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„Highly processed food consumption, physical activity and socioeconomic status: a cross-sectional comparison between Kazakhstan and Austria“

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Zusammenfassung

Der Verzehr von stark verarbeiteten Lebensmitteln (HPF) und eine reduzierte körperliche Aktivität nehmen in den meisten Teilen der Welt zu und verursachen eine Reihe chronischer Krankheiten und eine schlechte Lebensqualität. Sowohl der HPF-Konsum als auch das Niveau der körperlichen Betätigung scheinen sich in Ländern mit hohem Einkommen von jenem mit niedrigem und mittlerem Einkommen zu unterscheiden. Es mangelt jedoch an direkten Vergleichen und der Zusammenhang zwischen HPF-Konsum, körperlicher Betätigung und sozioökonomischem Status ist unklar. Ziel dieser Studie war es daher, den Konsum von HPF und die körperliche Aktivität in Ländern mit unterschiedlichem Einkommensniveau zu untersuchen. In dieser Studie beantworteten 138 Teilnehmer aus Österreich (hohes Einkommensniveau) und 142 aus Kasachstan (oberes mittleres Einkommensniveau) in anonymisierter Form Fragen zum HPF-Konsum (sQ-HPF) sowie zur körperlichen Aktivität *Global Physical Activity Questionnaire* (GPAQ). Daraus wurden ein HPF Score sowie das Ausmaß der körperlichen Aktivität berechnet.

Es wurde festgestellt, dass der Mittelwert des HPF-Konsums in Österreich ($M = 4,65$, $SD = 2,62$) signifikant höher war als in Kasachstan ($M = 3,78$, $SD = 2,57$, $p = .005$). Eine Varianzanalyse (ANOVA) ergab signifikante Unterschiede zwischen dem HPF-Konsum und dem Auslassen von Mahlzeiten ($p = .020$) mit einem höheren HPF-Wert für häufiges Auslassen von Mahlzeiten ($M = 4,97$, $SD = 2,70$) im Vergleich zu einer geringeren Häufigkeit des Auslassens von Mahlzeiten ($M = 3,46$, $SD = 2,47$, $p = .014$). Insbesondere waren die HPF-Werte bei denjenigen, die das Frühstück ausließen, höher ($M = 4,90$, $SD = 2,61$) als bei denen, die das Mittagessen ausließen ($M = 3,48$, $SD = 2,51$, $p = .001$). Schließlich ergab ein Chi-Quadrat-Test auf Unabhängigkeit, dass die körperliche Aktivität in den beobachteten Ländern unterschiedlich war ($\chi2(2) = 6,09$, $p = .047$). Länder mit einem hohen Pro-Kopf-BIP wie Österreich neigen dazu, zwar aktiver zu sein, aber auch mehr stärker verarbeitete Lebensmittel zu konsumieren, während Personen aus Kasachstan, einem Land mit einem niedrigen Pro-Kopf-BIP angaben, weniger körperlich aktiv zu sein, aber auch weniger hoch verarbeitete Lebensmittel zu konsumieren. Andere Faktoren wie das häufige Auslassen von Mahlzeiten, das Auslassen des Frühstücks, aber auch

Lebensstilfaktoren wie das Rauchverhalten tragen zu einem hohen HPF-Konsum bei. Sowohl in Österreich als auch in Kasachstan sind weitere Strategien zur Förderung gesunder Gewohnheiten erforderlich, um einen gesunden Lebensstil in Bezug auf Ess- und Bewegungsverhalten zu fördern.

Abstract

Highly processed food (HPF) consumption and reduced physical activity are increasing in most parts of the world, causing a range of chronic diseases and poor quality of life. Both HPF consumption and physical activity levels appear to differ in high-income countries from those in low- and middle-income countries. However, there is a lack of direct comparisons and the association between HPF consumption, physical activity, and socioeconomic status is unclear. Therefore, the aim of this study was to examine HPF consumption and physical activity in countries with different income levels.

In this study, 138 participants from Austria (high income level) and 142 from Kazakhstan (upper-middle income level) answered anonymous questions on HPF consumption (sQ-HPF) and physical activity (Global Physical Activity Questionnaire (GPAQ)). From these, an HPF score and physical activity levels were calculated.

It was found that the mean score of HPF consumption was significantly higher in Austria ($M = 4.65$, $SD = 2.62$) than in Kazakhstan ($M = 3.78$, $SD = 2.57$, $p = .005$). An analysis of variance (ANOVA) revealed significant differences between HPF consumption and meal skipping ($p = .020$), with a higher HPF score for frequent meal skipping ($M = 4.97$, $SD = 2.70$) compared to a lower frequency of meal skipping ($M = 3.46$, $SD = 2.47$, $p = .014$). Specifically, HPF scores were higher among those who skipped breakfast ($M = 4.90$, $SD = 2.61$) compared to those who skipped lunch ($M = 3.48$, $SD = 2.51$, $p = .001$). Finally, a chi-square test for independence revealed that physical activity differed across the observed countries ($\chi2(2) = 6.09$, $p = .047$).

In conclusion, countries with high gross domestic product (GDP) per capita, such as Austria, tend to be more active but also consume more highly processed foods, whereas individuals from Kazakhstan, a country with low GDP per capita, reported being less physically active but also consuming less highly processed foods. Other factors such as frequent skipping of meals, skipping breakfast, but also lifestyle factors such as smoking behavior contribute to high HPF consumption. In both Austria and Kazakhstan, further strategies to promote healthy habits are needed to encourage healthy lifestyles in terms of eating and physical activity behaviors.

[IV]

Declaration

This thesis has been conducted within the joint programme 'European Master of Science in Health and Physical Activity' following the specific rules of the University of Vienna as well as those of the coordinating institution, the University of Rome 'Foro Italico', and the other partners (Norwegian School of Sport Sciences, University of Southern Denmark, German Sport University Cologne) as outlined in the multi- and bilateral agreements between the universities. As part of the respective requirements, the work was submitted to both the University of Vienna and the University of Rome 'Foro Italico'.

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[X]

Abbreviations

AD - Alzheimer's disease

AsA- ascorbic acid

BDNF - Brain-derived neurotrophic factor

BMI – Body mass index

BMR - Basal metabolic rate

CNS - central nervous system

CVD – Cardio-vascular disease

DHA - Docosahexaenoic acid

DLA - daily live activity

EPA - Eicosatetraenoic acid

FIT - Intensity and Time

GDP - Gross domestic product

GPAQ - Global physical activity questionnaire

HEI - Healthy Eating Index

HIIT - high-intensity interval training

HP - High protein

HPF - Highly processed food

IMF - International Monetary Fund

MET - Metabolic Equivalents tasks

NP - Normal protein

PA – Physical activity

PAHs - Polycyclic aromatic hydrocarbons

QoL - Quality of Life

sQ-HPF - A short screening questionnaire of highly processed food consumption

TCC - Total carotenoids

TEE - Thermic effect of exercise

TP - Total polyphenols

UPF – Ultra processed food

WHO - World Health Organization

YLLs - The number of years of life lost

1 Introduction

1.1 General overview

WHO defines “health” as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO, 1946). A person's mental and physical well-being will help the person to adapt to the physical, mental, and social challenges that she/he is exposed to. Proper food protects against many chronic non-communicable diseases, such as heart disease, diabetes, and cancer (WHO, 1999). It includes a limited amount of salt, sugars, and industrially-produced trans-fats. In contrast, many nutrients have been associated to health benefits, i.e. omega 3 fatty acids where the intake is associated with cognitive health (Strasser & Fuchs, 2015). This diet, when further combined with physical activity, has a beneficial effect on emotional and cognitive functioning.

Besides single nutrients also the processing of food seems to be important as several studies have shown that people with a higher intake of ultra- or highly processed foods (UPF or HPF) have a higher risk of chronic diseases such as obesity, diabetes type 2, cardiometabolic and cardiovascular diseases, and cancer (Beslay et al., 2020; Elizabeth et al., 2020; Fund & Research, 2007; Andrew M Prentice & Susan A Jebb, 2003).

UPF sales remain highest in Europe, North America and Australasia in 2016 (Vandevijvere et al., 2019). UPF's most popular products were baked goods and sodas. The consumption of UPF has increased among all sociodemographic subgroups of US adults from 2001-2002 to 2017-2018 (Juul et al., 2022). In contrast, minimally processed foods decreased significantly across all sociodemographic groups (Juul et al., 2022).

With regards to physical health, it will allow a person to perform everyday activities without endangering their body, while good mental and social health will allow a person to carry out social tasks entrusted to him in a correct and expected way (Piercy et al., 2018; WHO, 2020). Physically active people have many advantages over people who are sedentary as they are better able to perform activities of daily life (DLA) such as climbing stairs, carrying heavy packages, and doing household chores without undue fatigue (Piercy et al., 2018). Moreover, physical activity may help to improve cardiorespiratory fitness and muscle endurance and protect against developing several chronic diseases such as cardiovascular diseases and type 2 diabetes (Piercy et al., 2018). It is worth noting that there seems to be an association between income level and physical activity (Armstrong et al., 2018).

[2]

Proper nutrition, physical activity, and health have the same relevance. All of them could be influenced by different factors such as age, sex, smoking, skipping meals, number of family members, health status, and the socioeconomic status of a person, which is a measure based on income, education, and occupation.

According to the study, Austria outperforms Kazakhstan in expectancy at birth, 69.1 years in Austria and 58.2 years in Kazakhstan as of 2010 (Feigin et al., 2014). With regards to the number of years of life lost (YLLs) due to premature death in Austria, ischemic heart disease, stroke,e and lung cancers were the highest ranking causes in 2010. Also, ischemic heart disease, stroke, and lower respiratory infections were the highest-ranking death causes in 2010 in Kazakhstan. Austria and Kazakhstan also share major risk factors such as dietary risks, smoking, and high blood pressure. In addition, high body weight, physical inactivity, and alcohol consumption are these countries' following leading risk factors (Feigin et al., 2014).

The consumption of HPF and reduced physical activity is present worldwide, but it is still unclear whether there is a difference between a high-income country and a low-income or middle-income countries. In this study, a cross-sectional comparison between Kazakhstan and Austria is carried out to discover the consumption of HPF and physical activity in these countries.

1.2 Impact of highly processed food on health

Adequate nutrition and exercise are considered as potential health factors at all ages.

As it is already known, HPF contain multiple ingredients and are produced through a variety of industrial processes. Since such products usually have an intense taste, fats, and other biologically active products and can be stored for longer, they are popular among the population, although being associated with many health problems. According to different studies, consuming HPF may cause overweight, obesity, diabetes type 2, cardiometabolic risks and cardiovascular diseases as well as cancer (Beslay et al., 2020; Elizabeth et al., 2020; Fund & Research, 2007; Andrew M Prentice & Susan A Jebb, 2003). This is unsurprising as HPF tends to be high in calories, refined carbohydrates, saturated fats, but low in dietary fiber and water (Butler et al., 2021). In addition to weight problems, HPF have a high glycemic load, making them prone to negatively impact endogenous processes in the nervous system (Fardet, 2016). Most detrimental, these endogenous processes in the nervous system play a significant role in satiety signaling and controlling appetite (WHO, 2003). Moreover, a meal plan that includes HPF is high in saturated fats and simple carbohydrates (WHO, 2003), thereby further increasing the risk of neurodegenerative diseases (Popa-Wagner et al., 2020). Besides, the consumption of HPF, as well as proper cooking, can lead to many health issues such as obesity (Ludwig, 2011), (Beslay et al., 2020), cardiovascular disease

(CVD) (Srour et al., 2019), hypertension (Mendonca et al., 2017) and type 2 diabetes (Srour et al., 2020). Similarly, research also supports a link between high consumption of sugar-sweetened beverages and an increased risk of obesity, diabetes, and heart disease (Plate, 2021). It may be explained that the energy density of HPF ranges from relatively high (225-275 kcal per 100 g) for baked goods, too high (350-400 kcal per 100 g) for energy bars, or very high (400–500 kcal per 100 g) for most cookies and chips (Monteiro et al., 2012). Due to the richness of the palatability of these products and the high energy densities of many fast foods, people are prone to inadvertent over-consumption, and therefore to overweight and obesity (A. M. Prentice & S. A. Jebb, 2003). Nevertheless, studies show that people are more likely to consume HPF than unprocessed foods and have decrease levels of physical activity (C. A. Monteiro et al., 2013).

1.2.1 Definition of HPF

Highly processed or ultra-processed foods (HPF or UPF) went through several processing steps and lean to be higher in calories, salt, fat and added sugar (C. A. Monteiro et al., 2018).

To better describe the degree of processed food in the diet the NOVA classification system can be used. As established by NOVA, food processing includes physical, biological, and chemical processes, whereby four categories have been defined (C. A. Monteiro et al., 2018).

The first group is 'unprocessed or minimally processed foods.' Unprocessed foods have not been added preservatives, dyes or harmful substances. Such foods may include fresh vegetables, fruits, and animal products such as meat, fish, and eggs. Fresh vegetables and fruits are considered the most valuable vitamins, minerals, and fiber sources. Such products may include minimal processing such as removing inedible or unwanted parts, drying, filtering, roasting, boiling, non-alcoholic fermentation, pasteurization, refrigeration, freezing, and vacuum packaging (C. A. Monteiro et al., 2018). This way of preparing food allows the food to be stored for more time and stay edible. However, the amount of nutrients in the skins of fruits or vegetables depends on their type, and unrefined foods contain more vitamins, minerals, and other beneficial plant compounds than their refined counterparts. Moreover, one of the studies proved that the peel and fractions of the seeds of some fruits could be rich sources of natural antioxidants (Guo et al., 2003). Therefore, some products are more valuable to leave without processing.

The second group is “processed cooking ingredients.” Foods in this category are obtained from minimally processed foods by pressing, refining, grinding, or milling (Plate, 2021). These products are usually obtained directly from group 1 or from nature and are mainly used in cooking. This may include products such as olive oil, butter, maple syrup, sugar, and salt (C. A. Monteiro et al., 2018). This means that they are usually not eaten on their own but are used to make foods with

minimal processing, such as oils from plants (Plate, 2021). Such processes aim to create long-lasting products that can stay at the kitchen for cooking, seasoning, and preparing first group food. The third group is "processed products." Salt, sugar, or fats are added to the products of any of the two previous groups (Plate, 2021). Some examples are canned fruits and vegetables, cheeses, freshly baked bread, and canned fish (Plate, 2021). These products can be added from second group to first group. These products are usually prepared with at least 2-3 ingredients and can be easily eaten without additional preparation (Plate, 2021). The treatment aims to increase the longevity of group 1 products or to change or improve their organoleptic qualities (C. A. Monteiro et al., 2018).

The fourth group is “ultra-processed foods.” Products included in this category such as soft drinks, sweet or savory packaged snacks, reconstituted meat products, and pre-prepared frozen dishes go through several processing steps (C. A. Monteiro et al., 2018). The aims of these products are to be stored for a long time, retain their texture and improve the taste. Typically, these foods are ready for eating with minimal additional preparation. Generally, such products are included as sugars, oils, fats, or salt, which can be used in processed foods (C. A. Monteiro et al., 2018). It is no wonder why such foods are low in fiber and nutrients. Nevertheless, ultra-processed products also include other sources of energy and nutrients not typically used in culinary preparations, such as casein, lactose, whey, and gluten. Many are derived from further processing of food constituents, such as hydrogenated or interesterified oils, hydrolyzed proteins, soya protein isolate, maltodextrin, invert sugar, and high-fructose corn syrup (C. A. Monteiro et al., 2018). Since most of these foods are immediately ready for consumption, this constitutes the main diet of many people.

However, ultra-processed products have also advantages, i.e. as certain methods such as pasteurization, cooking with high temperature and different ways of drying can kill or suppress the growth of harmful bacteria, if the temperature is above 63°C for a period of about 30 minutes (Britannica, 2020). Moreover, some processed foods contain beneficial nutrients, such as olive oil (Plate, 2021). The predominant fatty acid is oleic acid, which has been shown to reduce inflammation and may have beneficial effects on genes associated with cancer (Menendez & Lupu, 2006). Oatmeal is also considered to belong to processed foods, but it is rich in antioxidants called avenanthramides. Avenanthramides are found almost exclusively in oats and have additional protection against coronary heart disease, colon cancer, and skin irritation (Meydani, 2009).

