The Role of High Fat Diet in Metabolic Diseases: An Inspection of Canadian Population

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Abstract. Metabolic diseases including cardiovascular disease, obesity, and diabetes account for about 20% of the population in Canada. Diets containing high amount of fats may be one of the most crucial causes of metabolic diseases. Canadian diets composing of large portion of ultra-processed foods containing saturated fatty acids constitutes for potential risks for health conditions regarding obesity and other diseases. Of the entire Canadian population, the aboriginal community and low-income households consume higher amount of ultra-processed foods and are more prone to metabolic diseases. Traditional diets of aboriginal people may be a healthier choice though the amount of fat contained in both diets are equal. As of non-aboriginal Canadians, alternative foods such as high-fat dairy product is not related with the progression of metabolic diseases. Thus, a switch in diet, proper education, and adjustment in public health policies regarding ultra-processed foods and high fat foods may be crucial in reducing the prevalence of metabolic diseases.

Keywords: High Fat Diet, Cardiovascular Diseases, Metabolism, Obesity, Diabetes.

1. Introduction

High fat diets, consisting both saturated and unsaturated fats, contribute to over 30% of the food consumptions across Canada [1]. The amount of saturated fat intake for Canadian has exceeded the amount of recommendation for overall fat from Canada's Food Guide. Though Canada's food guide 2019 revision entailed to limit saturated fat consumptions, about half of the saturated fats consumed by Canadians result from foods outside of the Food Guide [1]. Surfeit of saturated fats increases the formation of low-density lipoprotein cholesterol (LDL-C) when compared to polyunsaturated fats and monounsaturated fats. High fat diets thus correspondingly enhance the development of cardiovascular diseases and other metabolic and chronic diseases [2]. Of the entire Canadian populations, First Nation population are more susceptable to the adverse affect of consuming excess fats, where they are particularly prone to the intake of superflouous saturated fat. Population of aboriginal ancestery in Canada grew rapidly since the past few decades where the aboriginal ancestery individuals constitute over 1.2 million, representing about 3% of the population in Canada [3]. As the birthrate of aboriginal people surpasses the general population by 1.5 times and over half of the population being young people, the active growing population faces a disproportionate challenge regarding health issues and dietary decisions [4]. First nations, when compared to non-indigenous people of Canada, have lower life expectancy and higher prevalences of metabolic diseases including diabetes, cardiovascular diseases, and obesity [5].

Since metabolic diseases due to poor dietary choices with excessive fat consumptions are prevailing in Canada and especially amongst Aboriginal community, it is necessary to inspect the specific foods and diets adopted by the Canadian population which provoke this trending health concerns. Therefore, the objective of this paper prompts to appraise the modern diets of Canadian and their effect on metabolic health. This paper sections into discussion of a holistic overview of Canadian metabolic health issues concerning high fat diet following by attempts to inspect specifically into indigenous population of Canada and subsequently the modern and traditional diets of indigenous people.

2. Mechanism Behind The Causes of Metabolic Diseases Mediated By High Fat Diets

To begin the discussion, it is crucial to understand the mechanism behind the causes of metabolic diseases mediated by high fat diets. Metabolic diseases, as defined to be any sort of diseases or disorders that interupt and hinder the normal process of converting food into cellular energy, could be found all over the body disturbing a myraid of bodily functions. Enzymes that take parts carrying out this sort of processes work in complementary actions to perform biochemical reactions that transport carbohydrates, proteins, and lipids to their designated locations [6,7]. The most prominent metabolic diseases fixated in Canada includes cardiovascular diseases, obesity, and diabetes. High fat diets induce extra presentation of lipoprotein int the body that may be damaging to cardiovascular health [8].

