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LOMA LINDA UNIVERSITY

School of Allied Health Professions

Department of Nutrition and Dietetics

A COMPARISON OF THE RISE OF SERUM LIPIDS, GLUCOSE, AND HS-CRP LEVELS AFTER CONSUMPTION OF A BEEF BURGER VERSUS A VEGETARIAN BURGER

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ABSTRACT

Background: A strong positive association exists between the consumption of fast food and risk of chronic diseases, which includes heart disease and type 2 diabetes. Some individuals seek more healthful food alternatives, which include vegetarian products. The fast food industry is investing in more plant-based products.

Objective: The purpose of this study is to compare the change in blood biomarkers (serum lipids, glucose, and high sensitivity C-reactive protein (hs-CRP)) after consumption of a beef burger versus a vegetarian burger.

Methods: Thirty-five healthy adults (22 females and 13 males), with mean age 28.5 ± 6.1 years and mean Body Mass Index 24.4 kg/m² ± 3.5 completed a double blind, randomized, crossover study. After an eight-hour fast, they were randomly assigned to eat either a beef or vegetarian (Impossible) burger. One week later, the burgers were switched. The biomarkers were measured while fasting, and at 30, 60, and 120 min post-burger consumption.

Results: Linear mixed model was used for data fitting to assess the effect of adjusted covariates on selected nutrients. Blood triglyceride levels significantly increased from baseline over time after consumption of beef burger ($p<0.001$). Consumption of the vegetarian burger showed significantly faster increase in triglycerides compared to the beef burger ($p<0.001$). At 120 min, there was no significant difference in the levels. Low-density lipoproteins cholesterol significantly decreased over time following both types of burgers ($p<0.001$). There was no significant difference between the two burgers. Glucose levels showed significant changes over time for both groups ($p<0.001$). There was a significantly ($p<0.004$) greater change (initial increase, then decrease) in glucose levels after the vegetarian compared to the beef burger. Glucose levels peaked at 30 min, returning to baseline at 120 min for both groups. There was no significant difference in total cholesterol

(p=0.62), high-density lipoprotein cholesterol (p=0.81), or hs-CRP (p=0.58) within or between groups.

Conclusion: Contrary to popular thought, consumption of beef and vegetarian burgers produce similar changes in acute blood biomarkers. Future research is warranted.

INTRODUCTION

According to the Centers for Disease Control (CDC) and Prevention, six in ten Americans live with at least one chronic disease, which includes heart disease and type 2 diabetes (T2D).[1] Chronic diseases are the leading cause of death in the United States, and the number of cases continue to grow annually.[2,3] Due to the growing number of health concerns, people are now seeking out more healthful food alternatives, which includes trying more vegetarian and vegan products.[4] Studies have shown that food plays an important role in the prevention and treatment of chronic diseases.[5-7] Recent evidence suggests that, in some cases, diet is responsible for decreasing low-density lipoprotein cholesterol levels, lowering blood sugar levels, and regulating inflammation levels.[7-9]

Although the demand for healthful foods has increased, consumers still have a strong desire for convenient, fast food products.[10] In the US, up to 37% of adults and 42% of children regularly consume fast food.[11] This demand has led the food industry to invest in more plant-based food products. Fast food restaurants such as Carl's Jr. and Burger King have already released their versions of plant-based alternative products (Beyond Famous Star and Impossible Whopper), and Del Taco added a new vegetarian menu item (Beyond Tacos).[12-14] Recently, Nestlé announced that they are planning to release a plant-based "meat" called the Incredible Burger.[15] The ingredients found in these plant-based food products may have an impact on our health.

Le et al., compared the prevalence of diabetes in non-vegetarians and vegetarians among Seventh-day Adventists in the United States.[16] They found that non-vegetarians have almost twice the prevalence of diagnosed diabetes compared to vegetarians. In addition, the study shows that people who consumed meat and animal products are at an increased risk of developing T2D.[16] Lanou et al., compared a population that followed either a vegetarian or non-vegetarian diet with

cancer risk.[17] Results from the study shows that following a vegetarian diet helps to protect against some cancers, decreases mortality rate, and reduces the risk of cardiovascular diseases (CVD).[17] Diet can also influence the levels of cholesterol, glucose, and inflammation in human bodies.