Therefore, highly processed foods can be beneficial if they retain nutritional value and long-term health effects, while unprocessed products are much more nutrient-denser than HPF. At the same time, ultra-processed foods with unevenly high calorie-to-nutrient ratios can be considered unhealthy because of the risk of improving chronic diseases. Furthermore, it has been shown that

over-processed food may induce addiction in people to such foods, which contributes to excessive consumption (Kessler, 2010). Perhaps this factor influences people to consume more ultra-processed food and makes it harder to easily reduce their consumption. This factor may explain the high rate of rejection of a healthy diet because ultra-processed foods can make people want to eat despite the desire to stop eating. In contrast, nutritious, minimally processed foods such as fruits, vegetables, and legumes do not meet these addiction criteria.

To sum up, the inclusion of highly processed foods in a diet may lower nutrient value, depending on the type of product and how people cook it, and may exert long-term health effects. Ultra-processed foods with a high ratio of calories to nutrients are considered unhealthy and cause chronic disease. However, some processed foods, such as olive oil or oatmeal contain beneficial nutrients and can be added to the diet (Plate, 2021).

1.2.2 Impact type of cooking on being processed food and health status

It is crucial to select an appropriate cooking method because the way of cooking food has an influence in the number of nutrients it contains and can improve health status and energy levels. Besides, there are many ways of cooking that keeps the quality and good taste of food (Spritzler, 2017). As outlined in the previous section, processed foods are generally less healthy than fresh foods. However, some processed foods can improve nutrient absorption and make food consumption safer. There are many ways to cook a meal, such as boiling, grilling, microwaving, baking, sautéing, stir-frying, frying, and steaming. Each of these methods has its own characteristics, ways, and quality of the nutrient content. Nevertheless, no cooking method can retain all nutrient elements. However, cooking for shorter periods at lower temperatures with minimal water will produce the best results (Spritzler, 2017).

Boiling and braising

Boiling and braising are similar cooking methods with water, but differ in the temperature of the water. In some studies, the authors found that boiling reduces the vitamin C content more than any other cooking method (Yuan et al., 2009; Zeng, 2013). A study was conducted on broccoli, spinach, and lettuce, where it was found that these vegetables can lose up to 50% of their vitamin C when cooked (Spritzler, 2017; Yuan et al., 2009; Zeng, 2013). Vegetables usually also have high levels of vitamin C. However, research has shown that most of it can be lost during cooking since vitamin C is water-soluble and sensitive to heat and can be leached from vegetables when immersed in hot water (Tian et al., 2016). It is advisable to choose a different method for cooking vegetables or to eat them ‘fresh.’ Boiling meat also causes loss of many nutrients, including

vitamin B (USDA, 2007). On the other hand, boiling fish has been shown to retain significantly more omega-3 fatty acids than frying or microwave cooking (Stephen et al., 2010). In addition, the cooking method is most suitable for the assimilation of egg protein. Studies conducted with stable isotope-labeled ileum using non-invasive tracking methods and found that boiled eggs are better absorbed than raw eggs 90.9 +/- 0.8 and 51.3 +/- 9.8%, respectively (Evenepoel et al., 1998). It means that some foods are safer and easier to digest when cooked in comparison to the raw products.

Grilling and broiling

These two cooking methods are listed together, as they are very similar. One of the differences is the heat. When grilling it comes from the bottom, and when broiling, it comes from the top (Plate, 2021). Nowadays, broiling is one of the most popular cooking methods because of the flavor and taste it gives food (Plate, 2021). However, due to the fat content and loss of B vitamins, this method is not desirable for cooking meat. Up to 40% of B vitamins and minerals can be lost during grilling due to the loss of juice, rich in nutrients (USDA, 2007). In addition, in one of the studies was found that when meat is cooked using high-temperature methods such as broiling or grilling, polycyclic aromatic hydrocarbons (PAHs) are formed, which can potentially cause cancer (Lee et al., 2016). Grilling and broiling give food a great taste, but these foods lower B vitamins and release cancer-causing substances. Therefore, cooking by grilling or broiling with high heating should be minimized or eliminated.

Microwave

There's some debate on whether microwaving decreases nutrient loss. A study found that vegetables lose some of their nutritional value in the microwave. Microwaving was found to remove 90% of the flavonoids in broccoli (Wu et al., 2019). Another study found that microwaving food retains nutrients due to the short cooking time and less heat exposure (Cross et al., 1982). It was noted that only about 20–30% of the vitamin C in green vegetables were lost when heated in a microwave oven, making this method the most suitable for vegetables (Yuan et al., 2009). In addition, it has been published that cooking in the microwave affects vitamin C content (Lee et al., 2018). Thereby, the highest amount of vitamin C after cooking was found after cooking in the microwave, and the lowest after boiling. Potentially, this is because food is cooked in the microwave using steam, not water, and therefore a higher concentration of vitamin C is retained as there is less contact with water. It means that using the least amount of cooking water and cooking for shorter periods of time should result in higher vitamin C retention. Microwaving is one of the most preferred cooking method among all domestic cooking methods, at least for

many but not all plant foods, as each food is different in terms of the texture and nutrients it contain (Wu et al., 2019).

Roasting and baking

Cooking food in a dry oven is a baking method. The loss of vitamins with this cooking method is minimal, similar to the microwave oven. However, with this method, the number of B vitamins in meat can be reduced by 40% due to the long cooking time at high temperatures (USDA, 2007). This cooking method is the most inappropriate for fish as with an increase in baking time, an increase in cholesterol and squalene was found in fish, probably due to evaporation of moisture content (Zotos et al., 2013). However, the baking and roasting methods do not affect most vitamins and minerals.

Frying

Frying is the most popular cooking method and includes high temperature cooking. Usually this method is the unhealthiest since it uses a large amount of oil, however, adhering to the research the content of proteins and minerals practically does not change during frying, and due to the high temperature and short time of the frying process, the loss of vitamins is minimal in comparison with other cooking methods (Fillion & Henry, 1998). Thus, the vitamin C content in French fries is as high as in raw potatoes, and thiamine holds well in fried pork and is a good source of vitamin E (Fillion & Henry, 1998). In contrast, studies that have shown that the omega-3 content is reduced by up to 70–85% when fish is fried (Stephen et al., 2010). At the same time, when frying anchovies in olive oil, cholesterol levels dropped significantly, probably because of two beneficial fatty acids (EPA and DHA) found in higher concentrations of olive oil (Zotos et al., 2013). However, heating oil to high temperatures for prolonged periods can lead to the formation of aldehydes, which are connected with an increased risk of cancer and other diseases (Guillén & Uriarte, 2012). The chances of increased aldehyde content are higher with reheating of the oil. This means that the frying method can be beneficial in preserving certain ingredients and vitamins. However, it is better to give up frying fish, use olive oil and not fry long.

Steaming

Steam cooking is a relatively quick and healthy method, although not the most popular. However, citing largely researches, steaming is one of the best ways to preserve nutrients, including water-soluble vitamins (USDA, 2007; Yuan et al., 2009; Zeng, 2013). Steam cooking avoids large amounts of butter, vegetable oil, and other fats. Furthermore, this method is excellent because,

unlike boiling and stewing, steaming does not stir the food, keeping all those valuable nutrients inside the food and not in the cooking liquid. This is explained by the fact that by boiling, some nutrients are washed out of vegetables and enter the water for cooking. Probably, the longer the food is cooked, the more nutrients will enter the water. It has been found that steaming vegetables only slightly reduced the vitamin C content to about 9-15% (Zeng, 2013). However, steaming is the gentlest method and leaves the most nutrients in food compared to all other cooking methods. The downside is that steamed vegetables may be tasteless, and it may be one of the reasons why people do not prefer this cooking method (Plate, 2021). Nevertheless, using moderate seasonings and oils after cooking makes can improve its taste.

Freezing

Many people prefer freezing for vegetables and meat to ensure that such products can be stored longer and the nutritional properties of the products are not lost. However, during freezing, the amount of nutrients is also lost. Differences in vitamin C levels between studies could be based on freezing the nutrients which differs between studies and were higher in as study of (Lee et al., 2018) in comparison to (Bureau et al., 2015). This is due to the fact that in the latter study the researchers used frozen vegetables while cooking (Bureau et al., 2015).

On the other hand, frozen food is easier to transport and keeps its shape better than fresh food. Because of that, frozen food is often used to transport fresh food and keep food longer in a household. However, fresh food outnumbers frozen food in terms of nutrients based on research.

1.2.3 Measurement methods

As previously described, HPF products are palatable and addictive, affordable, widely advertised and sold in convenient and attractive packaging (Martinez-Perez et al., 2022). All these facts contribute to their excessive consumption (Monteiro et al., 2019; Carlos Augusto Monteiro, Geoffrey Cannon, et al., 2018). Such products have a negative effect on health (Beslay et al., 2020; Fund & Research, 2007; Andrew M Prentice & Susan A Jebb, 2003). A short screening questionnaire of highly processed food consumption (sQ-HPF) was created to determine the frequency of HPF consumption in the population (Martinez-Perez et al., 2022).

In this questionnaire, products from 14 food groups are included, namely full fat dairy products, sweet dairy products, dried meats, fats, fermented alcohol, distilled alcohol, sweet and artificially sweetened drinks, sweets, snacks, prepared foods, refined cereals, sauces, additives and fried foods. One point is assigned to each item if the frequency consumption corresponds to the HPF

power model according to the calculated thresholds, and zero ponts otherwise (Martinez-Perez et al., 2022). Therefore, the higher the score, the higher the HPF consumption. An equivalence is then made between the sQ-HPF estimate and the estimated percentage of HPF intake of total intake in grams per day. Thus, these results will help identify people on the HPF diet with a focus on the frequency of consumption rather than the specific HPF foods they consumed daily (Martinez-Perez et al., 2022).

1.3 Impact of physical inactivity on health

An active lifestyle has a significant impact on physical and mental health of human being. A person with a healthy lifestyle is more likely to have good health than someone with an inactive or sedentary lifestyle. According to WHO, 60 to 85% of people in the world lead sedentary lifestyles (Prakash, 2002). Thereby, physical inactivity is defined as failure to accumulate 150 – 300 minutes of moderate physical activity or 75 – 150 minutes of vigorous physical activity or the combination of both intensities per week. It doubles the risk of cardiovascular disease, type II diabetes, obesity, and also increases the risk of colon and breast cancer, high blood pressure, osteoporosis, and depression (Bull et al., 2020; Piercy et al., 2018; WHO, 2020). In fact, a study that included data from 212,021 adult participants from 51 countries (most of them developing countries) found that about 15% of men and 20% of women were at risk for chronic diseases due to physical inactivity (Guthold et al., 2008). Sedentary lifestyles coupled with unhealthy diets and the resulting excess of calories, obesity and associated chronic diseases are a major public health problem. Besides, with respect to the study (Guthold et al., 2018) conducted from 2001 to 2016, globally more than a quarter of adults (27.5%, 95% UI 25.0–32.2) in 2016 were not physically active enough, and women were also less active than men (Mielke et al., 2018). Perhaps the difference in physical activity between men and women is due to gender differences in areas of activity, such as being active at work or in the household, or in leisure time, with varying intensities. Some previous studies show that women tend to engage in less physical activity in their free time and also less intense activity than men (Guthold et al., 2018; Mielke et al., 2018).

1.3.1 Definition of physical activity

World Health Organization (WHO) defines physical activity as any bodily movement produced by skeletal muscles that require movements during leisure time, for transport to get to and from places, or as part of a person's work (WHO, 2020). Besides, adults in age between 18-64 years old are recommended to do at least 150–300 minutes of moderate-intensity aerobic exercise, or at least

75–150 minutes of high-intensity aerobic activity a week (WHO, 2020). It is also recommended to do muscle-strengthening exercises 2 or more days a week and, if possible, replace a sedentary lifestyle with physical activity. Adults over 65 years of age are recommended the same physical activity as for adults 18-64 years old, but add balance and strength training 3 or more times a week. Such physical activity will help prevent falls, improve quality of life in daily life activities (DLA), and prevent or delay chronic disease (Piercy et al., 2018; WHO, 2020).

1.3.2 Health-related physical activity

People who engage in regular physical activity improve the quality of life, and prevent diseases such as the risk of cardiovascular disease, type II diabetes, obesity (Bull et al., 2020; Piercy et al., 2018; WHO, 2020).

People who perform physical activity regularly at a moderate-intensity pace may contribute to the production of brain-derived neurotrophic factor (BDNF) in response to exercise (Shobeiri et al., 2022). Yet, when it comes to the benefits of physical activity on health, doing some physical activity is better than not doing it at all. Even light-intensity activity could provide benefit and is preferable to sitting, but if the benefit is not enough, small and well-spaced increments in physical activity could increase the positive impact on health (Powell et al., 2011). This means that being physically active has a beneficial effect on emotional, cognitive functioning and improves the quality of life. Besides, in a study it was proved that proper nutrition, in combination with physical activity, has a positive effect on the prevention of neurodegenerative diseases (Kepka et al., 2022). That is, diet and physical activity nowadays help to prevent or delay the progress of Alzheimer's disease (AD) and other diseases associated with dementia (Kepka et al., 2022). People who are physically active and make preference to proper food are healthier and their quality of life is significantly higher. In contrast, people who spend more time sitting are more sedentary and prone to have health risks. This is why it is recommended that people move more and sit less. That said, the promotion of physical activity should not be done in isolation; but as a part of an integrated approach to enhance healthy lifestyle behaviors (Warburton & Bredin, 2016).

1.3.3 Assessment methods

Calculating total energy needs

Energy requirements are highly dependent on habitual physical activity. One way to describe physical activity is by classifying activity into different types with the physical activity level (PAL). The PAL is a way to express a person's daily physical activity with a person`s total energy

requirement (Vasconcellos & Anjos, 2003). PAL can be measured or estimated from the average 24-hour thermic effect of exercise (TEE) and basal metabolic rate (BMR) (i.e. PAL = TEE/BMR) (Kepka et al., 2022). BMR is needed to calculate the minimum amount of energy that the body needs to ensure the habitual functioning of the body under standard conditions. It can include such physical activity as dressing, showering, cooking, eating etc. Every physical activity has its own energy cost and the time spent on this activity. Means every daily activity should be count with respect to the time spent on it and lifestyle (sedentary, moderate or vigorous). Mean PAL will be calculated by time multiply on energy cost in total and then divide 24 hours (Vasconcellos & Anjos, 2003). Besides, TEE is needed to calculate the number of calories a person burns every day along with physical activity. It is calculated by multiplying BMR by a person's physical activity level. BMR constitutes about 45 to 70 percent of TEE in adults, and is determined principally by gender, body size, body composition and age (Vasconcellos & Anjos, 2003). Thereby, the formula in Table 1 can be used to calculate the BMR (Vasconcellos & Anjos, 2003).

Table 1 BMR formula

Men	BMR = (10 × weight in kg) + (6.25 × height in cm) - (5 × age in years) + 5
Female	BMR = (10 × weight in kg) + (6.25 × height in cm) - (5 × age in years) - 161

According to a study, energy requirements are highly dependent on habitual physical activity and the same PAL values are used to assign men and women to a PAL (Vasconcellos & Anjos, 2003). Classification of physical activity levels are presented in Table 2.

Table 2 Classification of physical activity levels

Sedentary or light activity lifestyles	Physical activity that does not require much effort. Such activities do not involve walking long distances and usually use a vehicle to get around. Most of the time is spent sitting.
Active or moderately active lifestyles	Physical activity is not intense, but requires much more energy than a sedentary lifestyle. Such physical activity may involve people with a sedentary job, but occasionally performing physical activity in their free time. This could be running, cycling, or other moderate to vigorous physical activity.

[12]

Vigorously active lifestyles	This lifestyle involves regular moderate to vigorous physical activity for several hours a day. In addition, such a lifestyle usually involves active work.

Each lifestyle carries a certain PAL value, with which daily physical activity is then need to be calculated. The table below shows the PAL value for each category according to a study by (Vasconcellos & Anjos, 2003).