Excess free fatty acids increase hepatic fat deposition and thus also increase the concentration of very-low density lipoprotein (VLDL) due to triglyceride synthesis in the liver [6] (Fig. 1). Normally VLDL exchanges triglycerides with high-density lipoprotein (HDL, the "good cholesterol) would receive cholesterol from HDL, yet in a situation with surplus triglycerides in VLDL, triglycerides are depleted from VLDL to LDL which would have longer transient time in the blood [6]. LDL in the blood could increase the risk of coronary diseases and other heart related diseases due to the build up of plaque in the blood vessels. Other metabolic diseases including obesity, where one of the main causes is the abnormal feedback of adipose tissue, and diabetes mainly caused by insulin resistence could all trace back and interrelate to the dysfunction of lipoproteins in the body [6].

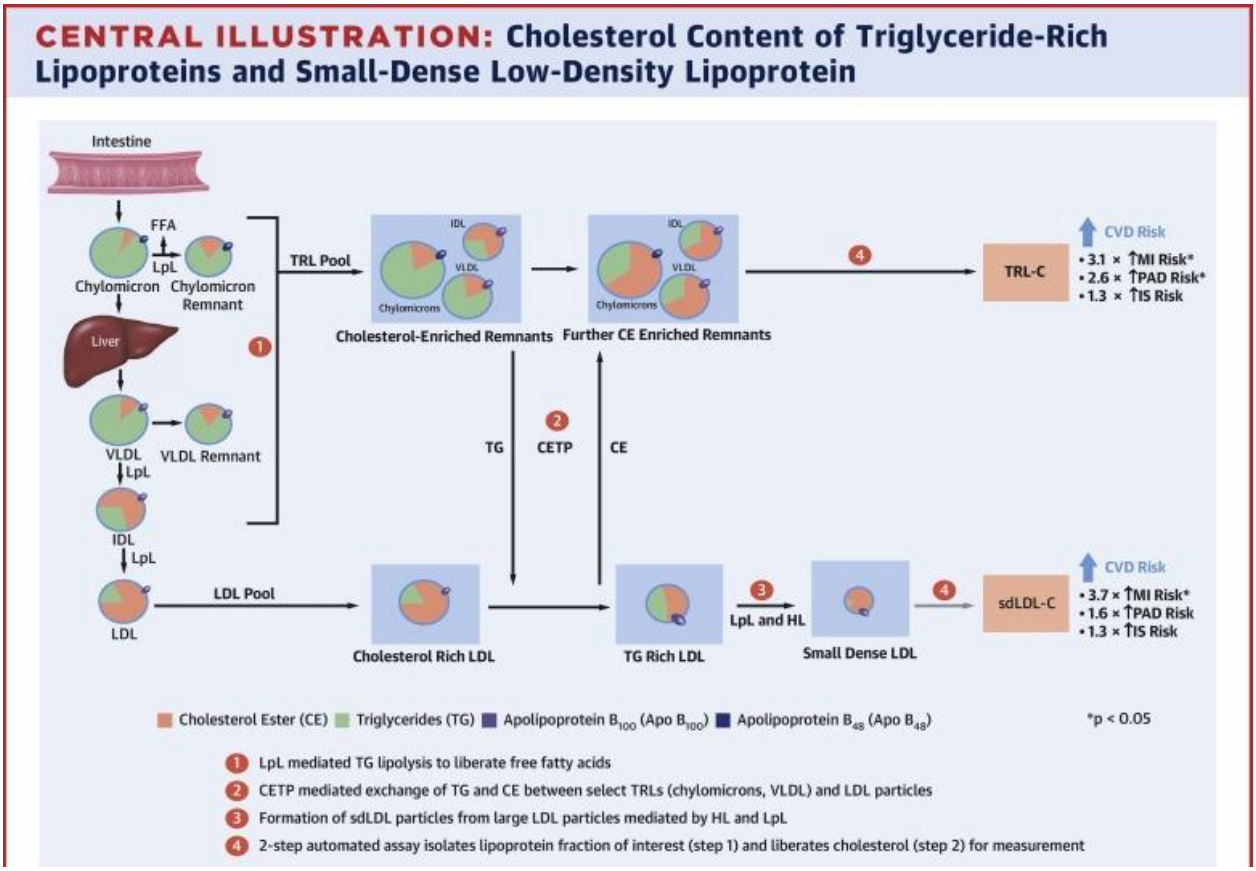


Fig. 1 The development of VLDL and sd-LDL with associations of triglycerides [6]

