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Whole Foods: Making a case for real nutrition

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Whole Foods:

Making a case for real nutrition

by

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An Honors Thesis Submitted in Partial Fulfillment of the
Requirements for Graduation from the
Western Oregon University Honors Program

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Abstract

Whole food consumption is a topic that is not significantly discussed in everyday culture. Whole foods have positive impacts to physical and mental health as well as to the environment. This thesis will explore the many benefits of whole foods, support a need for change, and persuade the reader to engage in a whole foods diet. This scholarly article will compile vast information from other researchers to examine the current whole foods situations around the globe, provide scientific confirmations behind the need for change, give recommendations for altering present habits, and will confront any pre-existing contradictions. The outcome of this thesis will be a text that is suitable for a reader with or without knowledge of nutrition to find usable and beneficial in making educated choices regarding nutrient intake.

Introduction

The broad topic of nutrition and how to best fuel the body has been debated for many years. As a whole, the general population longs to care for one's body, yet many do not have the tools, knowledge, ability, access, or will power to create a successful change that will stick throughout a lifetime. Many people see this obstacle and decide that it is too difficult to make any meaningful change to dietary habits, however, beginning to make changes is something that just about any person could do. Whole food consumption is perhaps one of the easiest and best ways to change one's chronic, lifelong diet. Consuming a variety of whole foods, that is, a diet composed mainly of unprocessed foods that do not have unnecessary additives or have key nutrients taken away, is considered to be one of the most healthy ways to fuel the body and to ensure adequate intake of nutrients necessary for a thriving human life. This review of scholarly literature will include a brief span covering three key topics: whole food consumption as it relates to nutritional density, bioavailability, and effect on chronic disease.

Definitions

In order to set the table for understanding whole foods, it is crucial to comprehend the differences between whole and processed foods. Whole foods are foods that are not significantly altered from their original, naturally occurring state. The three whole foods of interest are, in general, whole grains, whole fruits, and whole vegetables. Examples of common whole foods in these realms would include grains, such as whole wheat bread or brown rice; a fruit, such as an apple; and a vegetable, such as a carrot or crown of broccoli. 8 grams per 30 gram serving is the definition of a "whole grain food" as determined by the American Association of Cereal Chemists International [AACCI] (Ferruzzi, 2014; Slavin, Tucker, Harriman, Jonnalagadda,

2013), however, this is simply a minimal amount for labeling purposes. Processed foods, which may oppositely have key nutrients taken away (and sometimes reintroduced, or enriched), are lacking in certain macronutrients (proteins, fats, and carbohydrates), vitamins, or minerals, and may have additional substances added in. Looking again at grains, fruits, and vegetables, common examples of processed foods would be white bread, fruit juice, and canned vegetables. None of these foods should be considered “good” or “bad” necessarily, nevertheless, each do have differing amounts as far as nutrient content and satiety (the state of being satisfied with what one has eaten), as well as the health benefits or consequences that go along with each.

To examine nutritional density, one should also be aware of the differing parts of whole foods, specifically, whole grains. Whole grains consist of bran, germ, and endosperm. Refined or processed grains, however, remove the bran and germ leaving only the endosperm. This affects the fiber content and other bioactive components of the grain, which can be linked to various disease states and disorders. Common examples of whole grains include wheat, rye, oats, barley, quinoa, buckwheat, whole corn, rice, and many others, as long as the grain remains completely intact (van der Kamp, Poutanen, Seal, & Richardson, 2014).

Nutrient density is one of the biggest concepts as far as the differences between whole foods and processed foods. Nutritional density is having an abundance of nutrients with a relatively low amount of calories. This is seen in proportion to the food being consumed when compared side by side to another food. Whole foods have a higher nutritional density when compared to processed foods. This is demonstrated through the amount of micronutrients, that is, the vitamins and minerals that are present in each food. Mineral content is increased in whole foods and is decreased in processed foods as seen through the mechanical removal during various processing steps. This removal of certain key minerals may result in disease (Lillioja,

Neal, Tapsell, & Jacobs, 2013) as minerals are vital to a healthy human life. If an individual is deficient in any mineral or minerals, a plethora of holistic health related issues may arise.

According to Dixit, Azar, Gardner, and Palaniappan (2011), whole foods, specifically whole grains, contain minerals such as iron, potassium, phosphorus, magnesium, copper, zinc, and others. Lillioja, Neal, Tapsell, and Jacobs (2013) noted that a majority of certain minerals, such as magnesium, or specifically up to 70% of zinc, can be removed in the processing from whole wheat flour to white flour. Furthermore, it should be noted that it is not necessarily what is in the whole food, but rather, it is of greater importance to examine what nutrients have not been removed (Lillioja et al., 2013).