Cholesterol plays an important role in maintaining the chemical and physical properties of cell membranes.[18] Chen et al., found that hypercholesterolemia is associated with a range of diseases, such as atherosclerosis, coronary heart disease, diabetes, and stroke.[19] Hypercholesterolemia may also cause neuroinflammation, which can increase the risk of age-related neurological disorders.[19] Early detection and prevention is important in maintaining cholesterol levels before they become detrimental to an individual's health.

Okin and Ruslan et al., looked at the importance of controlling plasma glucose.[20] They found a specific mechanism in our body, which controls glucose homeostasis to ensure that all target tissues of our body will be supplied with glucose and to avoid toxic effects of hyperglycemia. In addition, inflammation and chronic diseases can also increase plasma glucose levels that may cause hyperglycemia, which correlates with morbidity and mortality.[20] This can also lead to the development of T2D, which is known to bring many challenges to the health of individuals.[21]

Low-grade chronic inflammation is also known to have an important role in several chronic diseases, such as obesity, T2D, and CVD.[22] Mazidi et al., found that there is an association between dietary fatty acid and serum levels of high sensitivity C-reactive protein (hs-CRP) and other inflammatory biomarkers.[23] Results of this study showed that the concentration of hs-CRP changes with fatty acid intake.[23]

Previous studies have looked at the association between fast food meals and health.[11,24] Klementova et al., used a randomized crossover design to compare the effects of two energy-matched meals (a processed meat-cheese burger and a plant-based tofu burger) on gastrointestinal

hormones and satiety in men that were either healthy, obese, or had T2D.[24] They found that there was an increase in gut hormones and satiety, following consumption of a single tofu burger compared to a processed meat-cheeseburger.[24] Rudolph et al., conducted a crossover study to look at the acute effects of conventional and alternative fast-food meals on vascular function and various cardiovascular biomarkers.[11] The different types of meals did not show any significant differences in acute effects on vascular reactivity. However, the importance of the Rudolph study to our proposed study, is that they measured the biomarkers at baseline and then 2 and 4 hours after consumption of each fast food meal.[11] Additional studies have also compared the postprandial effects of meals between 0 to 4 hours.[24,25]

To date, there are limited studies available on plant-based food alternatives (Impossible Foods, Beyond Meat, etc.) and their effect on acute serum biomarkers in comparison to beef products. We hypothesized that there is no difference in the rise of serum lipids, glucose, and hs-CRP levels after consumption of a beef burger versus a vegetarian burger. The purpose of this study was to compare the change in blood biomarkers (serum lipids, glucose, and hs-CRP) after consumption of a beef burger versus a vegetarian burger in healthy adults.

SUBJECTS

We recruited thirty-six healthy individuals to participate in this study. Recruitment was conducted via word-of-mouth, email, social media, and flyers that were distributed around Loma Linda University campus. To be included in the study, participants had to be healthy, between 21 and 55 years old, willing to consume both beef and vegetarian products, have no distaste for whole wheat buns, lettuce, soy, tomatoes, or vegan mayonnaise, and be willing to abstain from caffeine and exercise the morning of the visits. Participants were excluded if they had a known history of

dyslipidemia, diabetes mellitus, or arthritis, or were allergic to the following food items: gluten, lettuce, soy, tomatoes, or vegan mayonnaise.

All methods and procedures were approved by the Institutional Review Board of Loma Linda University prior to the start of the study. The purpose, basic design, and individual's role within the study were explained to potential participants. While there were no direct benefits for participants, the results of the study will provide insight into acute changes in serum lipids, glucose, and hs-CRP levels after consumption of a beef burger versus a vegetarian burger. Risks to participants were minimal and involved a possible breach of confidentiality, distaste for the burger patties, and discomfort during the finger prick tests. All recruited participants signed a statement of informed consent prior to admission into the study.

METHODS

Questionnaires:

Participants completed a questionnaire that included questions about their demographics (age, gender, and race), eating habits, physical activity level, medical history (known allergies, history of dyslipidemia, diabetes mellitus, or arthritis), number of hours of sleep obtained the night before their visit, and current stress level. After consumption of each burger, participants were asked to try and identify the burger they consumed and to rate the taste of the burger. The questionnaires were developed by the researchers. Completion of questionnaires took 5 minutes or less to complete.