3. Canadian Health Issues Regarding High Fat Diets: A Holistic Overview

Therefore, high fat diet poses many threats to health conditions and has specifically become a common issue in developed countries including Canada over the past 100 year [9,10]. Currently, 27.3% of deaths in Canada are caused by heart disease and stroke [10]. Since 1938, household energy intake

of un-processed or basic processed foods has decreased while processed foods, especially ultra-processed foods increased with a drastic percentage of 28.7% to 61.7% [10]. Obesity in Canada tripled since 1970 with the availability of so much ready-to-eat foods. Ultra-processed foods, defined as foods with high palatability that requires no or mere culinary preparation on consumer ends, could be seen a noteworthy surge in Canada after 1953 (Fig. 2) [1,10]. These products formulated from extracted or refined natural foods contains little to no whole food [1]. Low nutrient quality diet with dense energy and high fats, sodium, and sugar content, along with minimal vitamins, dietary fibre, and protein are usually associated with ultra-processed foods. Weight gains, obesity, cardiovascular disease, and diabetes as results of intaking such foods with high saturated fats on a regular basis [1].

In addition to ultra-processed foods contributing to the overall saturated fat consumption in the Canadian population, other minimally processed foods could also contribute to total saturated fatty acids. According to Canada's Food Guide 2019, protein foods and "all other foods" commit to 47.8% and 44.3% respectively to saturated fatty acid intake where "milk and alternatives" and "meat and alternatives" contributes equally to the pool [11]. Canadian adults with obesity can be seen consuming more saturated fatty acids when compared to normal-weight Canadian adults. Other metabolic diseases in Canadian adults such as cardiovascular diseases, and diabetes could be seen with an increasing odds when the quantity of ultra-processed foods and saturated fatty acids increased in daily consumption.

Study in 2015 demonstrated Canadian adults that consumed the most ultra-processed food (59% to 100% food intake from ultra-processed foods) in a trichotomy of ultra-processed food intake had 31% more odds of obesity, 37% higher odds of diabetes, and 60% higher odds of high blood pressure (Fig. 3) [1]. However, high fat diets including ultra-processed foods may be a desperate choice for many people. As the aboriginal community of Canada constantly combats poverty, cheap and economincally-favored fast foods often contain high saturated fatty acids. The history of Canada may also be another focal point for inspecting the results of the prevalences of metabolic diseases in Canada today as the First Nation community makes up for 3% of the entire population but metabolic diseases share up to almost one third of the community population [3].

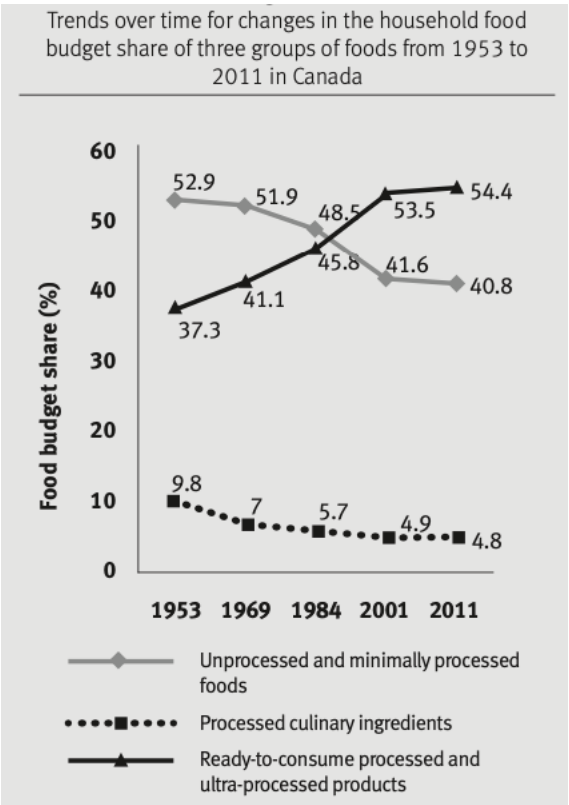


Fig. 2 A visible spike can be seen for "ready to consume processed and ultra-processed products" after 1953 [10]