It was previously of concern that the abundance of phytate, a carbohydrate found in high quantities in whole grain foods (Vucenik & Shamsuddin, 2006), would decrease the amount of possible absorption of minerals in whole foods. However, phytate has been found to actually be a marker for minerals. The quantity of minerals found only in whole grains is high enough to contribute to one's daily needs, despite the possible deductions from the presence of phytate if phytate does decrease mineral absorption in minuscule amounts (Lillioja, et al., 2013).

In addition to minerals, vitamins are the other micronutrient that are vital to human life and are likewise seen in abundance in whole foods. Vitamins are essential for a functioning and healthy lifespan. Whole grains contain all but one of the B vitamins, B12, which is only found in animal products (Dixit, Azar, Gardner, & Palaniappan, 2011).

Why is this Important?

The vitamin and mineral content observed in whole foods has many important benefits. One of the groups of these benefits, medical and physical advantages, have the potential to

change one's life as well as influence the quality of life. Diets rich in whole foods, specifically vegetables and fruits, have been linked to lowered risks of disease and illness (Palafox-Carlos, Ayala-Zavala, & González-Aguilar, 2011). The removal of minerals due to processing may lead to serious health conditions such as type II diabetes or cardiovascular issues. Lillioja, Neal, Tapsell, and Jacobs (2013) made an interesting point that it is not that certain foods need to be avoided, necessarily. Rather, it is that whole foods need to be included in one's diet. Studies have shown that consuming refined food is hardly ever linked to risk of disease (type II diabetes is an exception). More importantly, the absence of including whole foods in one's diet is what has been traced to chronic illness.

A fourteen year study observing over 360,000 participants tracked the intake of whole grains and cereal fiber in relation to cause of death. This study specifically considered whole grain foods as those containing at least one quarter of whole grains and/or bran. The researchers also included fiber in their study as well as taking many lifestyle factors into account, such as smoking, physical activity, and geographic location, among other criteria. According to these researchers, the intake of whole grains and cereal fiber was inversely related to the likelihood of being overweight and obese, as well the risk of certain specific diseases and non-cardiovascular and non-cancer related deaths. These include, but are not limited to: respiratory disease and infection, cancer, and those already mentioned in this review, such as cardiovascular disease and diabetes. Additionally, the intake of whole foods was associated with healthy habits, such as moderate and vigorous physical activities. Most importantly, the intake of whole grains was inversely associated with all causes of mortality. The risk of dying from one or more chronic diseases is significantly decreased due to the intake of whole foods (Tao, Min, Albert, Susan, & Lu, 2015).

Many whole foods topics cover solely whole grains or plant-based diets. This review includes a comprehensive study on the current recommendations for consuming a diet mainly composed of whole foods. This information includes the possible benefits for whole foods as single events, as well as combining the advantages as a synergy. The summed effects of whole foods each enhance one another to provide the most nutritional density.

One fascinating aspect about whole foods is that eating foods with certain micronutrients will actually enhance the micronutrient content of other foods. By pairing select whole foods together, one is able to achieve the micronutrient requirements necessary for essential daily function. Dixit, Azar, Gardner, and Palaniappan (2011) gave the example of combining green, leafy vegetables with whole grains to supplement the calcium that is lacking in whole grain products, but abundant in vegetables. By eating these types of foods together, micronutrients are consumed in adequate quantities and give numerous advantages to one's health.

Likewise, as noted by Lillioja, Neal, Tapsell, and Jacobs (2013), fruit provides antioxidants, which are chemicals that prevent development of some chronic diseases (Palafox-Carlos et al., 2011). Whole grains do not provide as many antioxidants as fruit does, thus, pairing a combination of fruit and whole grains together at a meal should increase the micronutrient amount. Consuming whole foods as a way to avoid and prevent disease is a major reason to begin this type of chronic diet. Numerous types of illnesses and diseases can be affected and influenced by the intake of whole foods. One example, for instance, is that magnesium (which, as previously mentioned, appears in whole grains) decreases blood pressure and has other positive cardiovascular benefits when consumed in appropriate quantities (Lillioja et al., 2013).

There have been proposals as to why the consumption of these whole foods contribute such crucial benefits to the human body, however, the exact properties that cause this correlation

from plant based foods are currently unknown and warrant future research to determine additional benefits. One such proposition specific to fruits and vegetables is that the antioxidant properties, found within vitamins and minerals, prevent cancer development as well as cardiovascular issues. These plant based foods have specific chemical structures and properties that protect from radiation, as seen through ultraviolet rays, as well as damage from pathogens. In addition to reducing the growth and spread of cancer cells, these structures also protect neurons in the brain as well as improve insulin secretion (Palafox-Carlos et al., 2011). The fiber content in whole foods, and specifically whole grains, can help regulate the body's insulin and glucose responses after consuming a meal. Overtime, chronic consumption of whole grains in adequate amounts may continue to regulate insulin metabolism in overweight and obese individuals (specifically females), directing these people toward a healthier lifestyle, weight loss, proper blood glucose management, and disease aversion (Kim et al., 2009).