Table 3 PAL value with respect to the classification of lifestyles

Category	PAL value
Sedentary or light activity lifestyle	1.40-1.69
Active or moderately active lifestyle	1.70-1.99
Vigorous or vigorously active lifestyle	2.00-2.40*

* PAL values > 2.40 are difficult to maintain over a long period of time

The categories indicated above represent the different levels of activity associated with a population's lifestyle. Usually, these categories indicate the physical activity most often performed by a person, over a period of time, as one month or longer.

Global physical activity questionnaire (GPAQ)

Questionnaires are most often used to monitor people's physical activity levels, as it is necessary to identify current problems associated with insufficient physical activity. For this, a standardized protocol is used. WHO developed the Global physical activity questionnaire (GPAQ) because it is a rather easy way to collect data. Since then, the GPAQ has gone through a research program that shows it to be valid and reliable (Armstrong & Bull, 2006).

The GPAQ includes 16 questions that consist of several components of physical activity, such as intensity, duration, and frequency, and assesses three areas in which physical activity occurs: occupational physical activity, transport-related physical activity, and leisure-time physical activity (WHO, 2012a). The GPAQ analysis uses MET (Metabolic Equivalents) to express the intensity of physical activity (WHO, 2012a). MET measures the metabolic rate at work to the metabolic rate at rest. One MET is the energy expended for sitting quietly, corresponding to a calorie intake of 1 kcal/kg/hour (Ainsworth et al., 2000). Applying MET values to activity levels allows to calculate total physical activity. However, energy consumption is different at rest, moderate exercise, and intense exercise.

After assessing the data, the data can be divided into three categories of activity such as low, moderate, and high. The high category refers to people who engage in high-intensity activity for at least three days, achieving a minimum of at least 1500 MET minutes per week, or seven or more days of moderate or vigorous intensity, achieving a minimum of 3000 MET minutes per week. The moderate category refers to people who do not meet the criteria for the "high" category but who engage in 3 or more days of vigorous activity of at least 20 minutes per day or 5 or more days of moderate-intensity activity or walking of at least 30 minutes per day or 5 or more days moderate to vigorous intensity, achieving a minimum of 600 MET-minutes per week. Finally, the low category includes people who do not manage the above criteria (WHO, 2012a).
Summing up, with the help of questionnaires from the GPAQ and the correct calculation of the MET value allows to estimate the total physical activity level.

1.4 Socioeconomic status, food intake and physical activity

Health is speculated to be influenced by plural factors. One of the important factors WHO highlights is the environment, which includes clean water and air, jobs, the safety of the population, parks or pedestrian walkways, and sports or leisure facilities (WHO, 2012b). This could be explained due to the fact that working people have an income, which in turn provides the opportunity to buy healthy food and pay for medicine. The environment must also provide people the opportunity to safely exercise outside home.

Research results show that UPF are predominant in high-income countries and that their consumption is currently overgrowing in middle-income countries (C. A. Monteiro et al., 2013). One of the researches show that by the early 2000s, ultra-processed foods had skyrocketed to more than half of all calories consumed in Canada and to more than a quarter in Brazil, although at relatively low levels (C. A. Monteiro et al., 2013). In addition, in this study, in the lowest income country, Kenya, UPF consumption was deficient, probably due to low income or availability. These studies show that UPF crowd out staple foods and impair public health. This may also be due to the fact that low-income people may be interested in keeping food longer. In one of his studies, the author concluded that ultra-processed foods make up a relatively large share of food spending among low-income households to their consumer familiarity and longevity storage (Moran et al., 2019). However, other studies showed that the population consumed more UPF as their income grew (Baker & Friel, 2016; Marron-Ponce et al., 2018; Carlos A Monteiro et al., 2013). Research has shown that between 1998 and 2012, per head sales of sweet or savory snacks and soft drinks increased by 50% in upper-middle-income countries and by 100 and 300%, respectively, in lower-middle-income countries (Carlos A Monteiro et al., 2013). And another

study showed that unhealthy diets are more common in people with lower socioeconomic status (Finger et al., 2013). The same study found that adults with lower socioeconomic status were more physically active or spent more energy than those with higher socioeconomic status. Perhaps this energy consumption is associated with the type of activity, as people with low socioeconomic status are more inclined to work at a job with high energy expenditure.
On the other hand, another study showed that younger age, higher socioeconomic status, and higher levels of education are the main factors associated with higher UPF intake (Marron-Ponce et al., 2018). In addition, some studies have shown that people with low income consume fewer fruits and vegetables, more sugar-sweetened beverages and have lower overall diet quality than those with higher income (Fox et al., 2004; Prevention & Promotion, 2000).

With regards to physical activity, a poor environment may be one of the factors behind low physical activity in low-income countries (Chiplonkar & Agte, 2007). Whether it is cycling to work, walking the dog, or parking away from a store or home, poor infrastructure reduces physical activity. It is likely that cyclists will be less likely to ride without bike lanes, and walking pets will be limited to a park next to the house, or even a small yard. This statistic is supported by another study that showed the largest inactivity occurred in high-income countries 36,8% middle-income 26,0% and low-income countries 16,2 % (Guthold et al., 2018). Perhaps a sedentary lifestyle in economically developed countries is associated with the availability of personal vehicles and vice versa, in low-income countries, more activities are carried out at work and in transport. In the same study was found that more than a quarter of adults (27.5%) were not physically active enough with women showing lower activity than men (Guthold et al., 2018). More parks in poor areas could increase physical activity among low-income people. In another study, reducing the distance to public transport to enable the transition from private cars to walking, cycling, and public transport led to improved health in all cities (Zotos et al., 2013). This means that the infrastructure of the city must ensure safe walking and cycling. Another significant factor affecting physical activity can be a factor of disability with limited mobility or temporary injury that limits activity.
This is in contrast to another study showing opposite results, where higher income was associated with higher physical status for women and men in leisure time (Kari et al., 2015). However, the study was based on pedometer data and varied by day of the week and type of physical activity. The steps were divided into weekdays and weekends, as physical activity was different between the sexes on these days. For women, income was positively associated with total steps measured on weekends, while for men, income was negatively associated with steps measured on weekdays. The authors suggested that the time limit for physical activity becomes more important for men than the budget limit (Kari et al., 2015). The data from the studies above show different outcomes

between income levels and physical activity hinting to the fact that further studies are needed (Kari et al., 2015).

1.4.1 Parameters of socioeconomic status

Socioeconomic status is a measure that evaluates a person's economic and social position in relation to others. Socioeconomic status is divided into three levels: high, middle, and low based on income, education, and occupation. Education can be measured with continuous (e.g., the number of years of education completed) or categorical variables (e.g., scales of education) (Association, 2018). A high level of education is associated with a better economy and social resources. Income can be measured through family income, assessments of wealth and subjective assessments of economic pressure (Association, 2018). Lack of income is related to poorer health due to limited access to goods and services. Finally, occupation can be evaluated through a survey where participants are asked about them most recent occupation or job title, industry and work tasks. Occupation is associated with health an occupational prestige is considered to be an SES indicator that explicitly represents social standing (Fujishiro et al., 2010).

1.4.2 Countries income level

The present study selected countries with high and middle income level with respect to the World Bank (Bank, 2017). One country from each group was selected: Austria, which belongs to high-income economies ($13,205 or more), and Kazakhstan, which belongs to the upper-middle-income economies ($4,256 to $13,205), as of the year 2022 (Bank, 2017)Another monetary measure used in this study was the gross domestic product (GDP). The GDP takes into account all the goods produced and services made available in a country in a period of time. In this study, we chose the GDP per capita in particular because it provides a better indicator of living standards as compared to GDP alone. Austria (GDP per capita – $53,370) belongs to the high GDP per capita group ($25,000 or more) and Kazakhstan (GDP per capita – $10,000) belongs to the middle group ($2,500 / $10,000) according to the IMF as of 2022 (Fund, 1980).

With regards to the salary, the minimum gross salary range for people who work in Austria is about 1,984 EUR, and the high is about 6,386 EUR (PayLab, 2022). For Kazakhstan people, the range of minimal gross salary is from 313 EUR and up to 995 EUR for the high salary (PayLab, 2022).

1.5 Current state of the art

Some studies have analyzed HPF consumption and/or physical activity levels in a single country, but very few of them have compared them between two or more countries. A very recent study compared HPF consumption in adults across 22 European countries using a database with surveys that ranged from 2003 and 2017 (Mertens et al., 2022). The energy shared from ultra-processed food and drinks ranged from 14 to 44%, being the lowest in countries like Italy and Romania, while the highest in the UK and Sweden. The study found that the UPF consumption considerably varied across Europe, but it is still unclear how the consumption differs in countries like Austria and Kazakhstan, whereby it has to be mentioned that the data acquisition for the thesis has been conducted in 2022 after several COVID-19 lockdowns potentially having an influence on lifestyle habits. With respect to physical activity data from 51 countries are available from 2007 (Guthold et al., 2008). Moreover, it is important to analyze how HPF consumption and physical activity are associated with other factors such as age, gender, BMI, family members, education degree, skipping meal, health status, income and smoking.

1.6 External reasons of HPF consumption and physical inactivity

1.6.1 Education reasons

Apart from socio-economic reasons, other factors may influence the consumption of HPF and physical (in)activity. One of the factors which may influence HPF food consumption and low level of PA is the education level of population. Consumption has been shown to be higher among people with a 'less than high school diploma,' and the lowest percentage was among people with a 'post-secondary studies diploma' (C. A. Monteiro et al., 2013). These data indicate that educational attainment may directly influence UPF consumption. This term is based on factors such as educational level, income level, occupation, and physical activity may also be associated with social-economic status dietary habits. A study examined the relationship between educational attainment, food intake, and physical activity. Results of the study showed that adults with low educational levels consumed more UPF and fewer fruits and vegetables than adults with higher educational levels (Abdi et al.; Finger et al., 2013). In addition, it was also found that the lower the level of education, the lower the consumption of UPF (Magalhaes et al., 2021).

1.6.2 Skipping meal

Moreover, it has been shown that people who skip breakfast are more likely to be obese than people who have breakfast regularly (Cho et al., 2003; C. A. Monteiro et al., 2013). This is most likely due to the fact that those who skip breakfast will eat more when having dinner or prefer unhealthy snacks during the day. This may be one of the reasons for UPF consumption. A systematic review found that people eating out of home consume a higher intake of calories and fat and a lower intake of micronutrients, especially vitamin C, calcium, and glands (Lachat et al., 2012) found. Therefore, it can be assumed that people with higher incomes will eat out more often and consume more processed products. Besides, it may be more difficult to calculate calories or identify a cooking method that affects the availability of micronutrients when eating in a restaurant or ordering food. Furthermore, people who ate breakfast presented less hunger during the day compared to people who neglected breakfast (Leidy et al., 2013). This study proved that a high protein based breakfast kept persons longer full compared to a normal protein based breakfast, although the calorie content of the two breakfasts was the same with 18% of daily energy intake (~350 kcal) (Leidy et al., 2013). At the same time, breakfast with high protein reduced the number of evening snacks compared to those who skipped breakfast. This is because meals reduced pre-lunch activation of the amygdala, hippocampus, and middle frontal cortex compared to those who did not eat breakfast. A particular decrease in hippocampal activation was observed in people who ate a high-protein breakfast. This explains satiety throughout the day. These data suggest that breakfast leads to quite beneficial changes in appetite. Having breakfast in the morning controls the regulation of food intake, and especially a protein-rich breakfast can help improve satiety and prevent overeating and UPF consumption.

1.6.3 Smoking habits

One more reason for overeating and consuming UPF may be a person's attachment to smoking. This is explained by the fact that smokers violate taste buds, and they need more saturation of tastes than people who smoke not so long ago and people who do not smoke (Jacob et al., 2014). In this study, a taste test was performed, and it was found that smokers were more likely to have erroneous taste recognition than non-smokers or ex-smokers. The salty taste was better recognized by women ($p < 0.0001$) (Jacob et al., 2014). An association between recognition and intensity of bitter taste was also observed and remained statistically strong ($p = 0.002$) and was also strongly influenced by smoking status ($p = 0.016$) (Jacob et al., 2014). This study indicates that smokers

need more concentration for salty, sweet, and sour tastes, leading to UPF consumption due to their enhanced flavoring.

1.6.4 Sociable reasons

Influence of sociable reason on HPF

The formation of dietary habits can be directly dependent on the environment. Friends, family, and social media can influence eating habits. The food sold is spurred on by marketing strategies such as advertising for UPF, full fat, and salt products and will not positively affect the body.

The nutrition of people, to a certain extent, depends on the media, whose influence extends not only to adults but also to children. Both groups would see ads related to UPF on their computer, phones, at school, TV, etc. The impact of food advertising was found to be quite high. A study showed that people chose products if the products were designed according to the color choice of the customers (Seher et al., 2012). Children and students who watch TV are more likely to have unhealthy eating habits, which has a long-term impact on diet (Harris & Bargh, 2009). Social networks aim to making products more tempting for buyers.

A study conducted by scientists from the College of Health and Life Sciences, Aston University analyzed the impact of social media on the eating behavior of participants (Hawkins et al., 2021). The research involved 169 adult women aged 18 to 65 years (mean age of 20.9) who had to take a look at an Instagram feed of images and videos of various foods, from raw foods to ultra-processed foods (Hawkins et al., 2021). Ultimately, the researchers found that those participants who viewed images of healthier food would consume more unprocessed foods than those who did not. In addition, the choice of products was influenced by their popularity in the feed (Hawkins et al., 2021). To sum it up, showing images of the food with the most likes on social media can encourage people to choose healthier foods over less nutritious ones.

Besides, food choices can also be influenced by age, gender and society. Some studies show that children learn eating behaviors by observing the eating habits of their parents (Young et al., 2004). This may be explained by the fact that children learn almost everything by copying the behavior of others. Children are prone to follow their parents' eating behavior in food selection, cooking methods, and the amount of food they eat. It is likely that if parents eat UPF or follow a vegetarian diet, children will follow them. However, as children get older and spend more time with friends and away from their parents, their diet may change completely to resemble that of the people they spend more time with. Parents may influence children's nutrition, and teens can try to make a good impression of healthy eating by eating with friends or eating the wrong foods. This could mean that the people we live with can significantly impact our diet. For example, in one study, children

of both sexes ate less unhealthy foods in the presence of their parents than in the company of friends, and adolescent girls also consumed more healthy foods than UPF when they were with their friends than with their mothers (Salvy et al., 2011). Besides, another study found that married couples had lower UPF intakes than singles, and smokers also showed higher UPF intakes than never-smokers (Magalhaes et al., 2021). At the same time, the main differences in nutrition were observed in adults, where women consumed more yogurt, and men consumed soft drinks.

Finally, it has been shown that people eat more in groups than alone (Herman et al., 2003). The subjects' food intake depended on the amount of food eaten by other people and the type of food eaten, and this could be different from eating alone. The author of the study suggested that people pay attention to the people around them to determine when to stop eating, in the absence of clear signals of satiety, but the presence of food (Herman et al., 2003).

It can be concluded that views are formed by society and can indirectly affect the nutrition of adults and children. The media and the immediate environment are more likely to shape eating habits, type of food, and the number of meals. Furthermore, the influence of the nearest people can influence the diet. Perhaps, if a partner or friend eats a particular food, then this may affect the diet of the other. The studies cited above may be proof that social media, TV and environmental factor may influence eating habits.

Influence of sociable factors on PA

As described above, physical activity also depends on the environment. Some studies have shown that for young people, physical activity depends on the environment, such as walking distance, proximity to recreational areas, and residential density, as well as the presence of sidewalks for walking (Brownson et al., 2010; Ding et al., 2011).

