are guys, just because they would constantly like to go out
Social environment	friends	my roommates, since we're all here all the time, we kind of see each other cooking.
Social environment	friends	just having your roommates around. And their behaviors kind of influencing yours. I think that's also something that's contributed to my more regular eating versus when it was on campus.
Social environment	friends	It's mostly my roommates. And my partner that influences my eating habits.
Social environment	friends	just being in university and in an apartment with roommates that's kind of helped shape my habits and trying to be more sustainable and healthy.
Social environment	friends	what I eat really depends on who I was hanging out with at the time. It really depended on my friends.
Social environment	friends	beyond just the healthy versus unhealthy, I think, friends do a good job of exposing you to new types of food that you wouldn't have necessarily tried beforehand
Social environment	friends	I do eat more with like my housemates than I do when I'm with my family, for example. And we do some shared meals regularly.
Social environment	friends	I listen to my friends sometimes when they give me recommendations on dishes that I should or shouldn't try. But I usually take that with a grain of salt.
Social environment	friends	when I see my friends or my flatmates, eating healthier things, I'm like, maybe I should try that.
Social environment	friends	I think if my friends convinced me, I would definitely try it
Social environment	friends	If they [friends] convinced me I probably would [eat a food without knowing it]
Social environment	friends	If my friends said the meal was good
Social environment	friends	I really hope that when my friends recommend something to me to eat that they have my best interests at heart. So then I would try it without knowing
Social environment	Social activity	You're also not eating with your family, you might be eating alone Or eating with a group, and it can be hard to be mindful in both settings
Social environment	Social activity	Food doesn't seem as fun anymore if you can't like share it with people or go out and get something
Social environment	Social activity	I don't really like eating with other people. I think it kind of gives me anxiety when people watch me eat, I don't know. So I just tend to not eat with others.

Social environment	Social activity	people that you're eating with have a big impact on choices
Social environment	Social activity	That definitely influences me and in addition to that, restrictive diet culture or I guess, not necessarily the food, but the social norms around that food have been part of my past.
Social environment	Social activity	so at school, I live with roommates. So sometimes I with eat them. And it's kind of nice to have people around.
Social environment	Social activity	at home, I would usually eat just with my family.
Social environment	Social activity	At home, I live alone, so I don't kind of eat with family.
Social environment	Social activity	I'm usually eating myself, There is a lot of having breakfast in our own room
Social environment	Social activity	then here, sometimes I eat alone, when I don't see any of my friends in the cafeteria space. But if I see my friends there, then I'll go eat with them.
Social environment	Social activity	at residence usually we would have social eating times and due to the restrictions that had lessened there were times when we would have probably had meals together with other apartment friends.
Social environment	Social activity	at home when I was cooking, it was usually either with friends or family. Because it was just a kind of a social activity.
Social environment	Social activity	[on campus] while I'm still like interacting with people at mealtimes, it's definitely just, eat and then go back to studying and stuff. And the social part of that has definitely gone down for me
Social environment	Social activity	with the restrictions now. I have been eating in my room a lot more
Social environment	Social activity	And I would usually eat alone because I was making my own meals and then my family would eat separately.
Social environment	Social activity	being on campus now, I always eat with my floor mates for every meal
Individual	Daily rhythm and structure	at university it's very limiting in that sense that there isn't a whole bunch of time to go, especially if you have classes and you don't really have that opportunity.
Individual	Daily rhythm and structure	I really think my eating habits change as my classes changed and as my schedule changes. so it's less of a schedule now for me eating than it was when I was on campus.
Individual	Daily rhythm and structure	now I eat at less regular times, sometimes I might even skip meals completely, because I'm not that hungry.

Individual	Daily rhythm and structure	So because we had scheduled times it was like if I don't eat enough now I'm gonna be starving by dinner. So I got to make sure this is a good meal.
Individual	Daily rhythm and structure	although I do eat breakfast, lunch and dinner, it really depends on the day. I wouldn't say that it's the same time that I eat those meals every day, because of school.
Individual	Daily rhythm and structure	I feel like if I go back to school now sticking to a diet would be really hard because I really like to eat especially, during class
Individual	Daily rhythm and structure	an in-person engineering schedule is supposed to be pretty hectic. So I would actually have to wake up early to attend lectures and. So I feel like with those time constraints imposed on my life, I would be more likely to eat breakfast.
Individual	Daily rhythm and structure	But I think that it is also making bad changes in my mealtimes. I don't know, I don't have control.
Individual	Daily rhythm and structure	that I can kind of plan around that, when maybe if I had classes, it would just take more work and same with going for groceries
Individual	Daily rhythm and structure	Whereas when I'm not at university, I kind of schedule myself in a different way, depending on what other commitments I have during the day sometimes
Individual	Daily rhythm and structure	once I kind of got into more of a rhythm and structuring my days, that's kind of where I was able to develop better eating habits.
Individual	Daily rhythm and structure	after the summer was over I had to go back to school I kind of returned back to my old eating habits and everything like that
Individual	Daily rhythm and structure	But as long as you aren't skipping meals to me, that looks like regular eating patterns.
Individual	Daily rhythm and structure	But then once studying school again, everything's a bit back to normal, now that my meal times are more structured
Individual	environmental values	I'm also vegan, so that also affects what I eat as well. So the thing about being at home is that my cousin is also vegan. So it is nice to eat at home sometimes, because then we kind of make the same meals.
Individual	environmental values	I think I would still choose the meat lasagna. But I guess if I was faced with it every single day, I wouldn't constantly choose it, I would then start to choose the sustainable one. But in moderation, or over time, once in a while it wouldn't be a bad thing to choose the other one.
Individual	environmental values	I would probably lean more towards the vegetarian side and then occasionally get the meat.

Individual	environmental values	I gave myself two days in the week that I do so to be more conscious of the meat that I was consuming.
Individual	environmental values	when I think of sustainable, I think there's something that you can do over a long period of time, obviously.
Individual	environmental values	if I have a full plate I feel bad that I have all this food and I don't want it to go to waste so then I'll force myself to eat the whole thing and that's obviously not a good feeling when you're full of all that new food and kind of dangerous for me
Individual	environmental values	So I found that the University did a pretty good job of having the different garbage cans and, you know, making us aware of what goes where, I'd spend two minutes staring at the pictures, trying to figure out what waste goes where
Individual	environmental values	I've been trying really hard to eat a lot of vegetarian meals which are better for the environment
Individual	Food literacy	Absolutely not [feel like you have sufficient cooking skills]
Individual	Food literacy	when I'm home, I don't really do a whole lot of cooking
Individual	Food literacy	I think I also struggled just because I don't think my cooking skills were up to par.
Individual	Food literacy	I don't think I have sufficient cooking skills to make healthy meals for myself.
Individual	Food literacy	I don't know if I have the abilities to prepare my own meals.
Individual	Food literacy	I think I will eat a lot of fast food. Because I don't know how to cook.
Individual	Food literacy	especially being at school I don't really cook anymore.
Individual	Food literacy	we're on our own to make our own meals.
Individual	Food literacy	I was hungry but didn't want to make food
Individual	Food literacy	and I really didn't have the motivation to cook all the time
Individual	Food literacy	Not me personally, but I do know, a lot of my peers are not super comfortable in the kitchen or don't have a ton of experience with cooking
Individual	Food literacy	I don't really know how to cook that well
Individual	Food literacy	cooking just takes practice and sometimes when I cook things, they taste terrible.
Individual	Food literacy	I don't have the patience to do it. I always kind of mush stuff together when you're supposed to do it separately.
Individual	Food literacy	I cannot cook I have tried.
Individual	Food literacy	I agree fully cooking definitely does take practice
Individual	Food literacy	I know for a fact that I didn't really know how to cook over the summer

