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FEATURE

Diet and Academic Performance

Josiah Gabriel Hunt

Abstract. *Healthy eating habits (i.e., consuming appropriate amounts of wholesome foods at the right times) are generally associated with proper body weight, illness prevention, positive emotions, and long life. For many, a wholesome diet is one enriched by animal products; for others, diets that are plant-based. The purpose of this study was to collect quantitative data that would affirm or reject the researcher's null hypothesis of there being no association between a person's diet and his or her subsequent academic performance. To accomplish this task, 50 students at a Seventh-day Adventist college in South Asia were randomly selected and surveyed about their diets, health, and academic performance. The original data was tabulated into percentages and interpreted by means of comparative statistical analysis. The data findings support the rejection of the null hypothesis.*

Keywords: diet, academic performance, vegetarian, Southeast Asia, survey, descriptive research, food service directors, students, teachers

Introduction

Nutrition with its ties to health has become a topic of keen interest among medical practitioners and laypeople in the 21st century. Given the rapid spread of diseases among livestock (i.e. avian flu, mad cow disease, swine flu) and increased accessibility of documentaries on the Internet revealing dietary practices related to unethical animal treatment (e.g., Fulkerson's *Forks over Knives*, 2011; Monson's *Earthlings*, 2005), more people are opting for plant-based lifestyles. Though once associated with ascetic faiths, vegetarianism—the practice of excluding meat from one's diet (vegetarianism, n.d.)—has exceeded the bounds of religion, being supported and practiced by athletes, celebrities,

restaurant owners, and youth groups like the Straight Edgers (Barcella, 2014; Morgan, 2014; Watters, 2015). Nutritionists have found that vegetarians tend to have better health than people who consume meat (American Health Association, 2007; Appleby, 2006; Berkow & Bernard, 2005). Vegetarians also have lower rates of cancer, diabetes, heart attack, heart disease, high blood pressure, stroke, and sickness such as common colds, stomach viruses, and the flu (Lanou & Svenson, 2010; Marsh & Brand-Miller, 2011; Marsh, Zeuschner, & Saunders, 2012; Tantamango-Bartley, Jaceldo-Siegl, Fan, & Fraser, 2013). It is possible that one's diet also plays a role in influencing one's mental acuity. In a time in which educators are increasingly interested in factors affecting student performance, the question of diet becomes particularly relevant.

Much has been written assessing the relationship between academic performance and variables such as motivation (Alivernini & Lucidi, 2011; Rowell & Hong, 2013), study habits (Baran & Kihc, 2014; Lei, 2015; West & Sadoski, 2011), and physical activity/sleep (Balcázar, 2015) as being factors that influence student performance. These works have produced rich findings that are reviewed by administrators, educators, policy makers, and students, to strengthen achievement. However, one factor frequently overlooked is the influence dietary habits have on learning.

Following a comparative analysis design, this study examines performance across vegetarian and non-vegetarian participants. Though classified in a number of ways (i.e., lacto, lacto-ovo, vegan), the term *vegetarian* will be used inclusively to refer to people who do not eat meat. Broad generalizations suggesting one form of diet as being best for all students will not be made due to the (a) limited number of participants in this study and their selection by non-probability sampling, (b) differences in course difficulty, (c) differences in study habits, and (d) possibility of there being factors unaccounted for (e.g. lower performance levels stemming from the use of a foreign language [English] as the medium of instruction). Thus, the purpose of this preliminary study is limited to collecting and analyzing data that substantiates or debunks the notion of associations existing between diet and academic performance as a precursor for further exploration. Should the findings reveal differences across the vegetarian or non-vegetarian participants, a larger-scale follow up study using SPSS's parametric test of correlation will be recommended to measure the strength and direction of the relationship between variables.