Besides, social media, as well as support from family and friends, can influence proper nutrition and physical activity. It is likely that the family's beliefs, diet plan and level of physical activity will have a significant role to play. The family can become the base for a physically active life, and a partner and friends can also easily influence. The study showed that women with high levels of support from family and friends had higher levels of physical activity (Eyler et al., 1999). Several studies have shown that parents are particularly important in showing behavior patterns and inspiring physical activity in children and adolescents (Beets et al., 2010; Cleland et al., 2011). It was also noted that physical activity was also influenced by the income factor, which included the purchase of the necessary equipment. Other important factors in raising active children are the level of activity in parents, time spent outdoors on weekends, and family income (Cleland et al., 2011). This highlights the importance of the influence of the immediate environment and spending time together on physically active formation in children, as well as physically active time spent

among the adult population. Also, one of the important environmental factors affecting not only physical activity, but also nutrition is work and school, which are places where people spend most of their time. The built environment and infrastructure development are an important factor in how people get to work. Sidewalks and bike lanes, as well as bike storage, protected cycle paths, and street planning that slows down traffic and makes it safe for pedestrians, can encourage people to take active commutes to work. Likewise, access to public transport can also increase physical activity, as it enables people to walk to and from the bus stop. The study examined the relationship between physical activity and workplace support for active commuting and active employee behavior (Kaczynski et al., 2010). The results showed a more significant positive relationship between cultural and physical support and active commuting in women than in men (Kaczynski et al., 2010). Besides, it was found that an important influence on active commuting was the psychological influence that other employees actively commute to work, as well as the availability of bicycle parking and space storage. Therefore, workplaces are the ideal place to test environments, monitor physical activity and nutrition programs, and socially influence colleagues (Kaczynski et al., 2010). In addition, the workplace nutrition and physical activity programs can result in modest weight gains for both men and women in a variety of workplace settings (Anderson et al., 2009). The type of work activity, time spent at work, and the way to get to work are important indicators. Adding physical activity with a duration of 10-15 minutes to the workplace and daily routines have also shown sustained benefits, not only on physical activity but also on workplace performance and mental health, such as reduced stress and improved mood (Barr-Anderson et al., 2011). Results showed improvements in academic performance, mental health, and increased levels of physical activity (Barr-Anderson et al., 2011). This result suggests that physical activity in the workplace can increase the overall physical activity and improve quality of life.

Based on the previous points, it can be concluded that work, the type of activity, and the integration of physical activity into everyday life during work or at school are important factors in relation to nutrition and physical activity of people. In addition to that, the influence and support of family, friends and the way to spend the weekend are important.

1.7 COVID-19 and behavioral change

One of the reasons for the consumption of ultra-processed products and less physical activity over the past two years may be the impact of the SARS-CoV-2 pandemic and the deterioration in the quality of life.

According to currently available data, SARS-CoV-2 can affect every organ in the body, leading to acute organ damage and long-term complications (Leung et al., 2003). COVID-19 typically affects the respiratory system, cardiovascular system, central nervous system (CNS), and gastrointestinal (GI) tract, which can lead to reduced quality of life or even death (Baig & Sanders, 2020). The symptoms of the COVID-19 virus depend on the extent of the disease. SARS-CoV-2 altered the sub-daily activities of people who were closed due to social isolation in order to slow the progression of the disease. Working and studying from home, isolation, and changing tastes and smells could lead to a change in the rhythm of life. Restrictions that were set to contain the spread of the virus could affect every aspect of food-related practices, from meal planning and shopping to food preparation and eating. Furthermore, some complications such as diarrhea and other gastrointestinal symptoms are frequently observed in patients with COVID-19, with symptoms such as diarrhea, nausea, and abdominal pain, and non-specific gastrointestinal symptoms being less common (Cipriano et al., 2020).

Influence of Covid-19 on HPF

All of symptoms of Covid-19 could lead to a change in diet and the choice of a different diet. According to the study, 52.9% of people reported a change in their diet (Scarmozzino & Visioli, 2020). They began to eat more, and 19.5% also gained weight. Moreover, 42.7% indicated increased anxiety and, possibly, in connection with this, the consumption of desserts, chocolate, and ice cream increased by 42.5% and salty snacks by 23.5% (Scarmozzino & Visioli, 2020). In the same study, 36.8% of the participants surveyed indicated a decrease in alcohol consumption, while 10.1% of them reported an increase. Besides, 33.5% of those interviewed in the research reported that they reduced their consumption of fruits and vegetables (Scarmozzino & Visioli, 2020). The reason was the lower availability of goods, probably due to their financial situation. In addition, only 21.2% of respondents increased their consumption of fresh fruits and vegetables, and 56.2% remained indifferent to them (Scarmozzino & Visioli, 2020).

Apart from the serious health implications, the COVID-19 pandemic had an impact on a social and economic level. People began to feel uneasy about finances and communication, as well as access and availability of food. In one study (Djoumessi, 2021), 60.93% of workers were affected by wage cuts and 31.6% by temporary job suspension due to the COVID-19 pandemic. The

employees were mostly in low-level jobs. This means that households of people with lower levels of education and income are more likely to be financially burdened by the quarantine. Therefore, it is likely that economically disadvantaged families would have high-calorie and low-nutrient diets, which in turn makes them vulnerable to the COVID-19 virus. People reported that supermarkets had increased food prices and that people had to spend extra money on their usual shopping baskets as it was a difficult time for their families' finances (Spyreli et al., 2021). This has especially affected the nutrition of low-income families. Families reduced grocery shopping, which encouraged proper meal planning, but also limited them to getting enough fresh food (Spyreli et al., 2021). However, the positive side of the pandemic was more time for cooking and the closure of takeaway restaurants. This contributed to the preparation of homemade food, and a restriction on ready-made food and snacks. The subjects noted a decrease in the consumption of fast food and takeaway food due to the closure of local restaurants. Some subjects noted that being unemployed or working from home gave them more time available, which they used to prepare more labor-intensive recipes (Spyreli et al., 2021). Moreover, people noticed a lack of structure during the day, such as skipping the main meal. There was also increased consumption of more food in the form of snacks among children, such as high-sugar drinks and snacks (Spyreli et al., 2021). This means that being at home due to a lack of work or isolation can cause an increase in UPF consumption.

Influence of Covid-19 on PA

Due to mandatory isolation, many countries restricted movement, which could not but affect physical activity among the population of many countries (Giustino et al., 2020). It is also worth noting that access to changes in the daily lives of people around the world as a result of COVID-19 and sports was limited during the pandemic due to limited access to training facilities, closing of fitness centers as well as the fear of going out for sports. All of these factors may have contributed greatly to the observed decline in sports participation due to the closure of schools and the transition of children to online learning. There was not only a decrease in the consumption of vegetables, fruits and UPF, but also a decrease in physical activity and an increase in time in front of the computer (Lopez-Bueno et al., 2020; Yomoda & Kurita, 2021). This is because schools provided physical education classes for students, where children showed their activity, and also considered active trips to school, such as walking, cycling, which were limited during forced isolation. The study also showed the effects of the pandemic not only on physical but also on mental health (Yomoda & Kurita, 2021). Decreases in physical activity appeared more in children with limited space, such as an apartment, and were more common among boys. Probably it’s worth considering preventing physical inactivity in children. There is also an increase in physical

inactivity in the adult population due to Covid-19 related restrictions (Giustino et al., 2020). Another study also noted a reduction in total weekly energy expenditure during lockdown when comparing pre-lockdown physical activity, as well as a difference between sex and age (Giustino et al., 2020). As a result, physical activity decreased more in the male group than in the female group, and also in the overweight group. In the study, in regard to different age groups, the young and adults were more affected than senior adults and the elderly (Giustino et al., 2020). This could be due to the reduced physical activity of older people before the quarantine.

1.7.1 Covid-19 effects in Austria and Kazakhstan

The coronavirus (COVID-19) pandemic and lockdown measures caused behavioral changes among the population worldwide. A study found that more than half of participants changed their lifestyle, diet, and physical activity due to the pandemic (Scarmozzino & Visioli, 2020). Previous studies found changes in emotional well-being and physical activity among participants in Austria. A study found that during the stay-at-home order, participants in Tyrol, Austria engaged less in sports than before and after the restrictions (Schnitzer et al., 2020). However, it was also found an increase in sports participation in less active groups when comparing the pre-and post-COVID-19 period. A positive association between being outdoors and higher emotional well-being has been found among Austrians adults during the COVID-19 pandemic (Stieger et al., 2021). In contrast, greater loneliness and greater daily screen-time were associated with poorer well-being.

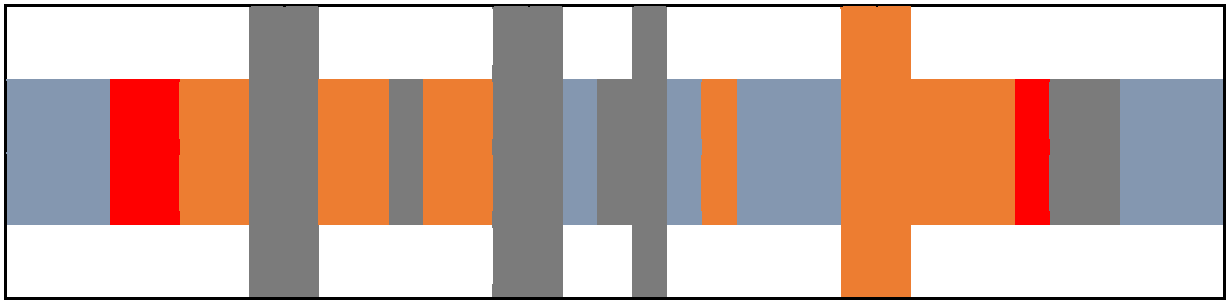
Relevant to the current thesis is the comparison of the Covid-19 related measures in the observed countries. Figures 1 and 2 show the stay-at-home measure implemented during the course of the pandemic in Austria and Kazakhstan respectively (Austria, 2022; Kazinform, 2022). The figures reveal longer periods of lockdown measures in Kazakhstan than in Austria between January 2020 and July 2022. In fact, the period that required the population not to leave home with some exceptions was longer in Kazakhstan than in Austria. Kazakhstan even presented periods that required the population not to leave home with few exceptions (Kazinform, 2022). Probably a longer stay-at-home order caused poorer emotional well-being and less engage in sports in Kazakhstan than in Austria.

Figure 1 Stay-at-home measures in Austria

Jan 2020 Jul 2022

Notes: Lockdown in Austria for the period January 2020 to July 2022.

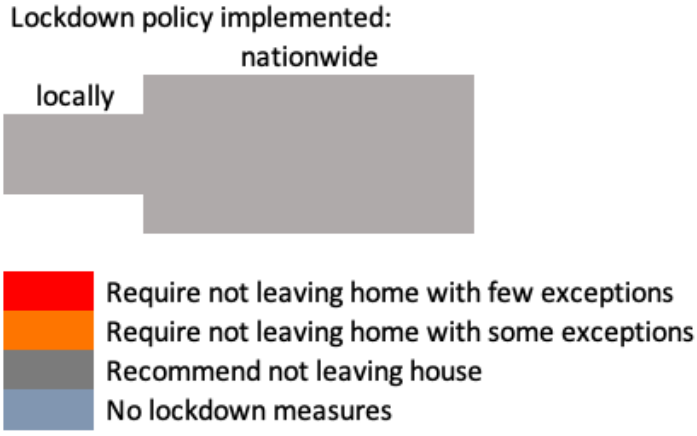
Figure 2 Stay-at-home measures in Kazakhstan



Jan 2020 Jul 2022

Notes: Lockdown in Kazakhstan for the period January 2020 to July 2022.

Figure 3 Designations for lockdowns



Notes: Description of lockdown periods.

2 Aims of the thesis

Due to the rapid increase in UPF intake and decrease in physical activity among all populations, which shows growth every year, the study was chosen to compare consumption of ultra-processed food and physical activity in countries with different incomes. The consumption of highly processed foods and physical activity level was assessed depending on gender, age, education, income, place of residence, numbers of people in the household, the influence of the SARS-CoV-2 measures, smoking and skipping meals.

Objectives of this study are:

I. To describe the consumption of ultra-processed foods and reasons for UPF consumption, type of cooking, consequences of ultra-processed food consumption, and changing meal plans before and after Covid-19 isolations, among all age groups from chosen countries with different levels of income.
II: To describe and find out physical activity, norms for all age groups, consequences of lack of physical activity, among all age groups from chosen countries with different levels of income.
III: To compare HPF consumption, health and fitness status of the population.
IV: Validate the theory of higher HPF consumption among countries with high-income. In addition, to compare HPF consumption between people with different income levels.
V: Compare physical activity among countries with different incomes. To identify the relationship between income and physical activity. Identify the level of physical activity of the respondents and association between gender and level of physical activity.
VI: To identify if there is a relationship between high HPF level and gender.
VII: To identify if there is a relationship between skipping breakfast and high HPF level.
VIII: To identify if there is a relationship between smokers and high HPF level.

3 Methodology

3.1 Study design

This empirical study is based on a cross-sectional design with influencing factors being derived from a priori literature research. This method was chosen because it allows the comparison of many different variables at the same time. Variables such as different population groups in different countries, age, sex, income, and educational level in relation to nutrition and exercise were compared at the same time.

These methods involve four fundamental steps. The first step is the literature search process to develop the necessary questions and formulate a search strategy. The second is data collection and connection of results from subjects by survey method. Finally, the third is an analysis of findings, which will include comparisons between literature review and findings in the quantitative research.

3.2 Subjects

The study was advertised through social media platforms (Facebook and Instagram). The target groups for the study were adults of both sexes who were older than 18 years. A total of 280 participants completed the questionnaire (138 people from Austria, 142 people from Kazakhstan) with 205 males (73.21% males); 69 female (24.64% females) and 6 preferred not to answer (2.14% preferred to answer). Most participants were males with an average age of 36.2 (18.8-88.6) years and BMI 24.7 (15.7 -36.0) (Table 5). Nearly all participants had 16.4 (2.0 -24.0) years of education, and had in average 3 people in their household. The subjects' descriptive analysis is shown in the results section in Table 5.

3.3 Data collection

In this study, a questionnaire was sent through social media sites such as Facebook and Instagram to participants. Participants were informed about anonymity, the time spent on the questionnaire, countries participating, age, permission to process data, and the ability to finish the survey at any time. This survey did not ask participants for any personal data. The questionnaire was created using Google Forms and consisted of a series of 51 multiple choice, rating scale, dropdown, and close-ended questions. The average time spent for the questionnaire has been 7 minutes. The answers to the questions related to a period of 12 months.

In the present study, the criteria followed to select participants was based on their nationality and age. With regards to age of participants, that they should not be younger than 18 years old. Adults

from a country with a high-income economy (Austria) and upper-middle-income economy (Kazakhstan), with regard to data front the World Bank in 2022, were selected to compare the HPF consumption and PA level in both countries (Bank, 2017). The survey was shared by collaborators from Austria and Kazakhstan with their social circles on Facebook and Instagram. That was the method of selection that tried to ensure that participants really live in the selected countries.

3.4 Data Processing

The questionnaire took place from June 2022 to July 2022 and was delivered in two languages: German and English (Appendix 1). The German version was directly translated from the original English one. Then all data was transformed using Microsoft Excel to SPSS 26 version. The questionnaire was divided into 4 blocks and cover general information, nutritional information, physical activity information, and health status. The final dataset was cleaned, and some operations were made to prepare the data for analysis. For the first block of the questionnaire general questions about the subjects were used. The questions of the second block related to food were taken from sQ-HPF instrument (Martinez-Perez et al., 2022). Questions from the third block related to physical activity and were taken from the GPAQ instrument (WHO, 2012a). The last block related to general questions about the health and anthropometric data of the respondents.

sQ-HPF instrument

To find the results of HPF levels, this study used the Integrative development of a short screening questionnaire of highly processed food consumption (sQ-HPF), which included foods from 14 food groups and gave one point if the consumption frequency matched the HPF model (Martinez-Perez et al., 2022). The methodology used to calculate the HPF score is explained in Appendix 2.

GPAQ instrument

Physical activity was assessed using the global physical activity questionnaire (GPAQ), in which respondents were asked to indicate the number of days and duration of active tasks that they performed during the last week. The GPAQ consisted of 16 questions about physical activity at work, in transport leisure time, and time spent on it. In addition, GPAQ divides physical activity used to obtain physical activity scores and divide them into 'low', 'middle' and 'high' categories. The GPAQ data were cleaned and processed using the GPAQ analysis guide and presented in Appendix 3 (WHO, 2012a). In addition, brief explanations were added under questions explaining the meaning of vigorous, moderate and low activity.

The methodology used to calculate the MET score and PA level are presented in Appendix 3.