Another hypothesis as to why whole foods produce such benefits to the human body is that the fiber content in these foods decrease the bioavailability of macronutrients, and especially the bioavailability of fat (Palafox-Carlos et al., 2011). Bioavailability is the concept of how much a certain food has been ingested in relation to how much actually gets utilized by the body through digestion, absorption, and metabolism. Bioavailability differs greatly amongst each individual person based off of a variety of factors. One of the major causes of variance of bioavailability is how the food is prepared. If the food is bound to proteins or fibers, in crystalline form, or most notably, in the form of a fat, such as in the case of oils, the nutrients from the food will not be able to be optimally absorbed. Bioaccessability, in contrast, is how much of the consumed food is available to be absorbed (Palafox-Carlos et al., 2011). Bioavailability is dependent on bioaccessability.

Along with the numerous physical benefits seen from eating whole foods, there are also mental and cognitive advantages to consumption. A high population of individuals in today's society are concerned with performance, as seen in one's career or academics. Eating foods with high contents of micronutrients may aid in the realm of performance (Dixit et al., 2011). Many micronutrients, such as iron, zinc, and all of the B vitamins are directly related to sensations of hunger, energy, and cognitive ability. Additionally, improved memory is another area that may go along with similar breakfast food consumption. Recent research has shown that consuming whole grains at breakfast has been linked to higher testing scores in reading, both in fluency and comprehension, as well as in mathematics amongst elementary school aged children.

Interestingly enough, the consumption of fruit juices, mentioned previously as a processed food, showed opposite results. The processed juices were detrimental to the function and focus in students' academic endeavors (Ptomey et al., 2016). These juices are typically high in sugar, missing key nutrients and fiber, and possibly not containing solely actual fruit juice. In addition, children who do not consume any breakfast at all or an inadequate breakfast may suffer major academic and metabolic repercussions. This is due to the fact that children up to the age of ten utilize over twice as much glucose in the cerebral cortex when compared to adults. The cerebral cortex is the area of the brain associated with higher, complex thinking as well as making associations (Mahoney, Taylor, Kanarek, & Samuel, 2005).

Another group of researchers (Mahoney, Taylor, Kanarek, & Samuel, 2005) also compared the effects of two common breakfast foods in addition to consuming no food for breakfast. The compared foods were oatmeal-- a whole grain-- and a ready to eat cereal. Both were similar in amount of fat, sugar, and energy (in the form of kcals) that each food provided. However, the foods differed in nutrient content. As mentioned previously, adequate levels of

glucose are necessary for optimal function. Many refined foods have extremely high amounts of glucose, which spike or raise blood sugar and then quickly result in a plummet, causing a “crash” or fatigue, both physically and mentally. The “glycemic index” is a tool to assess a food based on how it will affect the body’s blood sugar after being consumed. Oatmeal, which is low on the glycemic index, and many other whole foods do not cause this intense rise in blood sugar and work to sustain blood glucose for ideal brain functioning. Children were tested in multiple areas to determine the influence of oatmeal, cereal, or no food for breakfast on cognitive function. Separated by gender, girls who ate oatmeal outperformed girls who ate cereal or no breakfast at all in the short-term memory portion of the test. Children who consumed oatmeal had better auditory attention compared to the other two groups. In other tests, no differences were seen, and in some tests, the group who ate the ready-to-eat cereal performed better than the group who ate oatmeal, but this may be due to the nature of the test given, depending on what it was asking of the children. The researchers noted that consumption of breakfast on most cognitive tasks and tests enhanced performance and that the breakfast composition can have improved effects on short-term and spatial memory, as well as auditory attention.

Whole foods also pose numerous cognitive benefits in non-academic settings. A group of researchers from Sweden recently looked at cognitive function and Alzheimer’s disease in relation to ideal chronic dietary habits. Participants, who were all 60 years of age or older, took a baseline test to measure cognitive function and were re-tested every three or six years, depending on starting age. The test given, the Mini-mental state examination, or MMSE, measured the functioning levels that included the following realms: language, attention, memory, orientation, and visual construction. Participants who consumed mainly a Western diet, that is a diet high in refined grains, fat, sugar, alcohol, and red meat, among other things, were shown to have the

greatest cognitive decline at the MMSE rest. Those who consumed a chronic prudent diet, one that is associated with healthy fats, low sugar content, regular fruit and vegetable intake, whole grains, and legumes, had the lowest cognitive decline. The prudent diet is seen to have these positive benefits because of the nutrients provided that are not present in processed foods as demonstrated through a Western diet (Shakersain et al., 2016).