Literature Review

In analyzing the available literature at the institution in which this study was undertaken during the 2007 academic year, the information seemed to be partial or one-sided. Due to the fact that the college is an Adventist institution, publishers such as the *Review and Herald* and the *Andrews University Press* are the primary

contributors of the literature available discussing diet and health. Undoubtedly, authors endorsed by these publishers assume a view that is harmonious with the teachings of their Church—that man's original diet was comprised of fruits, nuts, grains, and vegetables (Fraser, 2003; Gen. 1:29; White, 1976). Though much literature is devoted to the benefits of vegetarian and vegan lifestyles (see for example Davis & Melina, 2000; Messina & Messina, 1996; Rucker, 2002), seldom is its connection to formal learning addressed. This occurrence reveals a literary gap in need of exploration.

Two basic ideas are presented in the literature on vegetarianism and meat-enhanced diets. The first portrays diets devoid of animal products as being detrimental to health; the second promotes plant-based diets as the key to healthful living. Though the two positions sharply contrast, there seems to be a general consensus that (a) limiting meat intake can benefit health and (b) excluding meat and dairy products from one's diet without proper planning can be detrimental to health (see Craig, 2009; Myers, 2015; Wilkins, 2007).

Arguments Against Vegetarianism

A reoccurring argument against vegetarianism concerns its inability to supply the nutrients necessary for healthful living (Mandry et al., 2009; Martinac, 2014). Though consuming adequate amounts of fiber, carbohydrates, and vitamins, vegetarians are often deficient in the vitamins and minerals that meat readily provides (e.g. amino acids, calcium, fatty acids, iron, protein, vitamin B12, vitamin D, and zinc), (Antony, 2003; Edgar, 2014). In extreme cases, this may result in increased incidences of malnourishment (Inglenbleek & McCully, 2012; Shinwell & Gorodischer, 1982), lower bone density (Ho-Pham, Nguyen, & Nguyen, 2009; Norris, 2013), and irreversible nervous system damage (Bellows, 2014; Bourre, 2006; The Foundation for Peripheral Neuropathy, 2015). The increased susceptibility to diet-related illnesses vegetarians experience provides irrefutable evidence of the inability to get the proper combination of nutrients from diets that do not include meat or animal byproducts.

Advocates of vegetarianism often focus exclusively on the benefits of eliminating meat while failing to consider the ramifications such dietary changes may have upon a person's health. In a sense, awareness needs to be raised on the *negative* effects plant-based diets have on the body. For example, low intake of (a) vitamin B12 negatively affects the nervous system, (b) calcium weakens the bones, (c) iron impedes the blood's ability to clot and circulate throughout the body, and (d) zinc weakens immunity and the body's ability to heal itself—occurrences all too common among vegetarians (Anderson, Gibson, & Sabry, 1981; Bourre, 2006; Craig, 2009; Dror & Allen, 2008). Diets enriched with meat and low-fat dairy products contain most, if not all, the aforementioned nutrients, which, when taken on a regular basis, positively impact one's health and mental

functioning (Beisalski, 2005; McAfee et al., 2010; Medical Daily, 2010). This then implies it is the items that are *included* in one's diets—as opposed to *excluded*—that have the greatest impact on human health.

A widely accepted idea among vegetarians is the notion that eating meat is cruel (for example, see Couch, 1998; Haynes, 2013; People for the Ethical Treatment of Animals, 2015). A number of health professionals, farming-industry personnel, and bloggers feel vegetarians have wrongly led people to believe that (a) eating meat is inhumane, and (b) meat eaters commission the next live animal to slaughter by purchasing animal products for consumption (Chao, 2010; Monibot, 2010; Moritz, 2013; Woginrich, 2011). Considering the animal's fate in the wild, Fitzroy (1999) notes the following:

> Fish, fowl, mammals and insects in their natural state do not die of old age or go peacefully in their sleep with the family around the bedside; they are generally killed and eaten by other fish, fowl, mammals or insects. We might assume that such deaths are more frightening and painful than the swift death they experience in the slaughterhouse. For a wild animal, to be killed and eaten is natural; for a farm animal, to be slaughtered by humans might be a privilege. (para. 20)

The morality of vegetarianism (e.g., see Bekhechi, 2015; ProCon.org, 2015), a fundamental reason why this lifestyle is chosen, is directly challenged by Fitzroy's (1999) suggestion that animals being eaten by others (i.e., larger animals or humans) is simply a part of life.