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BMI categories

Table 4 BMI categories

Category	Adults (BMI)
Underweight	Less than 18.5 kg/m^2
Healthy weight	18.5 to 24.9 kg/m^2
Overweight	25.0 to 29.9 kg/m^2
Obesity	30.0 kg/m^2 or more

Subjects were asked to provide height and weight. BMI was calculated accordingly: weight in kg / (height in meters)^2. In the present study, BMI categories was used with category levels presented in the Table 4 (Committee, 2010). All participants were divided into BMI groups according to these data.

Covid meal plan

The current study includes questions about dietary changes associated with Covid-19 restrictions. These questions are based on the subjective opinion of the respondent and include the choice of one answer from much more healthier, more healthier, did not change, more unhealthy, much more unhealthy, I did not have Covid-19, I do not want to answer.

Salary range

According to the World Bank, Austria and Kazakhstan were divided into countries with high-income levels and upper-middle-income, respectively (Bank, 2017). Participants have to choose one of the gross salary ranges according to each country's low, medium, and high salary data. Furthermore, it was considered that students and part-time employees participate in the current research. Besides, participants were asked about the salary of all family members. In this study for Austria, the low income was divided into up to 500€ and 501 to 1000€, middle 1001 to 1600€ and 1601 to 2700€, and high 2701 to 5000€, 5001€ and more. For Kazakhstan, the low income was up to 188€ and 189 to 302€, the middle 303 to 656€ and 657€ to 1000€, and the high 1001€ and more.

3.5 Statistical Analysis

In this study, quantitative analysis was used to examine the statistics of consumption of high processed products, and the level of physical activity among selected categories of the population. In addition to that, quantitative analysis was used to conduct statistics between countries, age of participants, gender, income, profession, education, health status, and the reasons to choose a healthy or unhealthy lifestyle.

All statistical analyzes were performed using SPSS statistical software version 26. Three types of analysis were used to calculate statistical data: ANOVA, Two-Tailed Independent Samples t-Test and Chi square test. The Tukey test was used as post hoc test if there was any significance with ANOVA. Statistical significance was set at $p < 0.05$.

4 Results

4.1 Subjects characteristic

A total of 280 participants completed the questionnaire (138 people from Austria, 142 people from Kazakhstan) with 205 males (73.21% males); 69 female (24.64% females) and 6 preferred not to answer (2.14% preferred to answer). Most participants were males with an average age of 36.2 (18.8-88.6) years and BMI 24.7 (15.7 -36.0) kg/m² (Table 5). Nearly all participants had 16.4 (2.0 - 24.0) years of education, and had in average 3 people in their household. The subjects' descriptive analysis is shown in Table 5.

Table 5 Subjects' descriptive analysis

	Total (mean)	Total (min)	Total (max)	Austria (mean)	Austria (min)	Austria (max)	Kazakhstan (mean)	Kazakhstan (min)	Kazakhstan (max)	P-value
Sex (M)	205.0	74.82%		101.0	36.86%		104.0	37.96%		**0.676**
Sex (F)	69.0	25.18%		33.0	12.04%		36.0	13.14%		
Age (years)	36.2	18.8	88.6	43.6	20.2	88.6	28.9	18.8	70.5	**<.0001**
Height (cm)	173.1	148.0	199.0	175.3	152.0	197.0	170.9	148.0	199.0	**<.0001**
Weight (kg)	74.4	47.0	132.0	78.0	50.0	111.0	71.0	47.0	132.0	**<.0001**
BMI (kg/m²)	24.7	15.7	36.0	25.3	17.3	35.1	24.1	15.7	36.0	**0.019**
Education (years)	16.4	2.0	24.0	17.6	2.0	24.0	15.2	4.0	22.0	**<.0001**
Householde people (numbers)	2.9	1.0	4.0	2.8	1.0	4.0	3.2	1.0	4.0	**<.0001**

4.2 Influence of general subject characteristics

4.2.1 Impact on HPF scores

Table 6 Influence of general subject characteristics on HPF scores

	HPF								
Parameters	**Mean**	**SD**	**n**	**%**	**SS**	**df**	**F**	**ηp2**	**p-value**
Age					1.25	3	0.06	0.001	**0.981**
18- 20 years	4.42	2.61	12	4.29%					
21 - 35 years	4.24	2.68	153	54.64%					
36 - 50 years	4.2	2.48	71	25.36%					
51+	4.09	2.76	44	15.71%					

Sex					22.1	2	1.61	0.01	**0.202**
Male	4.38	2.72	205	73.21%					
Female	3.75	2.3	69	24.64%					
Don’t want to Answer	3.67	2.5	6	2.14%					
BMI					26.25	3	1.27	0.01	**0.285**
Underweight	4.88	2	16	5.71%					
Healthy weight	3.94	2.67	147	52.50%					
Overweight	4.40	2.85	84	30.00%					
Obesity	4.61	1.97	33	11.79%					
Family Members					33.61	4	1.22	0.02	**0.302**
One	3.83	3.37	23	8.21%					
Two	4.79	2.4	62	22.14%					
Three	4.30	2.85	54	19.29%					
Four	3.90	2.24	92	32.86%					
Five or More	4.14	2.91	49	17.50%					
Education Degree					27.23	4	0.99	0.01	**0.416**
Upper secondary education completed (9-13 years)	4.69	2.63	16	5.71%					
Post-secondary non-tertiary education completed	5.00	2.33	26	9.29%					
Bachelor's or equivalent completed	4.10	2.79	111	39.64%					
Master or equivalent level	4.06	2.54	125	44.64%					
I do not want to answer	5.50	2.12	2	0.71%					

Notes: Comparisons subject characteristics between HPF, Age, Gender, BMI, Family members and Education degree. The test used was ANOVA.
*SS - sums of squares
** df - degrees of freedom
***F - a value on the F distribution
**** ηp2- Partial eta squared

Although the mean HPF scores decreased with age groups, the results test did not show significant differences in HPF scores with respect to age categories, $F(3, 276) = 0.06$, $p = 0.981$.

Furthermore, HPF scores did not differ between males and females, $F(2, 277) = 1.61$, $p = 0.202$, indicating the differences in HPF score among the levels of Gender were all similar (Table 6).

Similarly, HPF scores did not differ between BMI category groups, $F(3, 276) = 1.27$, $p = 0.285$, indicating that the consumption of HPF is not related to BMI level.

Finally, the number of family members ($F(4, 275) = 1.22$, $p = 0.302$) and education level ($F(4, 275) = 0.99$, $p = 0.416$), did not impact HPF score.

4.4.2 Impact on PA levels

Table 7 Comparison between physical activity levels by general subject`s characteristics.

	Physical activity levels			
Parameters	Low level	Moderate level	High level	**p**
Age				**0.640**
18-20 years	5 (7.0%)	5 (4.4%)	2 (2.1%)	
21-35 years	39 (54.9%)	65 (57.5%)	49 (51%)	
36-50 years	16 (22.5%)	28 (24.8%)	27 (28.1%)	
51+	11 (15.5%)	15 (13.3%)	18 (18.8%)	
Gender (%)				**0.083**
Don’t want to Answer	0 (0.0%)	2 (1.8%)	4 (4.2%)	
Male	52 (73.2%)	77 (68.1%)	76 (79.2%)	
Female	19 (26.8%)	34 (30.1%)	16 (16.7%)	
BMI (%)				**0.668**
Underweight	6 (8.5%)	4 (3.5%)	6 (6.4%)	
Healthy weight	39 (54.9%)	63 (55.8%)	45 (46.9%)	
Overweight	18 (25.4%)	34 (30.1%)	32 (33.3%)	
Obesity	8 (11.3%)	12 (10.6%)	13 (13.5%)	
Education degree (%)				**0.565**
Upper secondary education completed (9-13 years)	8 (11.3%)	4 (3.5%)	4 (4.2%)	
Post-secondary non-tertiary education completed	7 (9.9%)	10 (8.8%)	9(9.4%)	
Bachelor's or equivalent completed	26 (36.6%)	44 (38.9%)	41 (42.7%)	
Master or equivalent level	30 (42.3%)	54 (47.8%)	41 (42.7%)	
I do not want to answer	0 (0%)	1 (0.9%)	1 (1%)	

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Health status				**0.702**
Excellent	5 (7.0%)	9 (8.0%)	7 (7.3%)	
Very Good	18 (25.4%)	24 (21.2%)	30 (31.3%)	
Good	22 (31%)	39 (34.5%)	35 (36.5%)	
Satisfactorily	22 (31%)	32 (28.3%)	21 (21.9%)	
Poor	4 (5.6%)	7 (6.2%)	2 (2.1%)	
Do not want to answer	0 (0.0%)	2 (1.8%)	1 (1%)	
Notes: Comparison subject characteristics such as age, gender, BMI, education level, countries, health status by physical activity levels. These tests have done by chi square test.				

A Chi-square Test of Independence was conducted to examine whether there was an association between age groups and physical activity levels. The results of the Chi-square test were not significant, $\chi^2(6) = 4.27$, $p = 0.640$, suggesting that Age and Physical activity levels could be independent of one another.

The results of Gender and Physical activity were not significant, $\chi^2(4) = 8.26$, $p = 0.083$, suggesting that Gender and Physical activity levels could be independent of one another.

The results of BMI and physical activity levels were not significant, $\chi^2(6) = 4.06$, $p = 0.668$, suggesting that BMI levels and Physical activity levels could be independent of one another.

The results of Education degree levels and physical activity levels were not significant, $\chi^2(8) = 6.74$, $p = 0.565$, suggesting that degree education and Physical activity levels could be independent of one another. This implies that the observed frequencies were not significantly different than the expected frequencies.

The results of Health status and Physical activity levels were not significant, $\chi^2(10) = 7.24$, $p = 0.702$, suggesting that Health status and Physical activity levels could be independent of one another.

4.3 Countries comparison

4.3.1 Countries comparison by HPF

Table 8 Comparison between countries by HPF

Parameters	Mean	SD	n	%	t	d	p-value
Country					2.81	0.34	0.005
Austria	4.65	2.62	138	49.29%			
Kazakhstan	3.78	2.57	142	50.71%			
Notes: Comparison between Austria to HPF and Kazakhstan to HPF.							

A two-tailed independent samples *t*-test was conducted to examine whether the mean of HPF score was significantly different between Austrian and Kazakhstan participants. The result of the two-tailed independent samples *t*-test was significant, $t(278) = 2.81$, $p = 0.005$, indicating the null hypothesis can be rejected. This finding suggests the mean of HPF score was significantly higher in Austria as compared to Kazakhstan. The results are presented in Table 8.

4.3.2 Countries comparison by PA

Table 9 Comparison between countries and PA level

	Physical activity levels			
Paraments	**Low level**	**Moderate level**	**High level**	**p-value**
Country (%)				**0.047**
Austria	30 (42.3%)	51 (45.1%)	57 (59.4%)	
Kazakhstan	41 (57.7%)	62 (54.9%)	39 (40.6%	
Notes: Comparison between Austria and Kazakhstan by low, moderate and high physical activity level.				

A Chi-square Test of Independence was conducted to examine whether Country and Physical activity levels were independent. The results of the Chi-square test were significant, $\chi^2(2) = 6.09$, $p = 0.047$, suggesting that Country and Physical activity levels are related to one another.

4.4 Income comparison

4.4.1 Income levels and HPF

Table 10 Comparison between income by HPF

Parameters	Mean	SD	n	%	SS	df	F	ηp2	p-value
Income					48.65	3	2.38	0.03	0.07
Do not want to say	3.3	2.6	47	16.79%					
Low Income	4.26	2.9	50	17.86%					
Middle Income	4.37	2.5	63	22.50%					
High Income	4.47	2.54	120	42.86%					
Notes: Comparison between income with low, middle and high salary range by HPF. Low income is up 1000€, middle income from 1001€ till 2700€, high income is more than 2701€.									

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in HPF score by income level (independent of country). The ANOVA was examined based on an alpha value of .05. The results of the ANOVA were not significant, $F(3, 276) = 2.38$, $p = .070$, indicating the differences in HPF score among the levels of Income were all similar (Table 10).

4.4.2 Income levels and fruits and vegetables consumption

Table 11 Comparison between Income levels, fruits and vegetables consumption.

	Income				
Parameters	Low income	Middle income	High income	Do not want to say	**p**
Serving fruit					**0.578**
1 Serving	22 (20.18%)	19 (17.43%)	52 (47.71%)	16 (14.68%)	
2 Servings	16 (15.69%)	29 (28.43%)	41 (40.20%)	16 (15.69%)	
3 Servings	7 (17.95%)	10 (25.64%)	18 (46.15%)	4 (10.26%)	
4 Servings	1 (7.69%)	3 (23.08%)	5 (38.46%)	4 (30.77%)	
5 Servings or more	1 (16.67%)	0 (0.00%)	3 (50.00%)	2 (33.33%)	
Serving_Vegetables					**0.534**
1 Serving	8 (11.94%)	19 (28.36%)	30 (44.78%)	10 (14.93%)	
2 Servings	26 (22.81%)	23 (20.18%)	48 (42.11%)	17 (14.91%)	

3 Servings	13 (19.70%)	13 (19.70%)	26 (39.39%)	14 (21.21%)
4 Servings	1 (8.33%)	3 (25.00%)	6 (50.00%)	2 (16.67%)
5 Servings or more	0 (0.00%)	3 (37.50%)	5 (62.50%)	0 (0.00%)
Notes: Comparison between low, middle and high income by serving fruits and vegetables. Range from 1 serving till 5 serving and more.				

A Chi-square Test of Independence was conducted to examine whether Income and serving fruit were independent. The results of the Chi-square test were not significant, $\chi^2(12) = 10.43$, $p = 0.578$, suggesting that income and serving fruit could be independent of one another. This implies that the observed frequencies were not significantly different than the expected frequencies. Table 11 presents the results of the Chi-square test.

A Chi-square Test of Independence was also conducted to examine whether Income and serving vegetables were independent. The results of the Chi-square test were not significant, $\chi^2(12) = 10.94$, $p = 0.534$, suggesting that Income and serving vegetables could be independent of one another.

4.4.3 Income levels and PA

Table 12 Comparison between income and PA levels

	Physical activity levels			
Parameters	**Low level**	**Moderate level**	**High level**	**p-value**
Income				0.473
Do not want to say	11 (15.49%)	22 (19.47%)	14 (14.58%)	
Low Income	12 (16.90%)	22 (19.47%)	16 (16.67%)	
Middle Income	22 (30.99%)	20 (17.70%)	21 (21.88%)	
High Income	26 (36.62%)	49 (43.36%)	45 (46.88%)	
Notes: *Comparison between low, middle, high income by low, moderate and high physical activity levels. Low income is up 1000€, middle income from 1001€ till 2700€, high income is more than 2701€.*				

A Chi-square Test of Independence was conducted to examine whether income and Physical activity_levels were independent. The results of the Chi-square test were not significant, $\chi^2(6) = 5.57$, $p = 0.473$, suggesting that Income and Physical activity levels could be independent of one another. Table 12 presents the results of the Chi-square test.

4.5 Influence external factors on HPF

Table 13 External factors and HPF consumption

HPF									
Parameters	**Mean**	**SD**	**n**	**%**	**SS**	**df**	**F**	**ηp2**	**p-value**
Skipping Meal					66.99	3	3.31	0.03	0.02
Often	4.97	2.7	66	23.57%					
Sometimes	4.04	2.73	97	34.64%					
Seldom	4.23	2.38	71	25.36%					
Never	3.46	2.47	46	16.43%					
Skipping Frequently					95.64	2	7.25	0.06	0.001
Breakfast	4.90	2.61	133	56.84%					
Lunch	3.48	2.51	63	26.92%					
Dinner	3.92	2.52	38	16.24%					
Physical Activity level					6.51	2	0.47	0.0006	0.626
low	4.19	2.76	75	26.79%					
moderate	4.36	2.61	124	44.29%					
high	4.00	2.54	81	28.93%					
Covid meal Plan					163.56	6	4.22	0.08	<.001
Much more healthier	4.17	2.38	30	10.71%					
More healthier	4.84	2.77	73	26.07%					
Did not change	3.83	2.39	114	40.71%					
More unhealthy	5.22	2.71	23	8.21%					
Much more unhealthy	6.60	2.88	5	1.79%					
I did not have Covid-19	3.59	2.57	29	10.36%					
I do not want to answer	1.17	2.04	6	2.14%					
Health Status					27.91	5	0.81	0.01	0.546
Excellent	3.86	2.63	21	7.50%					
Very Good	3.86	2.2	72	25.71%					
Good	4.38	2.87	96	34.29%					
Satisfactorily	4.40	2.84	75	26.79%					
Poor	4.77	1.74	13	4.64%					

Do not know/ do not want to answer	2.67	0.58	3	1.07%

Notes: Comparisons between HPF by skipping meal, skipping meal frequently, physical activity level, Covid meal plan, and health status.