Individual	Food literacy	But for the most part, I would not know what to use, I can follow ingredient and recipes pretty well. But it's the fact that I don't know always how to use things in certain ways.
Individual	Food literacy	I don't always cook for myself, my boyfriend cooks for me most of the time, which is good
Individual	Food literacy	I'm definitely cooking more because I have to
Individual	Food literacy	I never really used to be that involved with either, but now I'm doing a lot more vegetarian baking and a lot more healthy baking
Individual	Food literacy	l'll just make healthy options for myself and just cook my own meals
Individual	Food literacy	I've been cooking more for myself doing, going out and doing my grocery shopping. I don't know if that's necessarily related to the pandemic. I think that's more so related to just me being away from home.
Individual	Food literacy	in a I way have become more involved in cooking, because if I'm cooking, you eat it.
Individual	Food literacy	when I left campus, during the fall term, I had my own place outside of campus. So then I had to cook my own meals and everything like that
Individual	Food literacy	I feel like I have developed some cooking skills since moving out of residence in first year and living in apartment and I'm still there during the pandemic.
Individual	Food literacy	I am fairly experienced with cooking.
Individual	Food literacy	I usually prepare my own meals
Individual	Food literacy	I feel like I have fairly sufficient skills in cooking
Individual	Food literacy	because I'm sticking to a diet, it also helps that I have cooking skills
Individual	Food literacy	I also really enjoy home cooked meals because I like cooking
Individual	Food literacy	I don't have any synchronous classes. So I think it does help with me. I have expanded my cooking repertoire because it has flexibility to do things that take multiple stages, like making bread
Individual	Food literacy	[before the pandemic] we'd cook like twice a week or three times a week, but not very often because my parents worked, and me and my sister were in school
Individual	Food literacy	they'll still cook every once in a while.
Individual	Food literacy	we cooked almost all of our own meals
Individual	Food literacy	I have an older sibling who was very good at cooking. So I was like, Why do something if I'm gonna mess it up and she isn't.

Individual	Food literacy	eventually, I figured I should learn how to cook. So I learned the basics of pasta, and eggs.
Individual	Food literacy	knowing how to cook would definitely change the way.
Individual	Food literacy	I feel like I've actually been eating healthier ever since I've been able to cook
Individual	Food literacy	When I was at home, I was usually cooking most of my own meals.
Individual	Food literacy	I would cook most of my meals throughout high school
Individual	Food literacy	I cook breakfast and lunch
Individual	Food literacy	I've been cooking a lot more than I've been used to, I feel like I've become very attuned to what I'm putting into my body.
Individual	Food literacy	But I know, generally what ingredients are probably better for you what aren't
Individual	Food literacy	I mean I could always try [to cook for myself]
Individual	Food literacy	I didn't always have ingredients to cook stuff that I usually would
Individual	Food literacy	I usually try to go for the options, where I can see them make it in front of me make what they're making, right in front of me
Individual	Food literacy	I look at the ingredients and there's some things in there that I like, then I would definitely try
Individual	Health	I wouldn't consider frozen food necessarily healthy or unhealthy.
Individual	Health	I wouldn't choose it[frozen food] just because of the preservatives but I wouldn't necessarily say it's unhealthy food.
Individual	Health	I would always make sure I go to the salad bar making sure I was getting my fruits and veggies, salads.
Individual	Health	I lived in a traditional style residence, and it was just the allotted of money I had, and you tap and just whatever the price is, it goes off of that. But I think for me, typically, what I chose to eat, or just how I chose to eat things is I again, we had salad bar, and we had fruit and stuff and all that stuff around, that was always good options for me.
Individual	Health	even though it may not be the most nutritious
Individual	Health	I prioritize the nutritional value of foods
Individual	Health	on the early parts of the pandemic, I was definitely eating healthier. So I had more time to sit down and meal plan and eat healthier and take time for that.
Individual	Health	I definitely tried to make it as healthy as possible at the same time. But the healthy options were, we always had a salad bar.

Individual	Health	there was always a salad bar and I in the mornings, they would have a variety of fruit and then for the rest of the day would be like different types of fresh salads.
Individual	Health	I definitely eat more and healthier at home because I guess my mom is making the food and I'm not buying random stuff off the street.
Individual	Health	I definitely would eat more unhealthy because I find that the options on campus weren't always something that you would have cooked for yourself at home
Individual	Health	I'm definitely eating more healthy at home than I was on campus
Individual	Health	I also noticed that living by myself, in Waterloo I'd be staying up really late, like 4am, and then getting up like at one and it was really unhealthy. S
Individual	Health	I think it's just more healthy now, because I'm not eating whatever
Individual	Health	but it was definitely something that I still did not find appealing to me or sufficient for what I wanted in terms of, health, the healthiness of the food, and also the variety
Individual	Health	But I think when it comes to eating healthy, it was difficult, because I noticed that when they did have vegetables, sometimes it wouldn't even be cleaned properly
Individual	Health	the food I take all made in home and are more healthy.
Individual	Health	still thinking healthy, in my mind trying to stay fresh.
Individual	Health	[on a meal plan] I'm choosing what I want to eat try to eat healthy stuff. Make sure I have at least one vegetable with each of my meals
Individual	Health	actually during lunch and dinner, they usually have, at least one vegetable and one grain, and one protein.
Individual	Health	I know I try and take into consideration the health aspects
Individual	Health	I try to eat healthy but it doesn't always happen
Individual	Health	So that [not knowing how to cook] probably inhibits me from eating the healthiest
Individual	Health	just seeing other people eat healthy kind of just for me, says, Oh, that's what I should be doing
Individual	Health	it's just a reminder [to eat healthy] instead of, I don't think my friends would judge me for what I eat.
Individual	Health	I think it's just based off of a reminder that I should be eating healthier
Individual	Health	overall making more healthier foods
Individual	Health	we started eating healthier