In addition to these internal reactions to whole foods, choosing to purchase and use whole foods also generally has positive impacts on the environment, a recent and popular trend amongst many people concerned about global wellbeing. Research in this field is limited, due to its novelty or newness, however, information is emerging. Whole grains, as well as the commonly thought of fruits and vegetables in natural states all tend to have low water and carbon footprints (Downs and Fanzo, 2015). Purchasing locally grown produce and homegrown, handmade, and handpicked whole grain products at a farmer's market is a way to reduce one's impact on the environment and work to sustainably preserve the earth for future generations as well utilizing it efficiently and responsibly at the present time.

Analysis of present whole foods situation

Whole food consumption varies greatly across the globe. This is due to a wide variety of factors that may include the agriculture of the area, access to whole foods, knowledge and education, and economic or social state. According to Ferruzzi and colleagues, as well as Lillioja et al., the average American chooses refined grains over whole grains at a five to one ratio and a large majority are not consuming the recommended amount. Consumption rates do differ, however; varying by age group and are slightly increased in the over 50 population. 20% of Americans report consuming no whole grain foods at all (2014 and 2013).

Whole Foods and Disease

There are numerous reasons why an individual would be interested in choosing to adhere to a whole foods lifestyle. One of the most compelling reasons, perhaps, is the effect that whole foods have on many chronic diseases. Diabetes is a disorder characterized by abnormal metabolism and is plainly affected by the consumption of whole foods (Kerner & Brückel, 2014). A chronic diet consisting of whole foods has been shown to maintain homeostatic insulin and glucose levels and the sensitivity to and resistance of insulin is related to magnesium seen through processing, as well as insulin secretion being linked to zinc removal (Ferruzzi et al., 2014; Lillioja et al., 2013).

In addition to the role of potentially working to treat and inhibit hyperglycemic states, whole foods are also a viable strategy that one should consider for the prevention of diabetes. Replacing 50 grams of uncooked white rice for whole grains, such as brown rice, may lower the risk of developing type II diabetes, which is lifestyle preventable, by up to 36% (Sun et al., 2010). Once again, consumption of zinc, found in the bran and germ of grains, is associated with

a lower risk of type II diabetes (Lillioja et al., 2013). Whole foods can also be used as a “treatment,” or part of a healthy lifestyle habit, to manage blood sugar levels in type I diabetics.

Cardiovascular disease (CVD), the number one cause of death both in the United States and worldwide, is another chronic condition that whole foods can impact. An increase in 20 grams of whole grains per day decreases the risk of developing CVD by 26% and a 30 gram increase of whole grains per day decreases the risk by 36%. Once again, this may be due to the presence of magnesium that is not seen in refined foods (Lillioja et al., 2013). Ferruzzi and colleagues compared individuals who rarely or never consume whole grain products and those individuals who consume 2-3 servings of whole grains per day. Individuals who consumed 2-3 servings per day of whole grains with roughly a 21% lower risk for cardiovascular disease (2014). This may be due to the fiber content in whole foods which can reduce the bioavailability of macronutrients, especially of fat (Palafox-Carlos et al., 2011). Eating a diet of whole foods can also lower blood pressure, a risk factor for many cardiovascular conditions. Hypertension, or high blood pressure, is known as the “silent killer” because it has no symptoms. High blood pressure can partially be combated by fiber. Lillioja and colleagues demonstrated that increasing whole grain consumption by 30 grams per day or 40 grams per day would decrease the risk of hypertension by 4.0 of 1000 or 5.4 of 1000 people, respectively (2013).

Another disease that whole grains can influence as both a preventative measure and a treatment option is non-alcoholic fatty liver disease. Individuals who have non-alcoholic fatty liver disease, or NAFLD, are likely to be obese or have other comorbid diseases, however, consumption of whole grains has been linked to lower body weight and body fat, as well as many other health benefits, such as decreased cholesterol and glucose levels. There is no evidence for whole foods impacting NAFLD directly, but since consuming whole foods decreases body fat,

which is a risk factor for NAFLD, individuals with NAFLD may find positive benefits from engaging in a whole foods diet. This may be due to changing gut microbiota or the energy density of the food (Ross, Godin, Minehira, & Kirwan, 2013).