Arguments Supporting Vegetarianism

Proponents of vegetarianism focus on physical, economical, environmental, and ethical factors as grounds for plant-based diets. In regards to physical health, switching to a vegetarian diet is viewed as being essential to wellbeing (Rucker, 2002; White, 1976). Foods that were once the staple items in human diets (i.e. meat and dairy products) are now linked to foodborne illnesses, heart disease, avian influenza, cancer, and other preventable diseases (Dewaal, Hicks, Barlow, Alderton, & Vegosen, 2006; Golubic, 2013; United States Department of Agriculture, 2013). In terms of the environment, vegetarianism offers a cleaner and more sustainable world by reducing the animal industry's waste, which often (a) erodes the soil, (b) contaminates water sources, and (c) contributes to climate change (Anderson, 2014; Vidal, 2010). It is said that the poultry industry alone produces over 220 tons of chemically polluted waste daily (Davis, 1996). Ethical considerations center upon the animals' right to move freely, exercise, breathe fresh air, and live normal lives—all of which are generally denied. Vegetarianism creates a more humane world by directly reducing the number of animals raised for food under such conditions (People for the Ethical Treatment of Animals, 2015). Lastly, switching to a vegetarian diet positively impacts the economy by

lowering the cost of food production and making better use of national funds, the latter often being allocated to the treatment of preventable diseases that stem from diets rich in animal products (Lusk & Norwood, 2009; Null & Feldman, 2011). For this study, the following research questions were considered:

1. Is there an association between fruit consumption and alertness during class time?
2. Is there an association between fruit consumption and sickness?
3. Is there an association between meat consumption and fatigue?
4. Is there an association between frequency of meat intake and academic achievement?

The Study

Though much is known about the food-mood connection, less is known about the effects food has on the intellect. The null hypothesis of this study is that there is no association between food intake and academic performance. Accordingly, no difference should be seen across the vegetarian and non-vegetarian participants in this study. The independent variables include frequency of meat intake, frequency of fruit intake, diet orientation, and meal size. The dependent variable is measured through achievement scores, level of alertness, sleepiness, and frequency of sickness. Comparison of the findings from vegetarians and non-vegetarians has resulted in a rejection of the null hypothesis, as there appears to be an association between the independent and dependent variables. Further elaboration is contained in the Descriptive and Associated Findings sections of this report.

Research Design

This study employed a quantitative methodology to investigate the association between diet and academic performance. Quantitative research consists of a diverse array of statistical approaches used to "describe current conditions, investigate relationships, and study cause-effect phenomena" in the natural and social sciences (Bloomberg & Volpe, 2012, p. 27). This approach to inquiry is largely deductive, in that researchers begin with an abstract idea, generate hypotheses to be tested, and then devise empirical measures that precisely capture the idea in such a way that can be expressed numerically. To collect testable data, researchers rely upon the use of surveys and questionnaires containing multiple indicators that directly measures the concept(s) under investigation. Whereas an instrument's validity concerns the degree to which it actually measures the construct, its reliability is determined by the extent to which the results are reproducible (Creswell, 2009). The data collected can be nominal (e.g., gender, religion), ordinal (e.g., 1st, 2nd), interval (e.g., temperature), or ratio (e.g., monetary amounts) level data—note: identification of the data level

is of prime importance for it ultimately determines the (a) statistical approaches permissible, and (b) nature of the findings (e.g., descriptive, inferential). It is with this understanding that this investigation focused on the association between diet and academic performance in this descriptive study.