Individual	Health	the (caf) food that I'm eating. I'm not as healthy anymore.
Individual	Health	I would consider it to be okay, healthy. And then the other half of it is a lot of deep fried lot of fat and oil.
Individual	Health	a lot of fried food.
Individual	Health	there's not a lot of fruit provided. So I think that my fruit intake has gone down.
Individual	Health	I've had to buy additional fruit from the grocery store to supplement my diet
Individual	Health	there's not a lot of fruit options a lot of its canned
Individual	Health	Although I will say that I have been just trying to add more fruits and vegetables into my diet every day. And I think I've just been buying more fruits, buying more vegetables
Individual	Health	in terms of just eating healthier, unhealthy, I think, there's definitely factors I think sometimes, my family buys certain things from stores sometimes, processed food, the sugary drinks that are around
Individual	State of mind	But I'm also someone that tends to stress eat. And I found that was harder to do at home, because I'd have my parents kind of being like, didn't you just eat or something like that? versus at university.
Individual	State of mind	I definitely had an opportunity to stress eat a lot more than I think I would normally at home and I feel like I was also more stressed at university than I had been at home as well.
Individual	State of mind	as stressful university students, it can be hard to put that much time and effort into making sure you can go and seek healthy food.
Individual	State of mind	But all this stress and these new things to do with online classes inhibit me to take my food on my scheduled time.
Individual	State of mind	at the beginning, the stress of what was going on definitely affected how hungry I was. I do you think anxiety definitely, for me results in me eating less.
Individual	The pandemic	With me having just fruits around, that's something I like to snack on during the day and more often these days than maybe before the pandemic just in terms of other changes
Individual	Time and effort	And then I just give up before even trying something like this is so much effort.
Individual	Time and effort	I noticed that once school started, that it just kind of came to a stop, because online school was pretty demanding in ways that I did not expect it to be.

Individual	Time and effort	When I'm busier, I feel like I have a lot less time to prep and eat healthy, and to take care of myself
Individual	Time and effort	I found that I definitely ate a lot less just because I didn't have enough time, so only eat one meal a day sometimes
Individual	Time and effort	having more time to prepare foods because I'm at home.
Individual	Time and effort	my parents were also busy
Individual	Time and effort	I think the greatest factor for me is actually how busy I am in a day
Individual	Time and effort	on my more busy days, I tend to eat less
Individual	Time and effort	when I do have a bit of spare time, I like to get more food and then take my time eating it
Individual	Time and effort	I'm actually taking the time and making food which also makes me wait to eat rather than impulsively eat
Individual	Time and effort	don't have time to be at the grocery store every day
Individual	Time and effort	I think because the food was already cooked, it was there in front of me.
Individual	Time and effort	we use these food kits, like good food and hellofresh. So we order that quite often. So we do get to pick our meals ahead of time. And it comes pre packaged, I guess so it's quick and easy to make
Individual	Time and effort	I tried to make it work, depending on what they have available at the buffet.
Individual	Time and effort	I kind of get a mix of getting food from the cafeteria if I need to, if that's the more convenient option in the moments such as if I don't have a lot of time to do my own cooking
Individual	Time and effort	I feel like I have more time to plan and sit down and eat helping prepare meals

Appendix E

Calorie and protein calculation and normalization

Item	Item from USDA database for calorie calculation	Calorie kcal per 100 g	Protein g per 100g	Amount 2004 (g)	Comment	Amount 2015 (g)	Comment	Calorie 2004	Calorie 2015	Protein 2004	Protein 2015	Amount normalized 2004 (g)	Amount normalized 2015 (g)
miscellaneous	nutrition energy bar	471	11.76	3.32	coffee whitener, meal replacements, nutribars, whey protein	4.62	coffee whitener, meal replacements, nutribars, whey protein	15.63	21.77	0.39	0.54	2.51	4.12
dairy and egg_cheese	cheese, cheddar	409	23.3	49.27	cheddar 51% - mozzarella 21% - other cheese 28%	43.64	cheddar 44% - mozzarella 23% - other cheese 33%	201.51	178.48	11.48	10.17	37.19	38.88
dairy and egg_cream	cream, heavy	343	2.02	23.56	whipping, coffee, half and half 48% - sourcrea	23.12	whipping, coffee, half and half 75% - sour	80.82	79.28	0.48	0.47	17.78	20.59

					m 19%, soup 33%		cream 25%						
dairy and egg_egg	eggs, grade a, large, egg whole	143	12.4	25.87		33.64		36.99	48.11	3.21	4.17	19.52	29.97
dairy and egg_milk	milk, reduced fat, fluid, 2% milkfat	50	3.36	399.15	1%milk 26% - 2%milk 54% - other 20%	267.50	1%milk 27% - 2%milk 52% - other 21%	199.57	133.75	13.41	8.99	301.25	238.33
dairy and egg_milk substitute	soy milk	43	2.6	6.16		9.89		2.65	4.25	0.16	0.26	4.65	8.81
dairy and egg_yogurt	yogurt, greek, plain, nonfat	59	10.3	26.87		29.99		15.85	17.69	2.77	3.09	20.28	26.72
dairy and egg_sum				530.87		407.78		537.40	461.57	31.50	27.14	400.67	363.31
spices_herbs	na	0	0	4.43	56% salt	4.43	61% salt	4.43	4.43	4.43	4.43	4.43	4.43
fats_oils_butter	butter, without salt	717	0.85	3.65		3.07		26.18	21.98	0.03	0.03	2.76	2.73
fats_oils_margarine	margarine, regular	713	0.22	8.79		6.75		62.68	48.16	0.02	0.01	6.63	6.02

fats_oils_salad dressing	mayonnaise	714	0	14.22	mayonnaise 43% - cesar 12% - italian 12% - miracle whip 12%	12.23	mayonnaise 42% - cesar 15% - italian 14%	101.52	87.29	0.00	0.00	10.73	10.89
fats_oils_other	shortening, confectionery	884	0	8.35	shortening 85% - animalfat 15%	7.57	shortening 93% - animalfat 7%	73.78	66.95	0.00	0.00	6.30	6.75
fats_oils_vegetable oil	vegetable oil, nfs	886	0	6.70	canola oil 79%	6.30	canola oil 46% - olive oil 35%	59.35	55.84	0.00	0.00	5.06	5.62
fats_oils_sum				41.71		35.92		323.51	280.23	0.05	0.04	31.48	32.01
poultry_chicken	chicken, drumstick/breast	153.5	28	87.42		89.81		134.20	137.85	24.48	25.15	65.98	80.01
poultry_turkey	turkey, all classes	144	19.5	10.28		4.92		14.80	7.08	2.00	0.96	7.76	4.38
poultry_sum				97.70		94.72		0.00	0.00	0.00	0.00	73.74	84.39