In addition to diabetes, cardiovascular disease, and NAFLD, osteoarthritis is also affected by consumption of whole foods. Typical American diets consist of high amounts of animal proteins. These animal proteins contain arachidonic acid, a precursor to pro-inflammatory substances in the body. Whole-food, plant-based diets, however, are relatively low in arachidonic acid. It has been shown that diets low in arachidonic acid may alleviate some inflammatory symptoms seen in patients with arthritis. Consuming whole-food, plant-based diets limits the consumption of arachidonic acid, which therefore decreases the available amount of pro-inflammatory items in the body, making osteoarthritic symptoms less severe. Since whole foods help develop a healthier body weight, a decrease in the physiological load on arthritic joints leads to reduced pain (Clinton, O'Brien, Law, Renier, & Wendt, 2015).

Other inflammatory diseases are also affected by whole foods. Increased whole grain intake can lessen the symptoms of many inflammation disorders simply by increasing the consumption from no whole grains at all to a mere three and a half servings per week. Inflammatory ailments that are influenced by whole grain intake include respiratory diseases, digestive conditions, and musculoskeletal disorders. The decreased risk for these diseases may be due to antioxidant mechanisms found in whole grains (Jacobs, Andersen, & Blomhoff, 2007).

One of the largest medical threats to people across the globe is cancer. Consuming just 10 grams more per day of cereal and dietary fiber seen through whole grains, fruits, vegetables, and legumes results in a 10% reduced risk in colorectal cancer (Aune, Chan, Lau, Vieira, Greenwood, Kampman, & Norat, 2011). Total dietary fiber from grains and beans is also

inversely related to small intestinal cancer (Schatzkin, Park, Leitzmann, Hollenbeck, & Cross, 2008). In addition, whole foods decrease the risk of cancer mortality (Huang, Xu, Lee, Cho, & Qi, 2015).

Phytate, the carbohydrate found in whole foods and marker for minerals, provides anticancer effects (Lillioja, et al., 2013). Phytate has inhibited growth in human cancer models for numerous types of cancers that include cancers of the blood, colon, liver, breasts, pancreas, prostate, soft tissues, and uterine cervix, as well as melanoma. Phytate has also increased apoptosis, or natural and regulated cell death, in human cancer models for melanoma, cancers of the pancreas, prostate, and uterine cervix (Vucenic et al., 2006).

Mental Health

Not only do whole foods contribute to the proper function of one's physical body, but whole foods are extremely beneficial towards mental health and wellbeing; an area of life that is commonly overlooked. It has been noted many times that consumption of breakfast cereals has been linked to "lower levels of mental health problems" (Williams, 2014). Examples of these mental health issues may be related to depression, anxiety, stress, schizophrenia, and a variety of other concerns. Once again, whole foods have also been linked to better cognitive function which relates to memory and is important during and for school and work settings.

Weight

An additional reason that individuals may be interested in consuming a whole foods diet is for the possibility of weight loss, or at least achieving a healthier body composition. One's body mass index (BMI) may decrease into a more healthy range from the consumption of whole

foods. Whole grain consumption is beneficial by contributing to less weight gain in preadolescence as well as having less adipose tissue, which is related to cardiovascular disease. This may be due to the fiber content in whole foods. Choosing to use whole foods as a source of protein also would equate to consuming fewer calories since plant-based foods have less fat.

Performance and Quality of Life

The cognitive, mental, physical, and other benefits from whole foods also add to one's quality of life (QOL). Believing that any supposed benefits will increase QOL commonly will do so (the Placebo Effect). In addition, the consumption of whole foods may influence one's performance, not only in the work place or in academics, but also in athletics.

Environment

Again, the environment is positively impacted by the consumption of whole foods. Not only are carbon and water footprints lessened in whole foods, but so are the ecological footprints and impacts. Due to less greenhouse gases, the biodiversity of a given area is also typically not as damaged by whole foods in comparison to processed foods. For example, certain oils are related to high footprints, deforestation, and higher carbon emissions. Carbon and water footprints vary from food to food. Most fruits and vegetables have relatively low water footprints and grains have a low ecological footprint as compared to food such as beef, fish, and cheese, which is almost contrary to what one would think. The foods that require the most water to grow directly, truly have the lowest carbon footprints. Interestingly, as it relates to whole versus processed foods, foods such as dried fruit have higher ecological impacts, as opposed to whole

fruit which have a remarkably less impact ecologically. Additionally, refined foods, such as sugar and cookies, have moderate levels of ecological footprints (Downs & Fanzo, 2015).

Cost

The cost per serving for whole foods is a piece of information that many consumers are curious about. In many low-income neighborhoods worldwide, processed, convenient, and fast-food options are prominent over whole and healthy options. A whole foods diet may be challenging to maintain financially, however, ultimately, a fast-food diet is more costly.