Research Instrument

The primary aim of this study was to collect data to test the null hypothesis of there being no association between diet and academic performance. To do so, the researcher constructed an instrument designed to collect quantitative data from the surveyed participants, which would be used to gain insight into possible interactions between the independent and dependent variables. The questionnaire is divided into 4 sections: Sections I, II, II, and IV. Section I identifies the participants' gender and academic status—e.g., freshman, sophomore, etc. Section II consists of 8 questions. The questions included in this section cover dietary practices such as dietary orientation, duration of vegetarianism, frequency of intake (i.e., meat, fruits), meal size, and feeling after meals. Section III collects basic information regarding participants' personal health both inside and outside the classroom (i.e., frequency of sickness, feeling during class, and level of alertness). Section IV measures participants' academic achievement. In order to validate the survey instrument, the questionnaire was distributed to one faculty member and one student: One professor from the School of Graduate Studies and one graduate student enrolled in an education master's program. The feedback and suggestions provided by these two individuals were applied to the survey instrument. The survey questionnaire was then submitted for approval to the Research Methods course instructor, and permission granted to be distributed among the institution's student body.

Data Collection

Given the limitations of time, finance, and accessibility of student records, participant selection was based entirely upon convenience sampling. A total of 50 students from a Seventh-day Adventist college in South Asia were surveyed on January 22, 2007 in the school cafeteria. The time and location were selected for more than 80% of the institution's student body that dines at the cafeteria at noon. While convenience sampling may in some instances limit generalizability by under-representing or over-representing groups within a sample (e.g., vegetarians/meat eaters), this approach to participant selection permitted gathering useful data where governing bodies restricted access to relevant information.

Ethical concerns such as permission and participant safety were maintained through anonymity and voluntary participation. Informed consent was obtained from each student who received the questionnaire. The survey and collection

procedure were evaluated to minimize the possibility of academic, psychological, physical, or relational—harm occurring as a result of participating in this study.

Data Analysis

The survey's results were tabulated into percentages. The results have been displayed numerically to illustrate the general trends and findings.

Results

Of the 50 participants surveyed, 37 were meat eaters while 13 were vegetarians. The 37 meat eaters consisted of 17 females and 20 males, while the 13 vegetarians consisted of 7 females and 6 males. Statistically, approximately 74 percent of the participants ate meat, whereas 26 percent adhered to vegetarian dietary practices (a 3:1 ratio). Table 1 provides descriptive frequencies and percentages of the participants.

Table 1

General Frequencies and Percentages (N = 50)

Variables	Descriptors	Number of Participants	Percentage
Gender	Female	24	48.00
	Male	26	52.00
Diet Orientation	Non-vegetarian	37	74.00
	Vegetarian	13	26.00
Gender + Diet Orientation	Non-vegetarian Female	17	34.00
	Non-vegetarian Male	20	40.00
	Vegetarian Female	7	14.00
	Vegetarian Male	6	12.00
Frequency of Meat Intake	0 times per week	13	26.00
	1-2 times per week	17	34.00
	3-4 times per week	8	16.00
	5 or more times per week	12	24.00
Frequency of Fruit Intake	0-1 times per week	5	10.00
	2-3 times per week	20	40.00
	4-6 times per week	10	20.00
	7 or more times per week	15	30.00
Diet Orientation + Feeling after Meals	Non-vegetarian sleepy	27 out of 37	72.97
	Vegetarian sleepy	6 out of 13	46.15

(*Table continues)*

Table 1 (*Cont.*)

Variables	Descriptors	Number of Participants	Percentage
Rate of Sickness per Semester	Once	30	60.00
	Twice	12	24.00
	Three or more times	8	16.00
Diet Orientation (meat eater) + Academic Performance	"A" average	11	29.72
	"B" average	16	43.24
	"C" average	8	21.62
	"D" average	2	5.40
Diet Orientation (vegetarian) + Academic Performance	"A" average	2	15.38
	"B" average	10	76.92
	"C" average	1	7.69
	"D" average	-	0.00

Associated Findings

Fruits and Alertness. Comparison of the data findings produced a number of associations that warrant further discussion. In regards to the first question concerning fruit consumption and alertness, the data findings reveal an association between intake frequency and alertness (see Table 2).