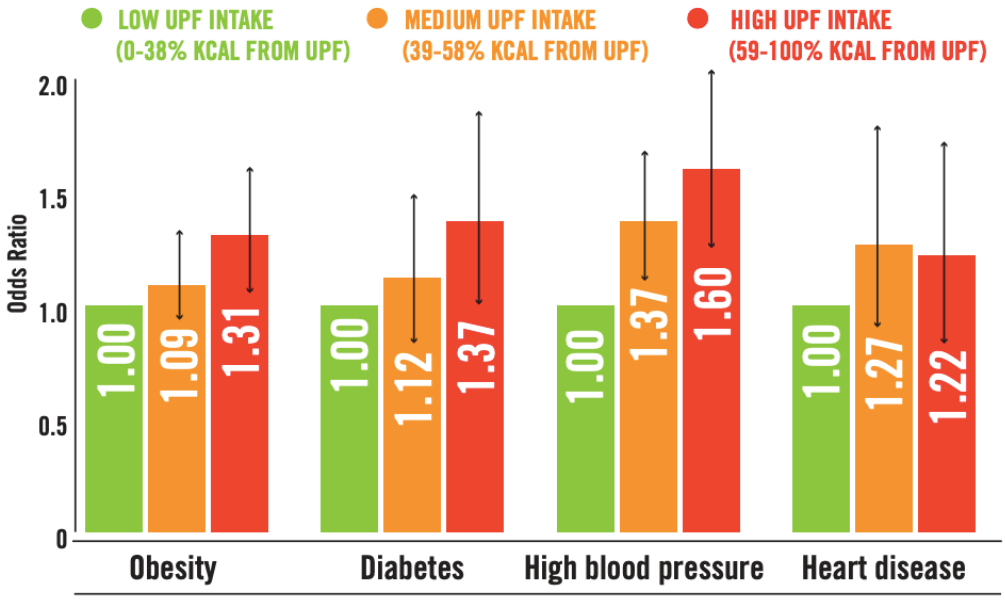


Fig. 3 Ultra-processed foods intake levels demonstrated in a trichotomy and the consequential risks for obesity, cardiovascular disease, and diabetes [1]. UPF: Ultra-processed Foods.

4. High Fat Diets in Canadian Aboriginal Community

4.1. History of Traditional Diets of Aboriginal Canadians

Modern day diets of First Nation community in Canada consist little of what was left to be called as traditional foods. The traditional diets of aboriginal people are defined as a collective term for fresh foods with minimal processing including foods such as caribou, seal, muskox, goose, polar bear, buffalo, trout, and other animal products inhering great amounts of fats [12]. As a matter fact, these animal fats perform an essential function for aboriginal people living in the arctics due to cold and harsh weather, the extra animal fats and energy from diets are to keep them "warm". Up until the pre-colonial ages and the early-colonial periods, aboriginal people living in the arctics and prairie in Canada nonetheless persist the traditional diets where hunting and collecting foods from the nature represent the entirety of their diets [12]. Customary preparations and gatherings for traditional foods still signify the social cohesion and cultural identity amongst First Nations though Europeans influences progressively infiltrated the lands of Canada [3,12].