Hamburgers:

Each participant consumed a burger with a whole wheat bun, lettuce, tomatoes, and vegan mayonnaise (free of cholesterol) during each visit (2 visits in total). The burger patties were 4

ounces (pre-cooked weight). The beef patty (Beef Patty Chuck) was 80% lean and 20% fat. The vegetarian patty (Impossible Burger) was 18% fat. Researchers were responsible for preparing the burgers.

Finger Prick Tests:

Finger prick tests (tiny drop of blood) were used to measure biomarkers at baseline, and then at 30, 60, and 120 minutes postprandial to determine each participant's lipid profile. The lipid panel consisted of total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C). Dyslipidemia, primarily in terms of TC and TG levels, has been identified as a risk factor for CVD.[26]

Blood from the finger prick tests was used to measure the participant's glucose levels. High blood glucose levels may indicate that the body is no longer able to produce or use insulin effectively.[27] In addition, the blood from the finger prick tests would provide information on inflammation by measuring hs-CRP levels, which increase during acute inflammatory responses.[28]

The finger prick test technology has shown to be accurate when the results have been compared with venous blood draw data performed in a standardized laboratory. Due to the ease of administration and rapid turnaround time for obtaining results, it is a popular tool used by healthcare professionals to measure lipid, blood glucose, and hs-CRP levels in the blood.

Steps for Data Collection using the Alere Cholestech LDX and Diazyme Smart 700-340

1. Label test tube with randomly assigned identification number and date.

2. Have participant wash hands with warm water and soap.

3. Select a finger and wipe with alcohol. Dry finger with a clean tissue.

4. Hold lancet firmly against the side of the chosen finger and press button on top of the lancet.

5. Massage finger to encourage drops of blood to exit finger. Hold finger against collection tube and let blood fill tube.

6. Label test cassette and test tube again with the same randomly assigned identification number to ensure confidentiality.

7. Submit to the lab for analysis and hs-CRP Biomarker Report.

PROCEDURE

During recruitment, if a participant decided to participate in the study, we had them complete an informed consent. They also completed a brief questionnaire regarding their demographics (age, gender, and race), physical activity level, and medical history (known allergies, history of dyslipidemia, diabetes mellitus, or arthritis). Participants were directed to fast for 8 hours prior to Visit 1.

On Visit 1, participants who met the criteria were directed to Nichol Hall, Room A112, at Loma Linda University to start the study. They were randomized into either Group 1 or Group 2 using a random number table. Next, they filled out a questionnaire on how many hours they slept and their level of stress. A finger prick test was used to determine baseline levels measurements for serum lipids, glucose, and hs-CRP levels. Group 1 was given vegetarian burgers to consume and Group 2 was given beef burgers to consume. Participants were then asked to attempt to identify the burger they ate and rate the taste of the burger.

Participants had to remain in Room A112 for 2 hours, postprandial (they were allowed to study, watch a movie, etc.). They were not allowed to consume anything except for water during this time. After consumption of the burger, finger prick tests were used to obtain blood at 30, 60, and 120 minutes. Visit 1 took approximately 3 hours. During the following week (Visit 2),

participants repeated the same procedure as Visit 1. However, this time the burgers were switched. Visit 2 took approximately 3 hours in total.

STATISTICAL ANALYSIS

All statistical analyses were conducted using a statistic software package SAS 9.4.[29] Linear mixed model was used for data fitting and to assess the effect of adjusted covariates on selected biomarkers. For each selected biomarker, three Kronecker product covariance structures that were available in PROC MIXED function were used for best data fitting.[30] The model with the lowest Akaike information criterion (AIC) was selected as the regression model to evaluate the crossover effect and changes among four repeated measures (0, 30, 60, and 120 minutes) after the meal. The difference of each baseline biomarker was adjusted as fixed effect in the linear mixed model. The level of significance was $p \leq 0.05$.

RESULTS

Thirty-six participants started and 35 completed the study (22 females and 13 males), with one participant unable to complete the study due to scheduling conflicts. The descriptive statistics for demographics of participants are shown in Table 1.

Table 1. Demographics of participants at baseline (n=35).