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in HPF score when skipping meals. The results of the ANOVA were significant, $F(3, 276) = 3.31$, $p = 0.020$, indicating there were significant differences in HPF score among the levels of Skipping meal (Table 13). The eta squared was 0.03 indicating Skipping meal explains approximately 3% of the variance in HPF score. The means and standard deviations are presented in Table 13. The Tukey HSD p-value adjustment was used to correct the effect of multiple comparisons on the family-wise error rate. For the main effect of Skipping meal, the mean of HPF score for Often ($M = 4.97$, $SD = 2.70$) was significantly larger than for Never ($M = 3.46$, $SD = 2.47$), $p = .014$. No other significant effects were found.

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in HPF score by skipping meal frequently. The ANOVA was examined based on an alpha value of 0.05. The results of the ANOVA were significant, $F(2, 231) = 7.25$, $p < .001$, indicating there were significant differences in HPF score among the levels of skipping meal frequently (Table 13). The eta squared was 0.06 indicating skipping meal frequently explains approximately 6% of the variance in HPF score. The Tukey HSD p-value adjustment was used to correct the effect of multiple comparisons on the family-wise error rate. For the main effect of skipping meal frequently, the mean of HPF score for Breakfast ($M = 4.90$, $SD = 2.61$) was significantly larger than for Lunch ($M = 3.48$, $SD = 2.51$), $p = .001$. No other significant effects were found.

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in HPF score by physical activity levels. The results of the ANOVA were not significant, $F(2, 277) = 0.47$, $p = 0.626$, indicating the differences in HPF score among the levels of physical activity levels were all similar (Table 13).

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in HPF score by Covid meal plan. The results of the ANOVA were significant, $F(6,$

273) = 4.22, $p < .001$, indicating there were significant differences in HPF score among the levels of Covid meal plan (Table 13). The eta squared was 0.08 indicating Covid meal plan explains approximately 8% of the variance in HPF score. For the main effect of Covid meal plan, the mean of HPF score for More healthier (M = 4.84, SD = 2.77) was significantly larger than for I do not want to answer (M = 1.17, SD = 2.04), p = 0.014. For the main effect of Covid meal plan, the mean of HPF score for More unhealthy (M = 5.22, SD = 2.71) was significantly larger than for I do not want to answer (M = 1.17, SD = 2.04), p = .010. For the main effect of Covid meal plan, the mean of HPF score for Much more unhealthy (M = 6.60, SD = 2.88) was significantly larger than for I do not want to answer (M = 1.17, SD = 2.04), p = .009. No other significant effects were found.

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in HPF score by Health status. The ANOVA was examined based on an alpha value of .05. The results of the ANOVA were not significant, $F(5, 274) = 0.81$, p = 0.546, indicating the differences in HPF score among the levels of Health status were all similar (Table 13).

Table 14 Comparison between HPF and smoking

Parameters	Mean	SD	n	%	t	d	p-value
Smoking					2.25	0.37	0.025
Yes	5.00	2.45	47	16.85%			
No	4.06	2.64	232	83.15%			
Notes: Comparison between HPF by smoking							

A two-tailed independent samples *t*-test was conducted to examine whether the mean of HPF score was significantly different between smokers and non-smokers. The result of the two-tailed independent samples *t*-test was significant, $t(277) = 2.25$, p = 0.025, indicating the null hypothesis can be rejected. This finding suggests the mean of HPF score was significantly higher in smokers. The results are presented in Table 14.

5 Discussion

Influence of socioeconomic status on high processed food consumption

An important point in this study was to compare HPF consumption and PA among **countries** with different incomes. In the current study, it was found a higher HPF consumption in Austria (*M=4.65*) than in Kazakhstan (*M=3.78*). This agrees with the result of previous studies that found that countries with high GDP per capita are more likely to consume highly processed foods, due to lack of cooking time and ease of preparation. In a study carried out in Canada about the consumption of ultra-processed foods and likely impact on human health, it was found that from an average per capita energy availability of 2129 kcal/day, over 61.7 % of dietary energy came from ultra-processed products, 25.6 % from unprocessed or minimally processed foods and 12.7 % from processed culinary ingredients (Moubarac et al., 2013). Similarly, to the study in Canada, another study carried out in Australia found that from an average daily consumption of 1,866 kcal, ultra-processed food had the highest dietary contribution (42.0% of energy intake), followed by unprocessed or minimally processed foods (35.4%), processed foods (15.8%), and processed culinary ingredients (6.8%) (Machado et al., 2019). The GDP per capita of Canada ($57,410) and Australia ($67,460) are close to Austria ($53.370) and, as found in this study, they also share similar patterns in high ultra-processed food consumption (Machado et al., 2019). On the other hand, the results of this study are consistent with previous studies where it was found that countries with low GDP per capita consume less processed foods. A study about ultra-processed food consumption in Mexico found that from an average daily consumption of 1,923 kcal, unprocessed or minimally processed foods had the highest dietary energy contribution (54.0 % of energy), followed by UPF (29.8 %), processed culinary ingredients (10.2 %), and processed foods (6.0 %) (Marrón-Ponce et al., 2018). The study shows that unprocessed or minimally processed foods such as unpackaged corn tortillas (19% of energy), read meat (4.9%) and milk (4.9%) are highly consumed in Mexico. Studies in other countries with low GDP per capita show also less consumption of processed foods. A study in Brazil shows that from an average daily energy consumption per capita of 1,866 kcal, 69.5% was provided by natural or minimally processed foods, 21.5% by ultra-processed food, and 9.0% by processed foods (Louzada et al., 2015). A study in Chile shows that from an average per capita daily energy intake of 1819 kcal, 33.8 % was provided by unprocessed or minimally processed foods, 28.6% by ultra-processed foods, 26.6 % by processed foods, and 11.0 % by processed culinary ingredients (Cediel et al., 2018). This and other studies shown that countries with low GDP per capita such as Kazakhstan ($10,000), Mexico ($10,700), Brazil ($8,570), and Chile ($15,940) have low consumption of ultra-processed food.

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Similar to this study, previous research compared ultra-processed food consumption among different countries. One study found that adults in European countries with low GDP per capita such as Romania ($14,830) and Croatia ($17,300) had a low percentage of UPF consumption among 22 European countries (Mertens et al., 2022). Romania obtained 4.9% UPF consumption in 2012, while Croatia obtained 3.3% UPF consumption in 2011. The GDP of both countries are as low as Kazakhstan, which shows that countries with low GDP per capita tend to consume less ultra-processed food. In contrast, the study found that adults in European countries with high GDP per capita such as Sweden ($57,980) the United Kingdom ($49.760), and Germany ($51.100) had the highest percentage of UPF consumption. The GDP of these countries are as high as Austria ($53.370), which shows that countries with high GDP per capita tend to consume more ultra-processed food.

Another important factor to considered is the household availability of UPF among countries. A study found a significant positive association between household availability of ultra-processed foods and prevalence of obesity among adults (Carlos Augusto Monteiro, Jean-Claude Moubarac, et al., 2018). This proves that if there are more ultra-processed foods available at home, people would consume more and develop obesity. In the study, the average household availability of ultra-processed foods ranged from 10.2 % in Portugal, 13.7% in Greece, and 17.9% in Croatia to 46.2 % in Germany and 50.4 % in the UK (Carlos Augusto Monteiro, Jean-Claude Moubarac, et al., 2018). This proves one more time that countries with low GDP per capita such as Portugal, Greece, and Croatia have less ultra-processed food consumption than countries with high GDP per capita such as Germany and the United Kingdom.

Another important point was **income** between countries and HPF consumption. In the present study, participants from Austria and Kazakhstan were asked about their monthly income with the purpose to find the relationship between countries with different income levels and HPF consumption. Although in the analysis there were no significant differences of HPF score by income levels, it was observed an increase of HPF consumption as the income level increased. Studies carried out in different countries found the same pattern in HPF consumption and income level.

A study about the socioeconomic characteristics and trends in the consumption of ultra-processed foods in Korea found that the dietary energy contribution of ultra-processed foods was high in urban residents, and increased with income level between 2010 and 2018 (Shim et al., 2021). Subjects were classified into three groups: low, middle and high household income. The dietary contribution of ultra-processed foods to total energy intake for low household income ranged from

20.3% in 2010-2012, 20.7% in 2013-2015 to 22% in 2016-2018. These numbers were higher for high household income, ranging from 23.9% in 2010-2012, 26.0% in 2013-2015 to 27.2% in 2016-2018. The study not only revealed that the energy contribution of ultra-processed food increased with the income level but also increased throughout the years in low, middle- and high-income level. Another study carried out in the metropolitan areas of Brazil found that the contribution of ultra-processed foods in households belonging to the upper income quintile was higher than in the lower income quintile between 1987 and 2002 (Monteiro et al., 2010). The contribution of ultra-processed food for the lower income quintile and upper income quintile was 15.5% and 24% in 1987, 18.4% and 27.2% in 1995 and 21.6% and 34.6% in 2002. Another factor to take into account is the socio-economic status. This isn't the same as income level, but usually the income has an influence in the socio-economic status of a person. People with high socio-economic status tend to have a high income, while people with low socio-economic status tend to have a low income (Gomez et al., 2021). In other studies, it was observed an increase of HPF consumption with the socio-economic status. A study carried out in Mexico found that the energy contribution from UPF was 4.5 % higher in both medium and high socio-economic status (SES) compared with low SES (Marrón-Ponce et al., 2018). Also, the study found that the energy contribution from UPF was 5.6 % higher in urban compared with rural areas, which shows that urbanization is also a relevant factor in UPF consumption. The impact of income on eating patterns is still underestimated. Some forms of food processing are beneficial, but over-processed foods are becoming increasingly dominant in high-income countries and now in middle-income countries. This type of food is shopper-friendly, tasty and cheap, which makes busy people to buy this ready to eat food and consume more UPF (C. A. Monteiro et al., 2013).

Although this and other studies found that the HPF increases with the income level, the dietary contribution of UPF for low and high household income was not too far in countries like Korea and Brazil where the biggest gap between these two income levels was 5.3% in 2013-2015 and 13% in 2002 respectively (Monteiro et al., 2010; Shim et al., 2021). People with low financial incomes are still likely to choose HPF as it reduces the risk of financial loss if food is thrown away (Daniel, 2016). Some research has shown that low-income people avoid waste when buying food (DeVault, 1994). Moreover, low-income families see food waste as a problem that can be solved by providing children with the foods they prefer, even if it is HPF (Reed, 1996). This means that low-income people have more difficulty feeding their families, especially the economic risk to them than to their high-income peers. Therefore, based on these nutritional data, recommendations can be made that minimize waste, as well as the purchase of products with a long shelf life and minimal time consumption, such as frozen vegetables and fish.

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A relationship has also been found between those who eat more high-processed foods and tend to have less free time for cooking, probably due to longer working hours compared to those who do not eat high-processed foods (C. A. Monteiro et al., 2013). The same results were found in this study, where 197 respondents out of 280 answered that the reason for their consumption of highly-processed products is related to the lack of time for cooking. People's lack of time to cook may be related to the high purchase of frozen foods, as they take less time to cook. In addition, it was shown in the study that the growth in sales of frozen products is higher from 5% to 10% and even more are observed in several countries with lower and upper middle-income levels, but not in high-income countries (C. A. Monteiro et al., 2013). In addition, 121 people said they buy UPF because they like the taste, and 54 buy because it's cheap. Further research is needed to establish which specific recommendations for minimally processed foods and cooking ways will appeal to people across income levels. And also, it would be good to identify how people with different incomes spend their time in activities such as hours of work, travel time, household, child care and hobbies to calculate the ideal time they should spend on cooking.

Influence of socioeconomic status on physical activity levels

In the present study, it was found a statistical significance between physical activity and **countries** (*p=0.047*). Most respondents reported a high physical activity level in Austria (59.4%), while the number of participants in this range was the lowest in Kazakhstan. The opposite results were found in the low physical activity level, where it was found more participants in Kazakhstan (57.7%) than in Austria (42.3%).

A study on the worldwide variability in physical inactivity in 51 countries found more countries with low GDP per capita in the top 10 countries with high physical inactivity in both men and women (Guthold et al., 2008). A good number of countries with low GDP per capita such as Mauritania (52.6% in women and 72% in men), South Africa (47.6% in women and 44.7% in men), Dominican Republic (44.2% in women and 38.3% in men), Turkey (43.5% in women and 29% in men) and Brazil (30.4% in women and 26.1% in men) were in the top 10, while only two countries with high GDP per capita (United Arab Emirates and Spain) had high physical inactivity for both women and men (Guthold et al., 2008). Other factors such as social environment could explain why countries with high GDP per capita are more likely to have a more PA than countries with low GDP. A study found that positive perceptions of the social environment such as social support and social capital were associated with higher levels of physical activity (Poortinga, 2006). Other factors such as the perceived access to leisure facilities, the perceived access to a post office, and the perceptions of the friendliness of the local environment were associated with sports

activities, walking, and self-rated health. Things like leisure facilities, post offices, friendliness of the local environment, and social support tend to be present more often in developed countries than in developing countries. Therefore, people living in countries with developed economies like Austria are more likely to have a higher level of physical activity. However, a similar analogy cannot be made for developing countries like Kazakhstan. Previous studies have found that the physical activity differed widely among low-income and middle-income countries. A study found a wide difference in the prevalence of physical activity during leisure, transport, and occupation in countries in South America such as Argentina, Peru, Chile, Ecuador, and Brazil (Werneck et al., 2019). Also, the PA tended to vary across sex and educational status in South American countries. Another study found that physical activity participation among adolescents between 12 to 15 years living in low and middle countries is a complex and multi-dimensional behavior determined by sociocultural, socio-economic, and policy-related factors (Vancampfort et al., 2019).

Perhaps exploring not only the economic situation of a country, but also specific characteristics in the population like their income might shed some light on physical activity in different countries. Although in the current study, there was not found a significance between income and PA, other studies have shown that high income is associated with high physical activity (Hamrik et al., 2014). A study on physical activity and sedentary behavior in Czech adults found a high number of participants reporting a high level of PA (Hamrik et al., 2014). Among participants, 32.3% reported a low level of PA; 21.3% reported a moderate level of PA and 46.4% reported a high level of PA. It is worth noting that self-reported physical activity could differ from reality. A study carried out in Finland found that higher income was associated with higher self-reported physical activity for both males and females (Kari et al., 2015). However, these self-reported results differed from the pedometer-based results in gender and the measurement type of physical activity (weekday vs. weekend day). Among women, income was positively associated with aerobic steps despite the measurement day. In contrast, among men, income was negatively associated with aerobic steps measured on weekdays. Another study carried out in the USA that combined self-reported data and information from physical examinations found that adults with an annual income of ≥$75,000 engaged in 4.6 more daily minutes of moderate to vigorous activity in comparison to those with <$20,000 annual income (Shuval et al., 2017). However, those with high income spent 11.8 more minutes daily being sedentary than their lower-income counterparts. In the future, it would be worth comparing the self-reported results obtained from the surveys used in this study with instruments like pedometers to see how these results differ from the results reported by people from Austria and Kazakhstan.

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Influence of socioeconomic status on fruits and vegetables consumption

In this study, it was followed a meal plan according to the American Heart Association (Association, 2017). According to these data, at low energy requirement 2,000 calorie per day a person is recommended to eat 4-5 servings of vegetables and fruits per day (Association, 2017). As the level of physical activity increases, the estimated need for food will also increase. In the current study, the results did not find significantly different between income and fruits (p=0.578) and income and vegetables (p=0.534).