However, with the introduction of European cultures that collided with the First Nation cultures along with the preface of the former's dietary habits and modernized foods, aboriginal people of Canada had gradually abandoned their traditional foods and departed for market and store-bought foods. As in reality, hunting and scavenging for wild animal products have become somewhat impractical due to animal preservations in modern days. Additionally, according to Canadian governmental report, 25% of indigenous people in Canada are currently living in poverty, market bought foods are the most cost-efficient choices for their daily dietary consumptions [3].

4.2. Modern Diets of Aboriginal Canadians

A transition from traditional foods to market bought foods in the indigenous community constituted a nutritional change that adopted a nutrient poor and high energy diets that also comprise high amount of fats. The absolute energy intake in kilojoules per day (kJ/d) for animal fats in Traditional diets are 5.52 and in market bought foods, that are predominately the current diets of First Nations, are 147 [3]. Of which, the total fat energy as a percentage of the total diet makes up to about 30% for both minimally processed traditional foods and market bought foods (ultra-processed) [3]. Though the total energy from fats is similar, the amount of saturated fat as a percent of total fats in market bought foods are slightly higher than traditional foods. In a likewise study, the results

suggested that saturated fats from different sources may result in drastically different outcomes to health. Stearic acids and lauric acids are examples of saturated fatty acids that are beneficial for cardiovascular health [11]. Fatty acids from milk sources or from other naturally existing sources may not necessarily cause cardiovascular diseases but saturated fatty acids from ultra-processed foods may result in higher chances of cardiovascular diseases [4]. Market bought foods are nutritionally inferior to traditional foods where the saturated fat intakes aboriginal individuals consuming non-traditional diets exceed the daily recommended levels for fats. Therefore, the modern diet composition of indigenous population consists of high fats market bought foods that very much roots from the inaccessibility of traditional foods and the economic challenges they face.

Though it is not widely acknowledged that Canadians possess a fat concentrated diet, the amount of foods selections, whether traditional or newly introduced to the country, mostly contain a high amount of total fats. The overall high fat diets of Canadian populations come from mainly ultra-processed foods such as those that are deep fried, grocery packaged read to eat dishes, salty snacks including potato chips and pretzels, and etc [1]. As no current studies have researched upon the consumption of ultra-processed foods and the income levels in Canadian populations, inferences can be made from results investigated in proximity of Canada that also occupies similar issues. Studies in the United States revealed the positive correlation between low income and education levels and the intake of ultra-processed foods [2,3,9]. Likewise of the situation for people living in low-income households in the US, Canadian First Nation community constantly faces the issue of poverty. The amount of ultra-processed foods constitutes for 54% of the overall food intake for indigenous community in Canada and that also coincides with the 63% of ultra-processed foods intake for low-income households in the US [3].

In most developed countries, market bought foods that are highly processed, containing large amount of saturated fat and free sugars to keep a longer shelf life and increase palatability are preferred over fresh foods due to the price and time efficiency. Especially amongst those who are living in poverty, these price efficient food products become eminently accessible to their daily meals. When increasing market bought foods are replacing traditional foods for aboriginal people, such nutritional transition facilitates the rates of obesity, cardiovascular diseases, and diabetes to be gradually escalating [12]. The increasing epidemic make it imperative for the transition of diets. As mentioned before, traditional diets of aboriginal people, although contain likewise saturated fats, the saturated fats from natural foods act differently upon the body comparing to the saturated fats in processed foods. Traditional diets have shown to be more nutrient dense and therefore beneficial to health. A conjecture can be called upon that traditional diets may lower the prevalence of metabolic diseases amongst aboriginal Canadians [12].