pork	pork, fresh, ground, raw	263	16.9	30.98		21.98		81.49	57.81	5.24	3.71	23.39	19.58
pork_sausage	sausage, pork	346	19.3	4.45		11.71		15.41	40.53	0.86	2.26	3.36	10.44
pork_sum				35.44		33.69		33.69	33.69	33.69	33.69	33.69	33.69
beef and processed beef products _beef	beef, loin, tenderloin roast,	168	27.7	82.55		60.38		138.69	101.45	22.87	16.73	62.31	53.80
beef and processed beef products _other meat	lamb, loin chop	298		3.29		3.68	lamb 74%	9.78	10.97	0.00	0.00	2.48	3.28
beef and processed beef products _sausage_deli	sausage, breakfast sausage, beef	341	13.3	14.60		8.61		49.77	29.37	1.94	1.15	11.02	7.67
beef and processed beef products _meat alternatives	tofu, raw, regular	76	8.08	1.82	tofu 43%, soy patty 18%	4.36	65% tofu, 30% soy patty	1.38	3.31	0.15	0.35	1.37	3.88
beef and processed beef products_sum				102.26		75.90		75.90	75.90	75.90	75.90	75.90	75.90

beverages_water	na	0	0	1335.68	water, municipal 64%	1466.16	water, municipal 74%	0.00	0.00	0.00	0.00	1335.68	1466.16
beverages_carbonated drinks	beverages, carbonated, cola	42	0	424.27	carbonated drinks, cola 58%	197.25	carbonated drinks, cola 52%	178.20	82.85	0.00	0.00	320.33	175.84
beverages_coffee	beverages, coffee, brewed	1	0.12	189.41	coffee, brewed 86%	183.21	coffee, brewed, prepared with tap water 91%	1.89	1.83	0.23	0.22	143.01	163.32
beverages_alcohol beverages	alcoholic beverage, beer	43	0.46	235.45	alcohol, beer, regular, (5% alcohol by volume) 75%	136.93	alcohol, beer, regular, (5% alcohol by volume) 66%	101.24	58.88	1.08	0.63	177.70	122.06
beverages_tea	beverages, tea, black, brewed	1	0	121.11	tea, brewed 59%	119.98	tea, brewed 50%	1.21	1.20	0.00	0.00	91.44	106.95

beverages_fruit juice	100% apple juice, apple grape juice orange juice, raw pineapple juice	50 60 54 53.2	0 0.36 0.7 0.9	39 12 135 4		31 4 77 2		89.84	53.53	1.02	0.57	143.90	101.44
beverages_other drinks	fruit punch	48	0	173.75	fruit drinks and fruit punch 58%	117.89	fruit drinks 49%	83.37	56.57	0.00	0.00	131.19	105.09
beverages_sum								455.76	254.85	2.33	1.42	2343.25	2240.86
fish_shellfish_salmon	fish, salmon	206	22.1	2.08	canned 29% - cooked 43% - raw - 28%	6.94	canned 5% - cooked 29% - raw 66%	4.29	14.30	0.46	1.53	1.57	6.18
fish_shellfish_tuna	fish, tuna, white	128	23.6	3.48	canned 98% - cooked 1% - raw 1%	3.97	canned 79% - raw 21%	4.45	5.08	0.82	0.94	2.63	3.53

fish_shellfish_other fish	fish, raw, atlantic, cod	82	17.6	5.84	cod 19% canned 12% - cooked 10% - raw 69% - soup 16%	7.05	cod 22% canned 2% - cooked 18% - raw 69% - soup 19%	4.81	5.81	1.03	1.24	4.41	6.28
fish_shellfish_shellfish	shrimp, raw	85	20.1	5.92	shrimp 35% canned 7% - cooked 45% - raw 48%	5.71	55% shrimp canned 13% - cooked 35% - raw 52%	5.03	4.85	1.19	1.15	4.47	5.09
fish_shellfish_sum				17.32	canned fish 37% - cooked fish 13% - raw fish 41% - fish soup 8%	23.67	canned fish 24% - cooked fish 26% raw fish 74% - fish soup 8%	18.58	30.04	3.50	4.86	13.07	21.09
pulses_beans				6.24	canned 94% - cooked	6.23	canned 64% - cooked					4.71	5.57

					5% - raw 1%		29% - raw 7%						
pulses_lentils				0.71	cooked 84% - raw 18%	1.08	cooked 65% - raw 28% - soup 7%					0.55	0.96
pulses_peas				0.39	canned 20% - cooked 17% - processed 21% - raw 42%	2.46	canned 6% - cooked 25% - processed 67% - raw 3%					0.28	2.18
pulses_sum	chickpeas	164	8.86	7.35	canned 81% - cooked 13% - processed 1% - raw 5%	9.77	canned 42% - cooked 32% - processed 17% - raw 8% - soup 1%	12.05	16.03	0.65	0.87	5.54	8.71
baked_goods_cake_muffin	muffins	250	6.25	8.37	english muffin 21% - waffle 19%	8.57	croissant 20% - english muffin 25% -	20.93	21.43	0.52	0.54	6.32	7.64

baked_goods_cracker	saltine crackers	429	7.14	4.10		4.01		17.57	17.21	0.29	0.29	3.09	3.58
baked_goods_biscuit_cookie	chocolate chip cookies	536	7.14	7.82	chocolate chip cookie 33% - chocolate sandwich cookie 18%	6.05	chocolate chip cookie 38% - chocolate sandwich cookie 20%	41.93	32.42	0.56	0.43	5.90	5.39
baked_goods_bread_bagel	white bread	263	7.02	94.85	white bread 47% - whole wheat 29%	93.51	bagel 12% - white bread 36% - whole wheat 14%	249.46	245.94	6.66	6.56	71.59	83.32
baked_goods_granola bar	granola bars	429	14.29	4.49	granola bars, soft, cereal bar, fruit 30%	6.26	granola bar, chewy, chocolate 44%	19.25	26.84	0.64	0.89	3.39	5.57
baked_goods_leavening	leavening agents	22		0.73		0.74		0.16	0.16	0.00	0.00	0.55	0.66
baked_goods_sum				120.37		119.14		349.31	344.01	8.67	8.71	90.85	106.15

sugar_sweets_candies	candies	590	12.4	6.61		4.77		38.99	28.13	0.82	0.59	4.99	4.25
sugar_sweets_chocolate	milk chocolate bar	411	7.14	8.87		7.41		36.45	30.46	0.63	0.53	6.69	6.60
sugar_sweets_desserts	vanilla pudding	101	1.01	15.79		6.82		15.94	6.89	0.16	0.07	11.91	6.08
sugar_sweets_jam	orange marmalade	250		2.89		2.01		7.22	5.02	0.00	0.00	2.18	1.79
sugar_sweets_other	syrups, maple	260	0.04	7.66	51% syrup, honey, sweetener , spreads	7.52	42% syrup	19.92	19.54	0.00	0.00	5.78	6.70
sugar_sweets_sugar	sugar, granulated	384		18.46		16.57		70.87	63.62	0.00	0.00	13.93	14.76
sugar_sweets_sum				60.27		45.10		189.40	153.67	1.62	1.19	45.49	40.18
grains_corn	corn, sweet, yellow, raw	86	3.27	9.36		6.59		8.05	5.66	0.31	0.22	7.07	5.87
grains_pasta	pasta, dry, enriched	371	13	80.22	macaroni 46%,	52.53	macaroni 34%,	297.62	194.88	10.43	6.83	60.55	46.80