When analyzing Income and fruits, fruit consumption rose from low income to high income. This applied to all servings. Also, among participants who answered "5 Servings or more", which is the recommended norm, 50.0% were people with high Income, 33.3% chose not to answer and 16.67% people with low income. The same results were found in another large study where low-income Americans consumed 1.43 cups per day, middle-income respondents consumed 1.54 cups per day, and finally, high-income respondents consumed 1.72 cups per day (Dong & Lin, 2009). The results of current and other studies may confirm that as income increases, so does the amount of fruit consume.

Influence of general participants' characteristics on HPF consumption

With regard to **age**, several studies have shown that UPF intake was higher in younger people and lower as they get older (Adams & White, 2015; Costa et al., 2021). Another study conducted in Germany confirms that respondents aged 17-39 consumed more HPF including fatty foods and foods rich in sugar than older respondents (Finger et al., 2013).

In that study, UPF consumption was highest in the 18-24 age group and decreased as they got older. Although in the current study the results were not significant between age and HPF level, the results showed that the highest level of HPF consumption was in people from the category under 20 years old (M=4.42) and it decreased with age. These results may suggest that people consume less HPF as they get older.

In the current study, the **male** sample made up the largest part, with 205 males and 69 females taking part, and also 6 preferred not to answer about their gender. The number of males (73,21%) in all levels of HPF was more than females (24,64%). The p-value obtained was 0.202, which means that no statistical difference was found. However, HPF results were higher in men (M-4.38) than in women (M=3.75), which is supported by other studies (Costa et al., 2021; Moubarac et al., 2017). Also, it was shown that consumption of five or more subgroups of ultra-processed foods was lower in women (Costa et al., 2021). Another study also found that men consume more HPF

including fatty foods and foods rich in sugar than female (Finger et al., 2013). This may confirm the fact that men consume more HPF.

Previous studies suggested a significant difference between **BMI** and HPF levels. This is due to the high content of sugars, oils, fats, or salt in these foods, which can lead to high levels of the energy density of ultra-processed foods, around 400–500 kcal per 100 g (C. A. Monteiro et al., 2018) (Monteiro et al., 2012). However, in the present study, no significant difference between the HPF level and body weight (BMI) was found. According to the results, people with underweight had the highest intake of HPF (M=4.88). Another study with a larger sample size than this study (n=2174 adults) also found no association between BMI and consumption of ultra-processed foods (Adams & White, 2015). The study used Monteiro's three-tier classification of processing, which groups processed and ultra-processed foods into one category (Adams & White, 2015). In addition, the study included keeping a diary, and also considered food waste, food eaten outside home, and also considered the difference in the nutrition of people from the same household, which reduces the possibility of bias (Adams & White, 2015).

Furthermore, another factor that was pointed out in the literature review was **education**. Different studies found an association between the level of education with the consumption of HPF. A study showed that higher education is associated with lower consumption of HPF. Participants showed lower HPF consumption at higher levels of education (12 or more years of education) (Costa et al., 2021). In the present study, no statistically significant difference was found, however, the results also showed a lower level of HPF in respondents with a master or equivalent level (M = 4.06). As education decreased, the level of HPF increased.

Another study was conducted in Germany, which has the same GDP level as Austria and included 7,124 participants aged 18 to 79 years (Finger et al., 2013). That study has shown that HPF rich in sugar and fat were consumed by respondents with primary education, while people with higher education consumed more fruits and vegetables. (Finger et al., 2013). In the same study, respondents with lower economic status and education were found to be more physically active and expend more energy than those with higher socioeconomic status. It is likely that high HPF consumption may be related to the type of activity, since people with low socioeconomic status are more likely to work in jobs with high energy costs (Finger et al., 2013).

The results of the present study may suggest that higher education has a positive effect on lower HPF intake.

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With regards to **households**, in the present study, there wasn't found any significance between the number of household members and HPF consumption. However, other studies suggest a positive association between national household availability of ultra-processed foods and national prevalence of obesity among adults (Carlos Augusto Monteiro, Jean-Claude Moubarac, et al., 2018). In the study, nineteen European countries were evaluated and it was found that countries with the highest household availability of ultra-processed food such as Finland (40.9%), Germany (46.2%), Ireland (45.9%), and the UK (50.7%) had also the highest prevalence of obesity among adults in nineteen European countries (Carlos Augusto Monteiro, Jean-Claude Moubarac, et al., 2018). The high household availability of ultra-processed foods could be related to a high number of household members. Further research is needed to find the relation between the number of household members and obesity among adults. The high household availability of ultra-processed foods could also be related to other factors. A study found that parents often buy products in accordance with the perceived preferences of children or other family members. Also, the study found that people prefer products with a high shelf life and little time to cook because they had a busy schedule, took into account the taste preferences of other family members, and lacked cooking skills (Moran et al., 2019).

Influence of general characteristics on physical activity

With regards to **age**, in this study, no significant difference was found between physical activity level and age. However, the results show the highest level of PA among people aging 21-35 years, and the physical activity decreased with advancing age. A study that analyzed the levels of physical activity and inactivity in children and adults in the United States found similar results (Pratt et al., 1999). It was observed a decrease in vigorous physical activity from 72.7% to 57.5% among students between 9th (age 14-15) and 12th grade (age 17-18). Moreover, it was observed a continued decline in participation with age during the college years where vigorous physical activity falls from 41.8% in students aged 18–24 to 30.2% in students aged 25 and older (Pratt et al., 1999). Although in the results of this study, very few participants aged 20 or less showed a moderate or high level of physical activity, the number of responses in this age group is low, so the sample may not reflect the overall physical activity at that age.

In addition, the sample of **men** was slightly larger than the sample of women. There was also no significant difference between physical activity and gender was found. However, the result p value ($p=0.083$) is close to a statistically significant difference, which may indicate that men are more active than women. These results are consistent with previous studies that have found similar results (Dumith et al., 2011; Guthold et al., 2008; Sjöström et al., 2006) (Guthold et al., 2018). One study found that 17.7% (15.2% of men and 19.8% of women) of a pooled sample of 212,021

people from 51 countries, mostly low- and middle-income countries, were physically inactive. The rate of inactivity among women was higher in all countries, with the exception of countries such as Croatia, the Czech Republic, Hungary, Kazakhstan, the Russian Federation, Slovakia and Ukraine (Guthold et al., 2008). Another study also found that men were 1.6 times more active than women, according to total weekly activity, and were less likely to be sedentary (Sjöström et al., 2006). However, men spent slightly more time sitting (at least 6 hours a day) than women, and no gender differences in normal walking was found (Sjöström et al., 2006). However, these results could be improved in future studies with a larger sample of participants, dividing activity time at work, travel and rest time, and using an accelerometer.

According to **BMI**, in current study no significant difference was found between BMI and physical activity ($p = 0.668$). Also, the results showed that the highest level of physical activity was in people with a healthy weight (46.9%). Healthy weight individuals also had the highest rates in moderate and low activity, 55.8% and 54.9% respectively. In addition, in the sample of people 'Overweight' and 'Obesity', the highest percentage also came to a high physical activity score of 33.3% and 13.5%, respectively. These results show that there is no difference between the BMI and the level of PA. Another study showed similar results, where among a sample of 1236 people where overweight was observed in 43.3% of individuals involved in physical activity, compared with 44.7% of individuals not engaged in physical activity (Kesavachandran et al., 2009). Also, the results of that study showed that a high percentage of body fat was observed in 48.7% of people not engaged in physical activity, compared with 45.8% of people engaged in physical activity (Kesavachandran et al., 2009). Another study also confirms the results of the current study, where respondents with overweight/obesity have the largest percentage among ‘vigorous physical activity time’ and ‘moderate physical activity time’, 43.2% and 56.0% respectively (Nguyen et al., 2020). The results of this and other studies show that BMI depends not only on one physical activity, but also probably on other factors.

Similarly, to HPF consumption, this study also analyzed between **educational** attainment and physical activity. The results of this study showed no significant difference (p=0.565). However, participants with ‘Bachelor's or equivalent completed’ and "Master or equivalent levels" achieved the highest results in physical activity (42.7%). The lowest figure in ‘High level’ fell on ‘Upper secondary education completed’ (4.2%). It is more likely that people with higher education will be more physically active than people with lower education. This data is supported by other studies where higher levels of education were associated with a less sedentary lifestyle (Droomers et al., 2001; Sjöström et al., 2006). People with a low level of education are at higher risk of reduced

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levels of physical activity compared to people with a higher level of education (Droomers et al., 2001). Finally, another study found that Hungarian participants over the age of 50 were more likely to perform PA if they had a university degree (Retsagi et al., 2020). All things considered, the presence of higher education could have a positive effect on physical activity.

Finally, this study also compared **health** status based on subjective responses of participants and physical activity. The results showed no significant significance ($p = 0.702$). Most of the participants chose the state of health 'good' (n=96; 34.29%) out of 5 possible answers, which is the average value. Some participants (36.5%) rated their condition as 'good', had a high level of PA and it is close in number to the moderate level of PA (34.5%). Respondents with low physical activity were respondents with a health status of 'good' and "satisfactorily" (31%). Only 2.1% of the respondents with a high level of physical activity were among the 'poor' state. These results may indicate that people with high and moderate physical activity status will range from ‘very good' till 'satisfactorily' health condition. Although, positive significant association was found between recreational activity and all domains of QoL (physical health, psychological and social relationships) (Retsagi et al., 2020). Also, active transport (time spent with walking or cycling) correlated only with psychological domain and sedentary behavior, and had a negative relationship with psychological health (Retsagi et al., 2020).

Influence of external factors on HPF consumption

In the present study, it was found that the more often participants **skip meals**, the higher their HPF consumption. Skipping meals create inconsistency in the time when one should eat, which could lead to eating disorders. A study conducted on a total of 331volunteer university students with a mean age of 22.08 found a significant correlation between dieting and skipping meals and the risk of eating disorders in both male and female (Kabakuş Aykut & Bilici, 2022). When the participants were asked about the reason to skip a meal most of them answered it was due to shortage of time. However, among all the reasons to skip a meal only a significant relationship was found between skipping meals in order not to gain weight and the risk of eating disorders (Kabakuş Aykut & Bilici, 2022). People see skipping meals as a technique for weight control; however, they end up developing eating disorders. A study about ultra-processed food intake and eating disorders found a positive association between UPF intake and eating disorders such as bulimic, binge eating, and other eating disorders (Figueiredo et al., 2022).

Friends and family can also be another factor for skipping meals. A study found an association between best friend and maternal factors with meal-skipping behaviors (Pearson et al., 2012).

Participants who perceived that their best friend often skipped meals were more likely to skip lunch, while those who perceived that their mother often skipped meals were more likely to skip breakfast and lunch (Pearson et al., 2012). As seen in this study, people who skip breakfast tend to consume more HPF. Recommendations can be made to educate young people on how to interpret unhealthy eating behaviors that they see from others. Involvement of mother and the promotion of regular consumption of meals in schools can also contribute to developing good eating behaviors.

Furthermore, in the current study, it was found a higher HPF consumption for people who **smoke.** The HPF consumption for the Yes category (*M=5.00*) was higher than for the No category (*M=4.06*). The results are consistent with a study that evaluated the UPF consumption in Canada (Nardocci et al., 2019). The study found that unhealthy lifestyle habits like smoking are associated with increased consumption of ultra-processed foods. The average percentage of energy intake from ultra-processed foods for non-smokers (43.74%) was higher than for smokers (49.19%). The study also found that the average percentage of energy intake from ultra-processed foods for physically inactive people (45.62%) was slightly higher than for physically active people (44.40%). This might indicate that people with healthy habits care about their health and would consume less UPF. Similar results were found in a study carried out in Australia. The study analyzed the ultra-processed food consumption of 8209 Australian adults and categorized the smoking status as either current smoker, ex-smoker or never smoked (Marchese et al., 2022). The percentage energy intake from ultra-processed foods ranged from 37.6% for ex-smoker, 38.3% for never smoked to 43.1% for current smoker. It's advised to promote healthy habits in the population because this could lead to less consumption of ultra-processed foods.

Finally, although in the present study, there wasn't found any significance (p=0.546) between HPF consumption and **health status**, it could be seen a slight increase in HPF consumption as the health status worsen. Similar results were found in a study that reviewed twenty-three studies (ten cross-sectional and thirteen prospective cohort studies) that investigated the association between UPF consumption and health status (de Oliveira et al., 2022). In the cross-sectional studies reviewed, it was found that the highest UPF consumption was associated with a significant increase in the risk of overweight/obesity, high waist circumference, low HDL-cholesterol levels, and the metabolic syndrome (de Oliveira et al., 2022). However, in that study wasn't found significant associations between UPF and other conditions such as hypertension, hyperglycaemia and hypertriacylglycerolaemia. In the cohort studies, highest UPF consumption was found to be associated with an increased risk of all-cause mortality in five studies, increased risk of

cardiovascular disease in three studies, cerebrovascular disease in two studies, and depression in two studies (de Oliveira et al., 2022). The results suggest that HPF consumption is associated with some but not all health issues.

Eventually, to find out the reasons why people with different income levels buy HPF, four options were presented in the survey: good taste, the influence of family and friends, no time for cooking, and cheaper products. The results showed that most people with high income buy HPF because they have no time for cooking, most people with middle income buy HPA because they think HPF has a good taste and also have no time for cooking, and people with low income mostly buy HPF because of its good taste. Regardless of the income level, no time for cooking seems to be the major reason why people decide to buy HPF food. This is consistent with another study that found people prefer products with little time to cook because they had a busy schedule (Moran et al., 2019). An improvement in a further study could be calculating subjects' free time to see how much they have left and could be used for cooking. This data would help direct efforts to find faster ways to prepare healthy meals, or to find and/or develop ready-made healthy foods that could be promoted for people with no time to cook

Influence of Covid -19 on change in food behavior

Another important point in this study was to identify changes in dietary changes associated with **COVID-19 isolation**. This study compared HPF levels and respondents' responses to their dietary changes. A significant result was found between those who did not want to answer and the level of HPF ($p=< .001$). Also, most people answered that their meal plan changed to much more unhealthy ($M=6.60$) after getting Covid-19. The lowest score belonged to people who did not have Covid-19 ($M=3.59$).

Due to the isolation as a necessary measure to protect public health, the results in other studies show that the physical activity and eating behavior got worse. While these restrictions help reduce infection rates, they also lead to negative outcomes such as limiting physical activity (PA), daily life, travel, and access to many forms of exercise (inability to leave home, closed gyms, increased social distancing). People started getting big mental problems include depression, anxiety, mood disorders, insomnia, fear, lack of self-control and other adverse mental health effects (Hossain et al., 2020). The COVID-19 lockdown has been shown to have a negative impact on physical activity, increasing daily sitting time from 5 to 8 hours a day (Ammar et al., 2020). Moreover, food intake and eating patterns have become unhealthier during lockdown (Ammar et al., 2020). Studies show that physical activity leads to changes in the immune system, this self-regulation is

important for adapting the immune response to the SARS-CoV-2 virus and eliminating it (Bloch et al., 2020). It has been shown that the number and function of cells of the immune system, the so-called T-regulatory cells, can be increased depending on physical activity and training (Bloch et al., 2020). Such restrictions worsen people's health, potentially impairing physical fitness, which is positively associated with the ability to cope with infections. The results of current study showed that due to Covid-19 the meal plan has changed people's diets to be much more unhealthier.

Limitations

A number of limitations in the present study should be mentioned. First, the present study used a relatively small convenience sample of adults. Second, this study applied a questionnaire-based assessment of HPF and PA, which has some limitations. Third, this study did not include complete information from medical records or health examinations about participants.

Nevertheless, these limitations do not prevent drawing conclusions from the study.

The goal of this study is a comprehensive comparison of HPF and PA on a socioeconomic basis, and also take into consideration other criteria's such as age, gender, education, smoking, skipping meals, and covid-19 virus. This makes it possible to compare and identify the cause of high HPF consumption and/or low PA level.