Researchers McDermott and Stephens compared low-income family diets from supermarkets and a fast-food chain and found that the healthier supermarket diet are roughly 25% less per calorie (2010). The supermarket diet consisted partially of whole foods. This diet included fresh and canned fruits, frozen vegetables, skim milk, and grains such as cereals and bread. In addition, the healthier supermarket diet option cost about half as much per day as the fast-food option. Families on the supermarket diet consumed, on average, nearly 1,000 calories less per day. Given that the nutrients present in whole foods are greater than in refined foods for a small number of calories (nutrient density), the cost per nutrients consumed is lower.

It is easy to make assumptions when comparing whole and process foods directly (in the case of canned versus fresh or two similar items, such as brown rice and white rice). In order to better understand nutrients available, although, one may need to examine the situation more closely. In the examples listed at the beginning of this paragraph, it is true that the processed food would, in comparison, be less expensive than the whole food alternative. However, looking closer, there is more than one way to determine the price of a food. A second way to analyze food cost is the quantity of food that can be consumed for the same amount of calories. For

example, 200 calories of lettuce is vastly more than 200 calories of candy (about 1 candy bar) in terms of weight and amount of portions. There are other methods of determining price as well, such as cost per unit or portion, or per gram, or even using multiple metrics to compare differing food options. Healthy foods should not be thought of as more expensive, but there are instances in which certain options may cost more, however, the same is true for processed foods as well (Carlson & Frazão, 2014). In addition, it may seem as though inexpensive fast-food is the best way to go if on a strict budget, however, in the long term, the potential health implications are much more costly.

Related to cost is the concern of purchasing more food than one can use in a single setting and not knowing how to properly store excess or use it sustainably, which can lead to throwing out perfectly good food, a wasteful habit. Knowledge on how to properly store whole foods is an important part of maintaining a cost-effective chronic diet. According to Lillioja and colleagues, grains specifically have a good storage life and are available in plentiful amounts. These researchers suggest whole grains should be given as high of, if not higher, appreciation and interest as fruit, vegetables, and sodium levels so consumers know how to use and store the food properly (2013).

Concerns

Other nutritional habits having benefits above Whole Foods

Whole foods pose a multitude of benefits, but Lillioja and colleagues also point out that there are other health habits that may possibly have influences that should be held at the same level or surpass the benefits of whole foods (2013). One such example is sodium intake. Long thought to be a major underlying cause of hypertension, sodium actually has a “J-shaped” relationship with cardiovascular disease (Alderman, 2007), where in a moderate dose, rather than a low dose, of sodium corresponds to a decreased risk of cardiovascular disease. Due to this independent relation of sodium having a positive effect on the state of the heart and its function, it is not thought that the impacts on the heart as seen through whole grain foods are related to sodium intake (Lillioja et al., 2013).

Another example of a health component that may have additional benefits beyond whole foods is that of the role of fiber. Fiber has many positive influences on the human body, most notably in the gastrointestinal system, but it should also be recognized that fiber coexists with many other nutrients that are critical for the body to have in order to function properly and efficiently. Lillioja, Neal, Tapsell, and Jacobs noted that the numerous medical benefits seen from consuming whole grains may actually be related to fiber itself. However, the researchers distinguished that fiber in whole grains has much greater effects than refined grains with added fiber (2013). Consuming both whole grains and fruits and vegetables with fiber indicates positive colorectal, metabolic, and cardiovascular health. It is hypothesized that the highly saturated fiber layer of endosperm of a grain, called aleurone, which is always accompanied by bran, is the strongest proponent of preventing chronic disease. Aleurone also contains many minerals, antioxidants, and healthful acids that have positive influences to body systems (2013).

Supplementation

Additionally, one may be concerned about supplementing nutrients when on a whole foods diet. Certain micronutrients (most notably the fat-soluble vitamins, A, D, E, and K) have the potential for toxicity if consumed in excess. Vitamins can be useful a vast majority of the time, but overconsumption can pose negative health effects. Bjelakovic, Nikolova, Gluud, Simonetti, and Gluud noted that vitamins A and E specifically may increase the risk of death and adverse reactions in participants who were not deficient in these vitamins (2015). The common, yet wise recommendation to keep in mind is “everything in moderation.” Once again, phytate is also a potential concern that consumers may have with whole food products as it relates to mineral absorption, but these concerns do not seem to be justified as phytate is actually a marker for minerals (Lillioja et al., 2013). There is a low likelihood that supplementation will be necessary while engaging fully in a whole foods diet.