Table 2

Fruit Consumption and Alertness

Fruit Consumption Rate	Descriptors	Number of Participants	Percentage
0-1 times per week	Always alert	-	0.00
	Normally alert	2	40.00
	Sometimes alert	3	60.00
2-3 times per week	Always alert	3	15.00
	Normally alert	9	45.00
	Sometimes alert	8	40.00
4-6 times per week	Always alert	1	10.00
	Normally alert	6	60.00
	Sometimes alert	3	30.00
7 or more times per week	Always alert	1	6.66
	Normally alert	10	66.66
	Sometimes alert	4	26.66

As fruit consumption increases, the tendency for one to be "normally" alert shows positive statistical growth. In like manner, a negative increase also occurs in the "sometimes alert" percentage as fruit consumption decreases.

On a surface level, the data seems to suggest that increased fruit consumption has a positive effect of stimulating the mind. How this is accomplished beyond the scope of this study; yet, what is known is that fruits help the brain process and recall information more efficiently (Hyson, 2001).

Fruits and Sickness. Analysis of the fruit intake and sickness frequency variables reveals a negative association between fruit consumption and sickness (i.e., as fruit consumption increases sickness frequency decreases; see Table 3). This may be attributable to fruits possessing a variety of vitamins, phytonutrients, and antioxidants that are vital to life (Gilbert, 1977). Nutrients from fruits help strengthen the immune system, build and repair muscle fibers, increase bone mass density, and maintain internal equilibrium in the nervous and circulatory system (Devault, 2011; United States Department of Agriculture, n.d.; Vatanparast, Baxter-Jones, Faulkner, Bailey & Whiting, 2005).

Table 3

Fruit Consumption and Sickness

Fruit Consumption Rate	Rates of Sickness	Number of Participants	Percentage
2-3 times per week	Once a semester	8	40.00
	Twice a semester	6	30.00
	Three or more times a semester	6	30.00
4-6 times per week	Once a semester	7	70.00
	Twice a semester	1	10.00
	Three or more times a semester	2	20.00
7 or more times per week	Once a semester	11	73.33
	Twice a semester	4	26.66
	Three or more times a semester	-	0.00

Wellbeing is an area of concern for educators as it directly affects students' performance. In a sense, sickness either results in students (a) being absent from school and missing important information, or (b) experiencing impairment in performing mental tasks should they choose to remain in class. The United States Environmental Protection Agency (2012), one of the most respected government associations in the United States of America, acknowledges that "children's overall performance decreases with illness" (para. 5). It is also worth noting that sickness not only affects students who are ill, but their classmates as well as their attention often becomes diverted from the task at hand to worrying about catching

the illness. Based on this, one can conclude that the wellbeing of students—or the lack of it—plays a part in influencing achievement.

Meat consumption and fatigue. The relationship between food and fatigue has been a topic of interest among health professionals and trainers in recent years (see Maridakis, Herring, & O'Connor, 2009; Sousa, Teixeira, & Soares, 2014). For example, meals rich in carbohydrates may induce fatigue thus lowering cognitive performance (Benton, 2002), whereas meals rich in protein and unsaturated fat are reported to heighten mental processing and performance (Lieberman, 1999). A logical conclusion would be to maximize protein intake; however, some studies show otherwise.

Meat consumption. After years of research, scientists have come to the realization that food affects the mind by altering the body's chemistry. Certain foods contain nutrients that can raise or lower one's serotonin, dopamine, adrenaline, and epinephrine levels (Colbin, 1991). Consuming large quantities of these foods result in an influx of chemicals in the bloodstream. If the level of these chemicals is excessively high, the brain's finely-calibrated pathways of neurons and neurotransmitters will be disrupted, leading to erratic mental functioning—e.g., feeling down, hyperactivity, lethargy, or even a lack of an ability to concentrate (BDA, 2014; Magee, 2009; Pierre, 2011).