					spaghetti 37%		spaghetti 34%						
grains_rice	rice, white	130	2.69	41.71		56.53		54.22	73.49	1.12	1.52	31.48	50.36
grains_wheat	wheat flour	340	13.2	34.36		37.10		116.81	126.13	4.54	4.90	25.93	33.05
grains_other				0.80		2.79							
grains_sum				166.45		152.74		476.71	400.16	16.39	13.46	125.02	136.08
snacks_pretzels	pretzel rings	357	7.14	0.50		1.72		1.80	6.16	0.04	0.12	0.38	1.54
snacks_potato chips	potato chips	500	7.14	10.09		6.79		50.45	33.97	0.72	0.49	7.62	6.05
snacks_popcorn	sea salt pop corn, sea salt	464	10.7	3.16		3.83		14.65	17.76	0.34	0.41	2.38	3.41
snacks_other chips and snacks	organic yellow tortilla chips	500	7.14	6.00	66% tortilla chips	7.63		30.00	38.14	0.43	0.54	4.53	6.80
snacks_sum				19.75		19.97		96.90	96.03	1.52	1.56	14.91	17.80
sauce_salsa	salsa	36	2	3.83		4.81		1.38	1.73	0.08	0.10	2.89	4.28
sauce_ketchup	classic ketchup	94	0	8.48		4.59		7.97	4.31	0.00	0.00	6.40	4.09
sauce_barbecue	barbeque sauce	129	0	3.26		3.43		4.20	4.42	0.00	0.00	2.46	3.06

sauce_other	mustard	304	4.7	7.97	30% mustard, 20% soy sauce	6.86	23% soy sauce, 17% mustard	24.25	20.86	0.37	0.32	6.02	6.11
sauce_sum				23.53		19.68		37.79	31.33	0.45	0.42	17.76	17.54
cereal_wheat	shredded wheat, original	347	12.24	6.32		3.71		21.94	12.88	0.77	0.45	4.77	3.31
cereal_oat	cereals, oats	379	13.2	18.12		14.15		68.66	53.63	2.39	1.87	13.67	12.61
cereal_multigrain	multi-grain cereal, original	388	8.16	1.85		3.26		7.18	12.65	0.15	0.27	1.40	2.90
cereal_corn	flakes of corn cereal	390	4.88	2.32	mixed cereal, puffed rice, peanut butter puffs, granola	2.41		9.04	9.39	0.11	0.12	1.75	2.14
cereal_other				1.09		3.18							
cereal_sum				29.70		26.71		106.82	88.55	3.43	2.71	21.59	20.96
fruits_apple	apples, raw	52	0.26	31.32		38.16		16.28	19.84	0.08	0.10	23.64	34.00

fruits_apple sauce	apple sauce	68	0	2.01		2.84		1.37	1.93	0.00	0.00	1.52	2.53
fruits_banana	bananas, raw	89	1.09	21.62		29.49		19.24	26.25	0.24	0.32	16.32	26.28
fruits_berries	blueberries, raw	84.2	0.74	6.02	raw 50% - juice 34% - frozen 11% - canned 4% - dried 1%	8.16	canned 6% - dried 6% - frozen 25% - juice 1% - raw 63%	5.07	6.87	0.04	0.06	4.54	7.27
fruits_citrus fruits	grapefruit, raw	42	0.77	11.92	juice 57% - raw 43% - canned 1%	9.10	raw 78% - juice 22%	5.01	3.82	0.09	0.07	9.00	8.11
fruits_grape	red grapes	71	0.88	7.13		8.48		5.06	6.02	0.06	0.07	5.38	7.56
fruits_lemon and lime (juice)	lemon juice, raw	22	0.35	3.47	juice 95% - raw 5%	3.19	raw 12% - juice 88%	0.76	0.70	0.01	0.01	2.62	2.84
fruits_mango	mangos, raw	60	0.82	1.66		4.66	raw 80% - juice 20%	1.00	2.80	0.01	0.04	1.26	4.15

fruits_melon and watermelon	melons, honeydew, raw	36	0.54	20.51		12.31		7.38	4.43	0.11	0.07	15.48	10.97
fruits_orange	oranges, raw	52	0.91	12.34		13.18		6.42	6.85	0.11	0.12	9.32	11.74
fruits_peach	peach, raw	42	0.91	9.11	raw 79% - canned 12% - juice 9%	4.78	canned 25% - juice 5% - raw 70%	3.83	2.01	0.08	0.04	6.88	4.26
fruits_pear	pears, raw	57	0.36	3.86	raw 91% - canned 6% - juice 3%	4.66	canned 9% - juice 5% - raw 86%	2.20	2.65	0.01	0.02	2.91	4.15
fruits_pineapple	pineapple, raw	50	0.54	3.33		5.09		1.67	2.55	0.02	0.03	2.52	4.54
fruits_strawberry	strawberries, raw	32	0.67	7.34	raw 80% - frozen 20%	8.60	raw 76% - frozen 24%	2.35	2.75	0.05	0.06	5.54	7.66
fruits_other				10.00		13.00							
fruits_sum				152.00	raw 79% - canned 4% - frozen 2%	166.00	raw 59% - canned 3%	77.63	89.49	0.93	1.01	106.90	136.06

vegetables_beans and pea (snap beans, green peas)	green beans, raw	31	1.83	12.47	canned 17% - cooked 37% - frozen 26% - raw 13% - soup 7%	8.15	canned 8% - cooked 39% - frozen 29% - raw 20% - soup 3%	3.87	2.53	0.23	0.15	9.41	7.26
vegetables_broccoli	broccoli, raw	34	2.82	9.70	cooked 61 % - frozen 12% - raw 25% - soup 1%	11.67	cooked 54% - frozen 11% - raw 32% - soup 4%	3.30	3.97	0.27	0.33	7.32	10.39
vegetables_cabbage and kale	cabbage, chinese	13	1.5	5.28	cooked 44% - frozen 5% - raw 51%	6.93	cooked 38% - raw 62%	0.69	0.90	0.08	0.10	3.99	6.17
vegetables_carrot	carrots, raw	41	0.93	18.33	juice 3% - canned 1% - cooked 32% - frozen 6% -	16.40	juice 2% - cooked 34% - frozen 4% - raw 59%	7.51	6.72	0.17	0.15	13.83	14.61

					raw 59%								
vegetables_cauliflower	cauliflower, raw	25	1.92	3.78	cooked 40% - frozen 10% - raw 49%	2.68	cooked 51% - frozen 33% - raw 16%	0.94	0.67	0.07	0.05	2.85	2.39
vegetables_celery	celery	16	0.7	6.31	raw 91% - cooked 9%	4.92	cooked 14% - raw 86%	1.01	0.79	0.04	0.03	4.76	4.38
vegetables_cucumber	cucumber	15	0.65	13.86		13.73		2.08	2.06	0.09	0.09	10.46	12.23
vegetables_lettuce	lettuce, iceberg	14	0.9	24.63		17.88		3.45	2.50	0.22	0.16	18.59	15.93
vegetables_mushroom	mushroom	21	3	5.42	cooked 43% - raw 40% - soup 2% - canned 15%	5.90	cooked 30% - raw 31% - soup 35% - canned 4%	1.16	1.26	0.17	0.19	4.09	5.25