Whole Milk

Dairy is a food group that is particularly intriguing to examine as it relates to whole foods. Dairy products typically come in full fat (whole), reduced fat, low-fat, and non-fat varieties. Folate, or B9, a vitamin associated with pre-natal supplements for the effects it has on the prevention of neural tube defects, has been examined closely in dairy products. In a small study in Spain, a group of researchers found that both fortified skim and fortified whole milk increased plasma concentrations of folate greater than that of unfortified whole milk at one and half hours post consumption, as well as hourly for the next five hours examined. However, the skim milk had a greater percentage increase between the baseline and the first test at one and half

hours, in addition to remaining elevated throughout the duration of the six and a half hour post-testing. Even though further studies are warranted, it seems as though the nutrient content in de-fatted milk is still accessible to the body, and in fact potentially more so than whole fat dairy products (Achón, Arrate, Alonso-Aperte, & Varela-Moreiras, 2011). This indicates that the removal of fat does not affect the absorption or presence of critical micronutrients and that vitamins and minerals in low-fat or non-fat version of dairy are equally as bioavailable to the body.

Additionally, lower fat contents of dairy products have other benefits when compared to whole-fat counterparts. In a study of nearly 500 children in Mexican boarding schools, researchers noted that fat-free milk decreased concentrations of multiple different types of cholesterol and lipoproteins, a good predictor of cardiovascular health, when randomly given to children across 13 different school. It may be relevant, however, to mention that the group of children who consumed lower fat milks also consumed more calories from carbohydrates. This is not necessarily positive nor negative, but is related to the calories and fat content that was consumed from milk (Villalpando, Lara Zamudio, Shamah-Levy, Mundo-Rosas, Manzano, & Lamadrid-Figueroa, 2015). Nevertheless, fat-free milks are widely considered to be the preferred choice for most populations.

Meeting too few calories

One may engage in a whole foods chronic diet to lose weight, but a concern that may need to be individually addressed is undereating. It is factual that hypocaloric diets result in weight loss and cardiovascular benefits to an extent, however, some consumers may not feel satiated, which may decrease persistence in adherence which would ultimately not result in

substantial weight loss (Katcher et al., 2008; Saltzman et al., 2001). An important thing to note with hypocaloric diets is the potential absence of nutrients, such as calcium or vitamin E, which are vital to a healthy life as well as utilizing amino acids as a fuel source (Melanson et al., 2006).

Severely restricting calories, especially carbohydrates can be particularly harmful. Some very low carbohydrate plans (20-50 grams per day) can force the body to rely on amino acids as a fuel source, which would therefore enable less protein synthesis to occur, a critical component of building muscle. Similarly, low carbohydrate lifestyles may impose protein breakdown in the liver to be utilized as glucose, which is necessary for brain function and damages skeletal muscle (Liebman, 2014).

Low carbohydrate diets may also result in gastrointestinal issues due to a decreased intake of fiber. A decreased function of the colon may lead to developing gastrointestinal disorders and discomfort. Additionally, high amounts of acid present in a low-carbohydrate, high protein diet may lead to an imbalance of potassium which is necessary in maintaining bone integrity and protecting against the possibility of developing osteoporosis (Liebman, 2014; Clinton, 2015).

Finally, a concern for engaging in a low carbohydrate diet is the effect on the exercising muscle. Since glucose is the main source of energy to the body, the ability to complete endurance or high intensity exercises will likely be diminished. Liebman concluded with a statement that low and very-low carbohydrate diets are unlikely to provide optimal health benefits, however, Clinton noted that except for a possible B12 deficiency as seen if one is engaging in a completely meat-free diet, malnutrition is not likely in a whole-food, plant-based diet (2014 and 2015). In summary, the focus should not be on limiting the amount of food or carbohydrates consumed,

but rather, choices should be made that promote positive, chronic diet habits of eating whole grains and foods.

Exceptions

There are relatively minor exceptions to the multitude of positive health implications from adhering to a whole foods chronic diet. Rock, Lovalvo, Emenheiser, Ruffin, Flatt, and Schwartz found that beta-carotene from pureed and thermally processed spinach was in a concentration three times higher than raw spinach in women during a four-week period (1998). Similar results were seen in thermally processed and pureed carrots as well as select other vegetables, such as sweet potatoes. This increase in concentration may be due to breaking apart the vegetable which increases bioavailability (1998).

Another food that is more bioavailable post-heating and homogenization is tomato puree. Lycopene, found in tomatoes, is a carotenoid which may promote antioxidant defense activities, such as protective mechanisms against certain types of cancers and is more readily available in tomato products that are processed, such as juices or pastes. Stahl and Sies noted that this may be through mild heating of tomatoes which may break cell walls, but the mechanism is not completely understood (1992, 1996). Not only is the absorption of lycopene at an increased concentration in tomato puree, but the level of absorption is elevated for a longer duration of time (Porrini, Riso, & Testolin, 1998).