When comparing traditional foods to market bought foods, a remarkable increase can be spotted in healthy fatty acids. Traditional aboriginal eaters present two times more the amount of omega-3 fatty acids and slightly more omega-6 fatty acids in their diets than nontraditional eaters where the ratio of omega-3 to omega-6 fatty acids are more favorable in tradition diets [12]. The amount of monounsaturated and polyunsaturated fat in traditional diets seem to be higher than those of nontraditional diets [12]. Though fat intake for both traditional and nontraditional eaters have all exceeded the recommended daily intake, other nutrients such as protein, vitamin C, vitamin D, niacin, vitamin B12, zinc, calcium, thiamin, riboflavin, and potassium all exhibit higher values in traditional diets than nontraditional diets [12]. Obesity has been associated with vitamin D deficiency and higher vitamin C intake has presented the positive correlation with less incidences of cardiovascular diseases [5]. Therefore, as diet adequacy and quality all seem to be higher in traditional diets, efforts to deviate Canadian aboriginal population from metabolic diseases should emphasize on transitioning the diets from market bought foods to traditional foods.

5. High Fat Diets Consumed By Non-Aboriginal Canadian

However, not only do aboriginal Canadians indulge a high amount of fats in their diets, but non-aboriginal Canadian diets also consist a large quantity of fats. A 2015 survey conducted towards Canadian adults disclosed that nearly half of the energy intake in the Canadian diet are composed of ultra-processed foods [1]. Such finding also corresponds with the situation of aboriginal people in Canada where the consumption of ultra-processed foods in non-aboriginal Canadians are critically concerned amongst young adults, those that live in rural areas with lower education levels [2,13]. There are several precarious issues associating with this type of high fat diets, often simultaneously accompanied by high free sugar and sodium. These foods generally contain less dietary fiber, protein, vitamins, and minerals. With reasons apart from nutrient contents, individuals consuming ultra-processed foods intake 500 more calories than individuals consuming minimally processed foods [1]. Despite the same nutrient contents for fats, protein, carbohydrates and etc, the number of calories contributed by ultra-processed foods are much higher than those of minimally processed foods. Metabolic diseases have evidently become a rampant result of such diets consisting high amount of saturated fats, free sugar, and sodium. Hormonal changes that affect the satiety of people who consume largely of ultra-processed foods explains why weight gains and obesity have been affiliated with the consumption of these foods.

On the contrary, besides ultra-processed foods containing high fats may be detrimental to health, dairy products have shown favorable associations with the development of cardiovascular disease. Out of which, regular intake of cheese, milk derivatives, and other dairy products that are high in fats are neutrally associated with risks of type II diabetes mellitus and cardiovascular diseases [4]. Milk and alternative contribute to around 12.3% of total energy in Canada, but the low energy input cannot be omitted in the overall diet as milk and alternatives make up for 36% of vitamin B12, 40% of vitamin D, and 46% of calcium in Canadian diets [4]. There has been a decrease of diary product in Canada from 2004 to 2015 with the number decreasing from 89.5% to 87.7% [4]. This could adversely affect the nutritional consumption of the Canadian population since healthy fats are potentially replaced by unhealthy saturated fats that in turns increase the risks and prevalence of multiple metabolic diseases. Thus, high fat diets may not have been an issue to health if the correct type of fat is consumed rather than those that may be damaging health.

6. Conclusion

In conclusions, though high fat diets contribute to such health phenomenon in Canada, one cannot solely censure high fat diets as the main reason for metabolic disease. Accompanied by low dietary fiber, vitamins, minerals, and etc, high fat foods in the form of ultra-processed market bought foods are usually also high in free sugars and sodium which accounts for the risk of hypertension, type 2 diabetes, stroke, and other metabolic related diseases. First Nations in Canada adopting a traditional diet and non-aboriginal Canadian practicing diets containing healthy fats may be crucial in lowering the prevalence of metabolic diseases. Public health policies in Canada should assist in the promotion of healthier diets such as restricting the marketing and advertisement of nutrient-lacking food and beverages. However, as mentioned that low-income households are prone to high fat diets, it may be just not feasible economically for people that live in poverty to implement a healthier diet consisting fresh foods. Therefore, in addition to raising the awareness and educating the population on nutrients intake and balance, policies in Canada should aim to strive to increase the availability of healthy food options by making healthy foods more affordable and appealing.

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