vegetables_onion	lettuce, iceberg	40	1.1	18.93	raw 80% - cooked 18% - frozen 1% - soup 1%	16.09	cooked 19% - raw 80% - soup 1%	7.57	6.43	0.21	0.18	14.29	14.33
vegetables_pepper	peppers, sweet	20	0.86	8.25	raw 81% - cooked 17% - canned 2%	12.57	canned 1% - cooked 20% - frozen 1% - raw 78%	1.65	2.51	0.07	0.11	6.22	11.20
vegetables_potato	potatoes, white	69	1.68	88.03	cooked 53% - frozen 37% - raw 9%	55.76	cooked 54% - frozen 33% - raw 11% - soup 2%	60.74	38.47	1.48	0.94	66.44	49.68
vegetables_spinach	spinach, raw	23	2.86	3.85	raw 59% - cooked 30% - frozen 9% - canned 2%	4.82	cooked 23% - frozen 6% - raw 71%	0.88	1.11	0.11	0.14	2.90	4.29

vegetables_squashes	squash, winter	234	1.12	3.46	cooked 62% - canned 21% - raw 16% - frozen 1%	4.43	canned 8% - cooked 48% - raw 27% - soup 185	8.09	10.37	0.04	0.05	2.61	3.95
vegetables_sweet potato	sweet potato, raw	86	1.57	5.01	cooked 98% - frozen 1% - raw 1%	5.64	cooked 80% - frozen 15% - raw 5%	4.31	4.85	0.08	0.09	3.78	5.03
vegetables_tomato	tomatoes, red	18	0.88	66.27	raw 34% - cooked 1% - canned 52% - soup 10% - juice 3%	60.13	juice 5% - soup 28% - canned 34% - cooked 5% - raw 28%	11.93	10.82	0.58	0.53	50.01	53.57
vegetables_other				21.02		17.48							
vegetables_sum				293.55	canned 13% - cooked 27% - frozen 13% - juice 3%	247.69	canned 9% - cooked 27% - dried 0% - frozen	119.18	95.98	3.92	3.28	221.56	220.68

					- raw 39% - soup 5%		11% - juice 3% - raw 42% - soup 9%						
nuts_seeds_almond	nuts, almonds	579	21.2	1.06	roasted 79% - dried 29%	1.40	dried 57% - processed 3% - roasted 401%	6.12	8.12	0.22	0.30	0.80	1.25
nuts_seeds_cashew nuts	nuts, cashew nuts	553	18.2	0.40	roasted 77% - processed 3%	0.56	roasted 94% - processed 5% - raw 1%	2.21	3.12	0.07	0.10	0.30	0.50
nuts_seeds_peanut	peanuts, all types	567	25.8	1.72	peanut butter 71% - roasted 25% - raw 4%	1.38	peanut butter 77% - roasted 18% - raw 5%	9.78	7.80	0.44	0.35	1.30	1.23
nuts_seeds_peanut butter	natural peanut butter	594	25	4.22		4.60		25.08	27.35	1.06	1.15	3.19	4.10
nuts_seeds_sunflower	roasted salted sunflower seeds	600	20	0.82	96% roasted	0.76	roasted 95% - raw 5%	4.94	4.56	0.16	0.15	0.62	0.68
nuts_seeds_other nuts	pure coconut milk	62	0.6	1.36	pistachio 17%, coconut	2.40	52% coconut milk	0.85	1.49	0.01	0.01	1.03	2.14

					milk 19% roasted 39% - processed 26% - dried 29% - raw 5%		raw 7% - dried 20% - processed 56% - roasted 17%						
nuts_seeds_total				9.59	roasted 41% - processed 47% - dried 9% - raw 3%	11.11	dried 16% - processed 51% - raw 4% - roasted 29%	48.97	52.44	1.97	2.07	7.24	9.89

Appendix F

Carbon footprint calculation

Item from my list	Data Source	Item from database	CF of 1 kg food item	Amount Normalized 2004	Amount Normalized 2015	percentage difference	Difference	CF 2004	CF 2015	percentage difference in CF
Miscellaneous	Assumption from CDB*	Granola bar, consumed	0.87	2.5	4.1	48.7	1.6	0.002	0.004	48.7
Dairy and egg_Cheese	CDB	Cheese, packaged, consumed	6.81	37.2	38.9	4.5	1.7	0.253	0.265	4.5
Dairy and egg_Cream	CDB	milk	1.75	17.8	20.6	14.6	2.8	0.031	0.036	14.6
Dairy and egg_Egg	CDB	Egg, boiled, consumed	4.76	19.5	30.0	42.2	10.4	0.093	0.143	42.2
Dairy and egg_Milk	CDB	Milk, bottle, consumed	1.75	301.3	238.3	23.3	-62.9	0.528	0.418	23.3

Dairy and egg_Milk substitute	DF	Soybean, soy milk	0.258	4.7	8.8	61.8	4.2	0.001	0.002	61.8
Dairy and egg_yogurt	Assumption from CDB	milk	1.75	20.3	26.7	27.4	6.4	0.035	0.047	27.4
Dairy and egg_sum	Sum			400.7	363.3	9.8	-37.4	0.942	0.911	3.4
Spices_herbs	CDB	Salt, table, consumed	0.42	4.4	3.5	22.2	-0.9	0.002	0.002	22.2
Fats_Oils_Butter	CDB	Butter, packaged, consumed	12.76	2.8	2.7	0.9	0.0	0.035	0.035	0.9
Fats_Oils_Margarine	CDB	Margarine, tub, consumed	2.16	6.6	6.0	9.7	-0.6	0.014	0.013	9.7
Fats_Oils_Salad dressing	Calculation from CBD	Mayonnaise (80% vegetable oil, 20% egg)	2.96	10.7	10.9	1.5	0.2	0.032	0.032	1.5

Fats_Oils_other	Assumption from CDB	vegetable oil	2.51	6.3	6.7	6.9	0.4	0.016	0.017	6.9
Fats_Oils_Vegetable oil	CDB	Canola oil, bottle, consumed Olive oil (virgin), bottle, consumed	2.51 1.73	5.1	5.6	10.5	0.6	0.012	0.012	0.0
Fats_Oils_Sum	Sum			31.5	32.0	1.7	0.5	0.109	0.109	0.0
Poultry_Chicken	CDB	chicken	5.18	66.0	80.0	19.2	14.0	0.342	0.414	19.2
Poultry_Turkey	DF**	Turkey, meat	2.571	7.8	4.4	55.7	-3.4	0.020	0.011	55.7
Poultry_Sum	Sum			73.7	84.4	13.5	10.7	0.362	0.426	16.3
Pork	CDB	Pork, roasted, consumed	6.48	23.4	19.6	17.7	-3.8	0.152	0.127	17.7
Pork_sausage	Assumption from CDB	pork	6.48	3.4	10.4	102.5	7.1	0.022	0.068	102.5