Table 4

Digestion Times

Type of Food	Descriptor	Average Time (hours)
Protein	Legumes	5
	Meat	12
Cheese	Tofu	4
	Dairy	10
Milk	Soy	3
	Dairy	12

Note. Table information obtained from Natural Ways to Health (n.d.)

Eating foods that contain carbohydrates and protein (rice and beans, a tuna fish sandwich) creates a calm and focused mood. Comparatively, eating foods that contain small amounts of protein energize the brain and make it more alert. Whereas consuming foods excessively high in protein or carbohydrates inhibits mental functioning (Colbin, 1991). What this suggests is that there is a great need for balance in one's diet.

In one experimental study, Hawley (1975) analyzed the effects of diet on nine Swedish athletes as they rode stationary bikes. Their assignment was to pump the pedals until their legs muscles were no longer able to respond. After three days on

a high fat and protein diet (such as meat, eggs, fish, cheese) the men lasted a total of 57 minutes. The same athletes were then tested following 3 days on a mixed diet—as eaten by the average person. Their time nearly doubled to 114 minutes. Finally, these same men went on a strictly vegetarian diet and were given the same task. The result was a total of 167 minutes.

If one were to compare Hawley's study to the statistics in this research project, one would see several similarities—in regards to feelings after meals. Of the non-vegetarian students participating in this study, 72.97% reported feeling tired after meals, whereas 46.15% of the vegetarians reported similarly. A possible reason for this result is that the body does not utilize energy derived from animal foods as quickly (see Table 4) and effectively as those from plant origin.

Frequency of intake and academic achievement. As seen in Table 5, there are marked increases in grade averages as meat intake decreases.

Table 5

Meat Intake Frequency and Academic Achievement

Weekly intake frequency	Grade Average	Number of Participants	Percentage
5 or more times	"A" average	-	0.00
	"B" average	5	41.66
	"C" average	6	50.00
	"D" average	1	8.33
3-4 times	"A" average	2	26.66
	"B" average	4	46.66
	"C" average	2	26.66
	"D" average	-	0.00
1-2 times	"A" average	9	52.94
	"B" average	8	47.05
	"C" average	-	0.00
	"D" average	-	0.00

In comparing the diet of students who consume one to two servings of meat per week to those who eat it five or more times weekly, the data suggests that the majority of the former group has an "A" average, whereas the latter majority has a "C" average. Given the limited nature of this study—in terms of statistical tools and sample size—it is not feasible to draw inferences from the data. Nonetheless, one thing is clear: individuals whose diets contain high amounts of fruits and minimal animal products outperformed their peers in all areas (i.e., being alert in class, frequency of sickness, feeling after meals, and academic performance).

Conclusions and Recommendations

Healthy eating habits (i.e., consuming appropriate amounts of wholesome foods at the right times) are generally associated with proper body weight, illness prevention, positive emotions, and long life. For many, a *wholesome diet* is one enriched by animal products, while for others, diets that are plant-based. The major goal of conducting this study was to collect data that test the null hypothesis of there being no association between a person's diet and his or her subsequent academic performance. The findings from this study led to the rejection of the null hypothesis. This study's results validate Scharffenberg and Walton's (1981) claim of there being an "intricate link between the digestive system and the brain" (p. 12). This study has led to conclude that happiness, health, and mental acuity in some senses hinge upon how well humans follow the rules of diet.

The primary limitations of the present study were (a) a small sample size; (b) institutional restrictions prohibiting access to student records, which in turn compromises reliability by thus rendering academic performance as being self-reported; and (c) convenience sampling's inability to produce generalizable findings. In light of the study's results, limitations, and methodology, the recommendations are as follows:

(a) design a similar study on a larger scale using random sampling procedures to obtain a representative sample of the population from which it is drawn to ensure generalizability; (b) collaborate with school administrators to obtain achievement records from participating students; and (c) redesign the survey instrument to obtain data at the interval and ratio levels.

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Josiah Gabriel Hunt, PhD Candidate
Adventist International Institute of Advanced Studies
Silang, Cavite, Philippines
hunj@aiias.edu