Recommendations

At least half the grains whole

A number of governmental and non-governmental organizations have made recommendations on the amount of whole grains or the type to consume. The current across the board standard is to make at least half of the grain products one consumes a whole grain, aiming for a minimum intake of 48 grams per day. At least 8 grams of whole grain per 30 grams of grain is what is considered the minimal amount to reach the 48 grams per day recommendation; this amount is the same as the lower limit qualifier for labeling something as a whole food. This is a good starting place or goal for those who are not currently consuming any whole grains. Ideally, making sure that all, or close to all, grains consumed be whole grains will result in greater benefits to each of the realms discussed in this paper.

Currently vary by country

Recommendations for whole foods vary depending on where one is looking in the world. Many developed and some developing countries already have guidelines in place, as well as the World Health Organization (WHO). Recommendations do vary by country. Increasing the intake of whole foods, however, is a consistent theme and trend. Many countries are gravitating towards more specific suggestions (Ferruzzi et al., 2014). Checking the present guidelines by country may be helpful when prescribing new recommendations.

Suggestions

There are many recommendations on how to incorporate whole foods into a part of a chronic diet. Ferruzzi and colleagues gave suggestions on how to introduce whole foods into

one's diet. One such recommendation is a gradual approach in which the consumer steadily replaces whole foods for refined foods (2014). For example, in the beginning of this process, the consumer could substitute one product in their breakfast. The following week a processed food would be replaced for a whole food in their snack. This would continue into swapping a whole food in another meal, eventually adding whole foods into every meal, and ultimately consuming as much as would have previously been consumed of the processed counterparts in any recipe. Another example of this would be to use $\frac{1}{4}$ of a whole food product, then move up to using a half, and so on until fully utilizing whole foods instead of processed ingredients.

Another method is called "direct substitution" in which the consumer replaces one food completely for another right away, such as a whole fruit for fruit juice or whole wheat bread instead of white bread (Ferruzzi et al., 2014). Additionally, indirect substitution, where a whole food is replacing a different processed food, is another strategy to consume more whole foods. Instead of potato chips for a snack, one may choose to eat a whole vegetables, for instance.

The last method to mention is "addition", in which whole foods are simply added to the diet instead of removing processed foods (Ferruzzi et al., 2014). This method may be easier on some individuals who are hesitant to fully commit to engaging in a whole foods chronic diet. It may also benefit those people concerned with missing the processed foods that are enjoyable.

These suggestions are helpful, but may not be beneficial if one does not or is unable to adhere to the recommendations. Health educators can offer solutions to individuals interested in maintaining endurance in a whole foods program. Rich Roll, athlete and author, offers a word of advice in his book, *The Plantpower Way: Whole Food Plant-Based Recipes And Guidance For The Whole Family*:

It's just not that hard. In fact, it can be fun.... Start slow and lean in at your own pace. Pay close attention to how new foods make you feel.... Be consistent. What was unusual will soon become the norm.... The lesson? There are no rules, just choices. By preparing fun, 'out of the box' healthy food options, you can boldly break the conventional... paradigm (p. xiv, 63, & 120).

In the long run, ensuring that the new changes are enjoyable and having continued motivation, whether intrinsic, extrinsic, or a mixture of both, can be helpful in adhering to a whole foods chronic diet. Allowing for grace and forgiveness when mistakes are made is crucial to staying on track with one's goals and a reward system may be beneficial to certain individuals to keep up the desire for change.

Conclusion

Continuing research and education

The information presented in this paper is a meta-analysis on the current whole foods situation. Even though the evidence in this article is recent and applicable to the topic, further research is warranted. Ongoing education on this subject will continue to add to the knowledge base that consumers and scientists alike will share on whole foods that will enable more positive choices and better explain the vast benefits of whole foods.

Benefits

Choosing to adhere to a whole foods diet has many benefits. Ranging from mental health and cognition, to the numerous physical benefits and the positive impact on the environment, there are many ways that a whole foods diet can be helpful to any individual who decides to engage in this lifestyle. With the abundance of vitamins, minerals, fiber content, and appropriate amounts of macronutrients, it is easily possible to consume the right foods to receive the nutrients necessary for a healthy life. From preventing disease to using whole foods as a part of a treatment plan, there is a reason for almost any individual to start or continue on a whole foods chronic diet.

Need for change

The recommendations for and awareness of whole foods have increased greatly in recent years, but there is still a long way to go. Having knowledge on the benefits of whole foods is a first step in creating change, however, motivating populations to actually implement change is another story. Almost every country has some area that could be improved in this respect.

Recognizing a need for change will hopefully spark the thought of following through with this transition allowing the consumer to receive the numerous benefits that a whole foods diet offers.

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