Pork_sum	Sum			26.7	30.0	11.5	3.3	0.173	0.195	11.5
Beef and processed beef products _Beef	CDB	Beef, ground, pan-fried, consumed	38.63	62.3	53.8	14.7	-8.5	2.407	2.078	14.7
Beef and processed beef products _Other meat	Assumption from CDB	Beef, ground, pan-fried, consumed	38.63	2.5	3.3	27.8	0.8	0.096	0.127	27.8
Beef and processed beef products _Sausage_Deli	CDB	Sausage, cooked, consumed	0.72	11.0	7.7	35.8	-3.3	0.008	0.006	35.8
Beef and processed beef products _Meat Alternatives	CDB	Sausage (soy), cooked, consumed Tofu, fried, consumed	1.14 0.54	1.4	3.9	95.4	2.5	0.001	0.003	95.4

Beef and processed beef products_Sum	Sum			77.2	68.6	11.7	-8.5	2.512	2.213	12.6
Beverages_Water	NA		0	1335.7	1466.2	9.3	130.5	0.000	0.000	0.0
Beverages_Carbonated drinks	CDB	Carbonated drinks, 0.5 liter bottle	0.42	320.2	175.7	58.3	-144.5	0.135	0.074	58.3
Beverages_Coffee	CDB	Coffee, brewed (l)	0.41	143.0	163.2	13.2	20.3	0.058	0.066	13.2
Beverages_Alcohol beverages	CDB	Beer, can, consumed	0.80	177.7	122.0	37.2	-55.7	0.141	0.097	37.2
Beverages_Tea	CDB	Tea, brewed	0.05	91.4	106.9	15.6	15.5	0.005	0.005	15.6
Beverages_Fruit juice	CBD, DF	Apple juice, bottle - Grape juice, can/bottle - Orange juice, bottle-	0.57 - 0.68 - 0.62 - 1.85	143.9	101.4	34.6	-42.5	0.092	0.064	35.8

		Pineapple, juice								
Beverages_Other drinks	Assumption from CDB	Orange juice, can, consumed	0.60	131.1	105.0	22.1	-26.1	0.079	0.063	22.1
Beverages_Sum	Sum									
Fish_Shellfish_Salmon	CDB	Salmon, canned (oil), consumed	11.5	1.6	6.2	119.0	4.6	0.018	0.071	119.0
Fish_Shellfish_Tuna	CDB	Tuna, canned (oil), consumed	10.06	2.6	3.5	29.5	0.9	0.026	0.036	29.5
Fish_Shellfish_Other fish	External (http://seafoodco2.dal.ca)	ATLANTIC COD, Pacific Cod	2.8	4.4	6.3	35.1	1.9	0.012	0.018	35.1
Fish_Shellfish_Shellfish	External (http://seafoodco2.dal.ca)	Shrimp	12.4	4.5	5.1	13.0	0.6	0.055	0.063	13.0

Fish_Shellfish_sum	Sum			13.1	21.1	46.9	8.0	0.112	0.187	50.2
Pulses_Beans	DF	Bean (kidney, Lima, pinto)	0.308	4.7	5.6	16.7	0.9	0.001	0.002	16.7
Pulses_Lentils	DF	Lentil, seed	1.88	0.6	1.0	53.3	0.4	0.001	0.002	53.3
Pulses_Peas	CDB	Split peas, boiled, consumed	0.88	0.3	2.2	154.8	1.9	0.000	0.002	154.8
Pulses_Sum	Sum			5.5	8.7	44.4	3.2	0.003	0.005	65.9
Baked_Goods_cake_Muffin	Calculation from CBD	40% flour, 20% egg, 4% sugar	1.64	6.3	7.6	18.9	1.3	0.010	0.013	18.9
Baked_Goods_cracker	Calculation from CBD	40% flour, 20% egg, 4% sugar	1.64	3.1	3.6	14.5	0.5	0.005	0.006	14.5
Baked_Goods_biscuit_cookie	Calculation from CBD	40% flour, 20% egg, 4% sugar	1.64	5.9	5.4	9.1	-0.5	0.010	0.009	9.1

Baked_Goods_Bread_bagel	CDB	Bread, wheat, consumed White bread, toasted	1.42 1.71	71.6	83.3	15.1	11.7	0.114	0.132	14.4
Baked_Goods_Granola bar	CDB	Granola bar, consumed	0.87	3.4	5.6	48.8	2.2	0.003	0.005	48.8
Baked_Goods_leavening	Assumption from CDB	Bread, wheat, consumed White bread, toasted	1.57	0.6	0.7	17.2	0.1	0.001	0.001	17.2
Baked_Goods_Sum	Sum			90.8	106.1	15.5	15.3	0.143	0.165	14.2
Sugar_Sweets_Candies	Assumption from CDB	sugar	0.58	5.0	4.2	16.0	-0.7	0.003	0.002	16.0
Sugar_Sweets_Chocolate	DF	Cocoa bean, chocolate	11.25	6.7	6.6	1.3	-0.1	0.075	0.074	1.3
Sugar_Sweets_Desserts	Assumption from CDB	sugar	0.58	11.9	6.1	64.9	-5.8	0.007	0.004	64.9

Sugar_Sweets_Jam	CDB	Strawberry jam, consumed	0.65	2.2	1.8	19.7	-0.4	0.001	0.001	19.7
Sugar_Sweets_Other	Assumption from CDB	sugar	0.58	5.8	6.7	14.6	0.9	0.003	0.004	14.6
Sugar_Sweets_Sugar	CDB	Sugar, packaged, consumed	0.58	13.9	14.8	5.8	0.8	0.008	0.009	5.8
Sugar_Sweets_Sum	Sum			45.5	40.2	12.4	-5.3	0.098	0.094	4.2
Grains_Corn	DF	Corn	0.204	7.1	5.9	18.5	-1.2	0.001	0.001	18.5
Grains_Pasta	CDB	Pasta, cooked, consumed	1.37	60.5	46.8	25.6	-13.7	0.083	0.064	25.6
Grains_Rice	CDB	Rice, cooked, consumed	1.36	31.5	50.4	46.2	18.9	0.043	0.069	46.2
Grains_Wheat	CDB	Wheat flour	1.13	25.9	33.1	24.2	7.1	0.029	0.037	24.2
Grains_Sum	Sum			125.0	136.1	8.5	11.1	0.156	0.171	9.0