Conclusions

HPF consumption was higher in Austria (*M=4.65*) than in Kazakhstan (*M=3.78*). Countries with high GDP per capita like Austria are more likely to consume highly processed foods, due to a lack of cooking time and ease of preparation, while countries with low GDP per capita like Kazakhstan tend to consume less highly processed foods. In fact, unprocessed or minimally processed foods have the highest proportion among countries with low GDP per capita. HPF consumption increased from low (*M=4.26*), middle (*M=4.37*), and high income (*M=4.47*), but no significant difference was found between HPF consumption and income level. More participants with high PA level were found in Austria (59.4%), while a low PA level was found more in participants in Kazakhstan (57.7%) than in Austria (42.3%). Income level did not impact PA, but countries with a high GDP per capita like Austria tend to do more PA and consume more HPF, while countries with a low GDP per capita like Kazakhstan tend to do less PA and consume less HPF. Other factors like skipping meals often, skipping breakfast, and smoking Yes contribute to a high level of HPF consumption. Health-adjusted life expectancy at birth (2010) 58.2 years in Kazakhstan and 69.1 years in Austria (Feigin et al., 2014). Dietary risks, smoking, high blood pressure and high body

mass index are the leading health risk factors in Austria and Kazakhstan. Further strategies to promote healthy habits in order to reduce HPF consumption are needed in both Austria and Kazakhstan.

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[62]

Appendix

Appendix 1

Questionnaire

Due to the rapid increase in ultra-processed food (UPF) intake and the decrease in physical activity in all population groups, which shows an increase every year, the aim of this study is to analyze ultra-processed food consumption and physical activity in countries to compare different incomes. In addition, the study will look for reasons that motivate people to eat ultra-processed foods and engage in less physical activity.

51 questions were structured for this survey and divided into 4 blocks including general information, nutritional information, physical activity information, and health status. This survey will take 7-10 minutes.

The answers to the questions relate to a period of 12 months.

Please read the following statements and tick the boxes if you agree with them. Please select all options if you agree.

- I agree to participate in the above survey. I understand that my responses are anonymous and confidential, and that I am free to withdraw from the study before submitting my responses for any reason.
- Protection of data: I consent to the University of Vienna processing the anonymous personal data I have provided. I agree that this data will be processed as described for all purposes related to this research project.
- I confirm that I am at least 18 years old.

BLOCK 1: Demographic information

Q1: What is your sex?

- Male
- Female
- LGBT
- I do not want to answer

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Q2: What is your date of birth?

_____

Q3: In total, how many years have you spent at school and in full-time study (excluding pre-school)?

- (drop-down list from 1 to 25 and more)

Q4: What is the highest level of education you have completed?

- No formal schooling (0 years)
- Primary school completed (4 years)
- Lower secondary education school completed (8-9 years)
- Upper secondary education completed (9-13 years)
- Post-secondary non-tertiary education completed
- Bachelor's or equivalent completed
- Master or equivalent level
- I do not want to answer

Q5: What is your marital status?

- Never married or alone
- Currently married or cohabitating
- Separated, divorced or widowed
- I do not want to answer

Q6: How many people live in your household (including yourself)?

- 1
- 2
- 3
- 4
- 5 or more

Q7: Which of the following best describes your main work status over the past 12 months?

- Employee
- Self-employed
- Non-paid work

- Student
- Retired
- Unemployed
- I do not want to answer

Q8: Which of these bests describes the area where you live?

- Urban
- Suburban
- Rural (village)
- Remote (Isolated house or farm)
- I do not want to answer

Q9: Choose the country where you live?

- Austria
- Kazakhstan

Q9a: Can you give an estimate of the monthly household income (gross salary)?
(For people who chased Austria as a country for living)

- Up to 500€
- 501 to 1000€
- 1001 to 1600€
- 1601 to 2700€
- 2701 to 5000€
- 5001€ and more
- I do not want to answer

Q9a: Can you give an estimate of the monthly household income (gross salary)?
(For people who chased Kazakhstan as a country for living)

- Up to 188€
- 189 to 302€
- 303 to 656€
- 657€ to 1000€
- 1001€ and more
- I do not want to answer

[66]

BLOCK 2: DIET INFORMATION

Think of a typical day/week/month during the past year. What was your average frequency of consumption of…

Q10: Fatty dairy products (cream, cured or semi-cured cheese, processed soft cheese wedges)?

- More than 2 times a week
- 2 times a week
- Less than 2 times a week
- Do not consume

Q11: Sugary dairy products (condensed milk, industrially produced milkshakes, flavored Petit Suisse yogurt, custard, crème caramel flan, pudding)?

- More than 3 times a month
- 3 times a month
- Less than 3 times a month
- Do not consume

Q12: Cured meats (serrano ham, sandwich ham, cured meats, pies, bacon, marbling)?

- Few times a week
- Once a day
- More than once a day
- Less than once a week
- Do not consume

Q13: Fats (margarine, butter, lard (animal fat))?

- More than 3 times a month
- 3 times a month
- Less than 3 times a month
- Do not consume

Q14: Fermented alcohols (rosé wine, muscatel wine, young red wine, aged red wine, white wine, Spanish sparkling wine (cava), beer)?

- Few times a week
- Once a day

- More than once a day
- Less than once a week
- Do not consume

Q15: Distilled alcohols (liquors, anisette, whisky, gin, vodka, cognac)?

- More than 3 times a month
- 3 times a month
- Less than 3 times a month
- Do not consume

Q16: Sugary and artificially sweetened drinks (soft drinks, artificially sweetened drinks, bottled juice)?

- More than 2 times a week
- 2 times a week
- Less than 2 times a week
- Do not consume

Q17: Sweets (ice-cream and sorbets, canned fruit in juice or syrup, biscuits, whole meal biscuits, chocolate biscuits, honey, homemade baking products, industrially produced confectionery, donuts, muffins, cupcakes, industrially produced cakes, churros, chocolates, soluble cocoa powder, nougat, marzipan, shortbread biscuits, jam)?

- Few times a week
- Once a day
- More than once a day
- Less than once a week
- Do not consume

Q18: Snacks (packaged potato crisps/chips, packaged snacks)?

- More than 3 times a month
- 3 times a month
- Less than 3 times a month
- Do not consume

Q19: Ready to eat products (pizza, croquettes, instant soup)?

[68]

- More than 3 times a month
- 3 times a month
- Less than 3 times a month
- Do not consume

Q20: Refined cereals (white and sliced bread, breakfast cereals, Spaghetti, macaroni, Spanish noodles, white rice)?

- More than 2 times a week
- 2 times a week
- Less than 2 times a week
- Do not consume

Q21: Sauces (mustard, mayonnaise, tomato sauce, Ketchup)?

- More than once a week
- Once a week
- Less than once a week
- Do not consume

Q22: Additives (sugar, table salt)?

- More than 3 times a day
- 3 times a day
- Less than 3 times a day
- Do not consume

Q23: Fried foods (eat out and homemade)?

- More than 2 times a week
- 2 times a week
- Less than 2 times a week
- Do not consume

Q24: In a typical week, how many days do you eat fruit?

- Everyday
- 1 day
- 2 days

- 3 days
- 4 days
- 5 days
- 6 days
- Do not eat
- Do not want to answer

Those respondents who eat fruit should have to answer the following question (Q24a)

Q24a: How many servings of fruit do you eat on one of those days? (One serving of fruit is about 150g or 1 medium banana/ apple/ orange or only occasionally 125ml (½ cup) or fruit juice (no added sugar))

- 1 serving
- 2 servings
- 3 servings
- 4 servings
- 5 or more servings

Q25: In a typical week, how many days do you eat vegetables?

- Everyday
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- Do not eat
- Do not want to answer

Those respondents who eat fruit should have to answer the following question (Q25a)
Q25a: How many servings of vegetables do you eat on one of those days? (One serve of vegetables is about 75g or only 1 medium tomato or ½ medium potato or ½ cup cooked green or orange vegetables)

- Everyday
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- Do not eat
- Do not want to answer

Q26: Do you sometimes skip a meal?

- Often
- Sometimes
- Seldom
- Never

Those respondents who skip a meal should have to answer the following question (Q26a)

Q26a: If so, which one do you skip most frequently?

- Breakfast
- Lunch
- Dinner

Q27: If you are responsible for the choice of food - What are your reasons to buy ready to eat (frozen or chilled, packed, highly processed) meals? (select a maximum of two that occur most frequently to you)

- Good taste
- Influence of family/ friends/ partner
- No time for cooking
- Cheaper
- Other _____

Q28: Did your meal plan change with the Covid-19 outbreak? My meal plan has become...

- Much more healthier

- More healthier
- Did not change
- More unhealthy
- Much more unhealthy
- I did not have Covid-19
- I do not want to answer

Q29: Do you currently smoke any tobacco products, such as cigarettes, cigars or pipes?

- Yes
- No
- I do not want to answer

Those respondents who smoke should have to answer the following question (Q29a)

Q29a: If yes, do you currently smoke tobacco products daily?

- Yes
- No
- I do not want to answer

Q30: Have you ever consumed any alcohol such as beer, wine, spirits or similar?

- Yes
- No
- I do not want to answer

Those respondents who consume alcohol should have to answer the following question (Q30a)

Q30a: During the past 12 months, how frequently have you had at least one standard alcoholic drink?

- Daily
- 5-6 days/week
- 3-4 days/week
- 1-2 days/week
- Few times a month
- Less than once a month

[72]

- Never
- I do not want to answer

BLOCK 3: PHYSICAL ACTIVITY INFORMATION

Next, we are going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

Think first about the time you spend doing work. Think of the things that you have to do at work, such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, and searching job.

These can be high-intensity activities, activities that require a lot of physical effort and cause a significant increase in breathing or heart rate, and moderate-intensity activities, and activities that require moderate physical effort and cause a slight increase in breathing or heart rate.

Q31: Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like (carrying or lifting heavy loads, digging or construction work) for at least 10 minutes continuously?

- Yes
- No

Additional questions related to vigorous-intensity activity like carrying or lifting heavy loads, digging or construction work (Q32 and Q33).

Q32: In a typical week, how many days do you do vigorous-intensity activities as part of your work? Number of days

- (drop-down list from 1 to 7)

Q33: How much time do you spend doing vigorous-intensity activities at work on a typical day?

- 0-10 minutes
- 11-30 minutes
- 31-59 minutes
- 1 hr - 1: 30
- 1:31 - 2 hrs
- 2 - 3 hrs

- 3 - 5 hrs
- More than 5 hrs
- I do not want to answer

Q34: Does your work involve moderate-intensity activity, that causes small increases in breathing or heart rate such as brisk walking or carrying light loads or at least 10 minutes continuously?

- Yes
- No

Additional questions related vigorous-intensity activity like (carrying or lifting light loads etc.)(Q35 and Q36).

Q35: In a typical week, on how many days do you do moderate-intensity activities as part of your work? Number of days

- (drop-down list from 1 to 7)

Q36: How much time do you spend doing moderate-intensity activities at work on a typical day?

- 0-10 minutes
- 11-30 minutes
- 31-59 minutes
- 1 hr - 1: 30
- 1:31 - 2 hrs
- 2 - 3 hrs
- 3 - 5 hrs
- More than 5 hrs
- I do not want to answer

The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to place of worship.

Q37: Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?

[74]

- Yes
- No

Respondents who walk or use the bicycle should have to answer the following question (Q38 and Q39).

Q38: In a typical week, how many days do you walk or use the bicycle for at least 10 minutes continuously to get to and from places? (Number of days)

- (drop-down list from 1 to 7)

Q39: How much time do you spend walking or bicycling for travel on a typical day?

- 0-10 minutes
- 11-30 minutes
- 31-59 minutes
- 1 hr - 1: 30
- 1:31 - 2 hrs
- 2 - 3 hrs
- 3 - 5 hrs
- More than 5 hrs
- I do not want to answer

The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure)

Q40: Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like (running or football) for at least 10 minutes continuously?

- Yes
- No

Additional questions related vigorous-intensity activity like (running or football) (Q41 and Q42).

Q41: In a typical week, how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities? (Number of days)

- (drop-down list from 1 to 7)

Q42: How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?

- 0-10 minutes
- 11-30 minutes
- 31-59 minutes
- 1 hr - 1: 30
- 1:31 - 2 hrs
- 2 - 3 hrs
- 3 - 5 hrs
- More than 5 hrs
- I do not want to answer

The next questions are about brisk walking, cycling, swimming, and volleyball as sports activities.

Q43: Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball, for at least 10 minutes continuously?

- Yes
- No

Additional questions about intense activities such as (swimming, volleyball) (Q44 and Q45).

Q44: In a typical week, how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities? (Number of days)

- (drop-down list from 1 to 7)

Q45: How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?

- 0-10 minutes
- 11-30 minutes
- 31-59 minutes

[76]

- 1 hr - 1: 30
- 1:31 - 2 hrs
- 2 - 3 hrs
- 3 - 5 hrs
- More than 5 hrs
- I do not want to answer

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, traveling in a car, bus, train, reading, playing cards or watching television (but do not include time spent sleeping)

Q46: How much time do you usually spend sitting or reclining on a typical day?

- 0-10 minutes
- 11-30 minutes
- 31-59 minutes
- 1 hr - 1: 30
- 1:31 - 2 hrs
- 2 - 3 hrs
- 3 - 5 hrs
- More than 5 hrs
- I do not want to answer

BLOCK 4: HEALTH INFORMATION

Q47: Weight (kg)?

_____

Q48: Height (cm)?

_____

Q49: Would you say your health in general is . . .

- Excellent
- Very good
- Good
- Satisfactorily

- Poor
- Do not know/ do not want to answer

Q50: During the past 30 days, for about how many days did poor physical or mental health keep from doing usual activities, such as self-care, work, school or recreation?

- (drop-down list from 1 to 30)

Q51: Do you have any illness that affects your diet or activity level?

- Yes
- No

Additional questions related illness of a diet or activity (Q51a)

Q51a: Which illness affects your diet or activity level? Please Specify

_____

Appendix 2

HPF Score Calculation

In the present study, a screening questionnaire of highly processed food consumption was used to calculate the HPF Score (Martinez-Perez et al., 2022). Criteria for 1 point was followed for each answer provided by participants in the questionnaire. After summing the points in the 14 questions, the total HPF score for a participant is obtained.

The HPF score obtained represents an estimated percentage of HPF consumption over the total intake in grams per day as shown in Table 13 (Martinez-Perez et al., 2022).

Table 13: sQ-HPF scores and their estimated percentage of HPF consumption over the total intake in grams per day:

Score	1	2	3	4	5	6	7	8	9	10	11	12	13	14
% HPF	11.3	15	18.7	22.4	26.1	29.8	33.5	37.2	40.9	44.6	48.3	52	55.7	59.4

Appendix 3

PA Score Calculation

Questions from the Global Physical Activity Questionnaire (GPAQ) were asked to participants to calculate their metabolic equivalent of tasks (MET). The formulas used to calculate the total MET slightly changed based on the activity (WHO, 2012a).

Activity	Calculation
Cycling and walking	4 METs × minutes × number of days
Moderate PA	4 METs × minutes × number of days
Vigorous PA	8 METs × minutes × number of days
Total PA	Sum of cycling and walking + moderate PA + vigorous PA

The formulas above were applied to some questions in the questionnaire to calculate the total MET.

Cycling and walking	Q38 x Q39 x 4
Moderate PA	Q35 x Q36 x 4
	Q44 x Q45 x 4
Vigorous PA	Q32 x Q33 x 8
	Q41 x Q42 x 8

Once the total MET was calculated, some guidelines were followed to classify the total physical activity in low, moderate, and high. To calculate a categorical indicator, the total time spent in physical activity during a typical week, the number of days, as well as the intensity of the physical activity, were taken into account. The guidelines below show how to deal with continuous and categorical indicators when analyzing GPAQ data (WHO, 2012a)

High

A person reaching any of the following criteria is classified in this category:

[80]

- Vigorous-intensity activity on at least 3 days, achieving a minimum of at least 1,500 MET-minutes/week OR
- 7 or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of at least 3,000 MET-minutes per week.

Moderate

A person not meeting the criteria for the "high" category, but meeting any of the following criteria is classified in this category:

- 3 or more days of vigorous-intensity activity of at least 20 minutes per day OR
- 5 or more days of moderate-intensity activity or walking of at least 30 minutes per day OR
- 5 or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes per week.

Low

- A person not meeting any of the above mentioned criteria falls in this category (WHO, 2012a).