Snacks_Pretzels	NA			0.4	1.5	120.6	1.2			
Snacks_Potato Chips	NA			7.6	6.1	22.9	-1.6			
Snacks_popcorn	NA			2.4	3.4	35.4	1.0			
Snacks_other chips and snacks	NA			4.5	6.8	40.1	2.3			
Snacks_Sum	Assumption from CDB	Potato chips, consumed	2.88	14.9	17.8	17.7	2.9	0.043	0.051	17.7
Sauce_Salsa	NA			2.9	4.3	38.9	1.4			
Sauce_Ketchup	NA			6.4	4.1	44.1	-2.3			
Sauce_Barbecue	NA			2.5	3.1	21.7	0.6			
Sauce_other	NA			6.0	6.1	1.6	0.1			
Sauce_sum	Assumption from CDB	Tomato puree, canned, consumed	5.09	17.8	17.5	1.3	-0.2	0.090	0.089	1.3
Cereal_wheat	DF	Wheat, grain	0.347	4.8	3.3	36.3	-1.5	0.002	0.001	36.3

Cereal_oat	CDB	Oatmeal	0.40	13.7	12.6	8.1	-1.1	0.005	0.005	8.1
Cereal_multigrain	DF	Wheat, grain	0.347	1.4	2.9	70.1	1.5	0.000	0.001	70.1
Cereal_corn	CDB	Ready-to-eat cereal, consumed	0.69	1.7	2.1	20.3	0.4	0.001	0.001	20.3
Cereal_Sum	Sum			21.6	21.0	2.9	-0.6	0.009	0.009	1.5
Fruits_Apple	CDB	Apple, consumed	0.28	23.6	34.0	36.0	10.4	0.007	0.010	36.0
Fruits_Apple sauce	CDB	Applesauce, consumed	1.45	1.5	2.5	50.0	1.0	0.002	0.004	50.0
Fruits_Banana	CDB	Banana, consumed	0.45	16.3	26.3	46.8	10.0	0.007	0.012	46.8
Fruits_Berries	DF	Blackberry Blueberry	0.5990.496	4.5	7.3	46.2	2.7	0.003	0.006	46.2
Fruits_Citrus fruits	DF	Grapefruit	1.21	9.0	8.1	10.4	-0.9	0.011	0.010	10.4
Fruits_Grape	CDB	Grapes, consumed	1.89	5.4	7.6	33.7	2.2	0.010	0.014	33.7

Fruits_Lemon and lime (juice)	DF	Lemon, juice Lime, juice	0.332 1.943	2.6	2.8	8.2	0.2	0.003	0.003	8.2
Fruits_Mango	DF	Mango	0.639	1.3	4.2	107. 2	2.9	0.001	0.003	107. 2
Fruits_Melon and Watermelon	CDB	Melon, consumed	0.70	15.5	11.0	34.1	-4.5	0.011	0.008	34.1
Fruits_Orange	CDB	Mandarin orange, consumed	2.79	9.3	11.7	23.1	2.4	0.026	0.033	23.1
Fruits_Peach	DF	Peach	0.274	6.9	4.3	47.1	-2.6	0.002	0.001	47.1
Fruits_Pear	CDB	Pear, consumed	0.35	2.9	4.1	35.1	1.2	0.001	0.001	35.1
Fruits_Pineapple	CDB	Pineapple, consumed	1.61	2.5	4.5	57.4	2.0	0.004	0.007	57.4
Fruits_Strawberry	CDB	Strawberry, consumed	0.48	5.5	7.7	32.1	2.1	0.003	0.004	32.1
Fruits_Sum	Sum			106.9	136.1	24.0	29.2	0.091	0.115	23.1

Vegetables_Beans and pea (snap beans, green peas)	CDB	Green peas, boiled, consumed Snap beans, boiled, consumed Snap beans, raw consumed	0.45 0.45 0.16	9.4	7.3	25.8	-2.2	0.003	0.003	25.8
Vegetables_Broccoli	CDB	Broccoli, boiled, consumed	0.99	7.3	10.4	34.7	3.1	0.007	0.010	34.7
Vegetables_Cabbage and Kale	CDB	Cabbage boiled, consumed	0.56	4.0	6.2	43.0	2.2	0.002	0.003	43.0
Vegetables_Carrot	CDB	Carrot, boiled, consumed Carrot, raw, consumed	0.56 0.47	13.8	14.6	5.5	0.8	0.007	0.007	5.5

Vegetables_Cauliflower	CDB	Cauliflower, boiled, consumed	1.65	2.9	2.4	17.6	-0.5	0.005	0.004	17.6
Vegetables_Celery		Celery	0.331	4.8	4.4	8.3	-0.4	0.002	0.001	8.3
Vegetables_Cucumber	CDB	Cucumber, consumed	4.92	10.5	12.2	15.7	1.8	0.051	0.060	15.7
Vegetables_Lettuce	CDB	Lettuce, consumed	6.08	18.6	15.9	15.4	-2.7	0.113	0.097	15.4
Vegetables_Mushroom	DF	Mushroom	3.093	4.1	5.3	24.9	1.2	0.013	0.016	24.9
Vegetables_Onion	CDB	Onion, raw, consumed	0.73	14.3	14.3	0.3	0.0	0.010	0.010	0.3
Vegetables_Pepper	CDB	Pepper, raw, consumed	3.35	6.2	11.2	57.1	5.0	0.021	0.038	57.1
Vegetables_Potato	CDB	Potatoes, baked, consumed	0.71	66.4	49.7	28.9	-16.8	0.047	0.035	28.9
Vegetables_Spinach	DF	Spinach	0.307	2.9	4.3	38.6	1.4	0.001	0.001	38.6

Vegetables_Squashes	DF	Squash, winter	0.028	2.6	3.9	40.8	1.3	0.000	0.000	40.8
Vegetables_Sweet potato	DF	Sweet potato	0.302	3.8	5.0	28.3	1.2	0.001	0.002	28.3
Vegetables_Tomato	CDB	Tomato, raw, consumed Tomato juice, can, consumed Tomato puree, canned, consumed	4.83 7.27 5.09	50.0	53.6	6.9	3.6	0.253	0.275	8.0
Vegetables_Sum	Sum			221.6	220.7	0.4	-0.9	0.537	0.563	4.7
Nuts_Seeds_Almond	CDB	Almonds, dry roasted, consumed	3.93	0.8	1.2	44.2	0.5	0.003	0.005	44.2

Nuts_Seeds_Cashew nuts	CDB	Cashew, dry roasted, consumed	4.43	0.3	0.5	49.9	0.2	0.001	0.002	49.9
Nuts_Seeds_Peanut	CDB	Peanut, roasted, packaged, consumed	1.35	1.3	1.2	6.0	-0.1	0.002	0.002	6.0
Nuts_Seeds_Peanut butter	CDB	Peanut butter, consumed	2.53	3.2	4.1	25.1	0.9	0.008	0.010	25.1
Nuts_Seeds_Sunflower	DF	Sunflower, seed	0.848	0.6	0.7	8.5	0.1	0.001	0.001	8.5
Nuts_Seeds_Other Nuts	CDB	Walnut, dried, packaged, consumed	5.58	1.0	2.1	69.9	1.1	0.006	0.012	69.9
Nuts_Seeds_Total	Sum			7.2	9.9	31.0	2.7	0.021	0.032	42.5

Overall	5.91740 014	5.71273 187	3.5

*CBD = Canadian Data Base

**DF = DataField