Characteristics	Frequency (%)
Gender:	
Female	22 (63)
Male	13 (37)
Age (years)*:	27 ± 6.5
BMI (kg/m^2)*:	23.8 ± 4.3
Race:	
Asian/Pacific Islander	17 (49)
White	11 (31)
Hispanic or Latino	7 (20)
Level of Physical Activity:	
Extremely Active	2 (6)
Very Active	7 (20)
Moderately Active	19 (54)
Sedentary	7 (20)
Type of Burger Usually Consumed:	
Beef	10 (29)
Vegetarian	3 (9)
Both	35 (62)

* Values are presented as mean± standard deviation

Results from Figure 1 showed that TG levels significantly increased from baseline over time after consumption of each type of burger ($p<0.001$). Consumption of the vegetarian burger showed a significantly faster increase in TG levels compared to the beef burger ($p<0.001$). At 120 min, there was no significant difference between the levels. Figure 2 shows that LDL-C significantly decreased over time following consumption of both burgers ($p<0.001$). There was no significant difference between the burgers. Glucose levels showed significant changes over time after both burgers were consumed ($p<0.001$). There was a significantly ($p<0.004$) greater change (initial increase, then decrease) in glucose levels after the vegetarian burger compared to the beef burger. Glucose levels peaked at 30 min and returned to baseline at 120 min after both groups (Figure 3). There were no significant differences seen in total TC levels ($p=0.62$), HDL-C ($p=0.81$), or hs-CRP levels ($p=0.58$) within or between the two burgers (Figure 4-6).

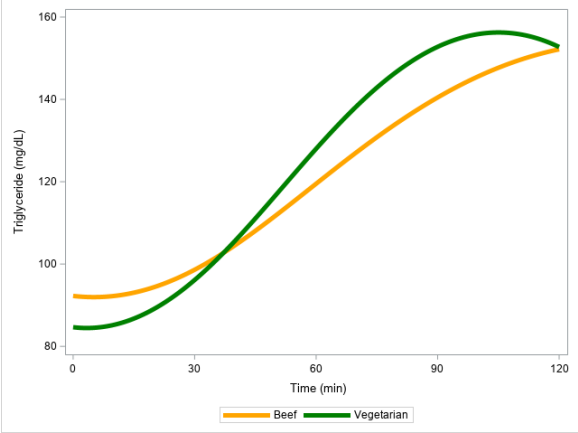

Figure 1. Average triglyceride levels over 120 min (n=35).

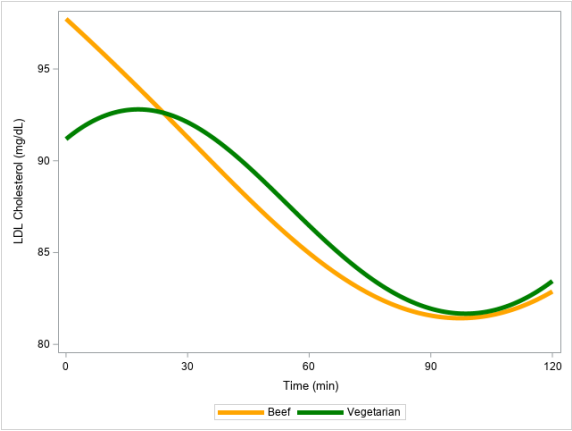

Figure 2. Average LDL cholesterol levels over 120 min (n=35).

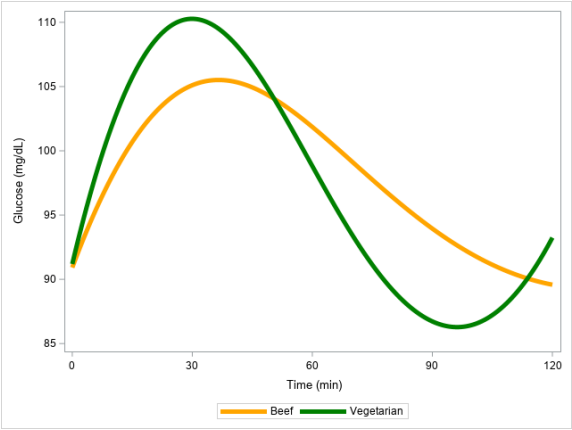

Figure 3. Average glucose levels over 120 min (n=35).

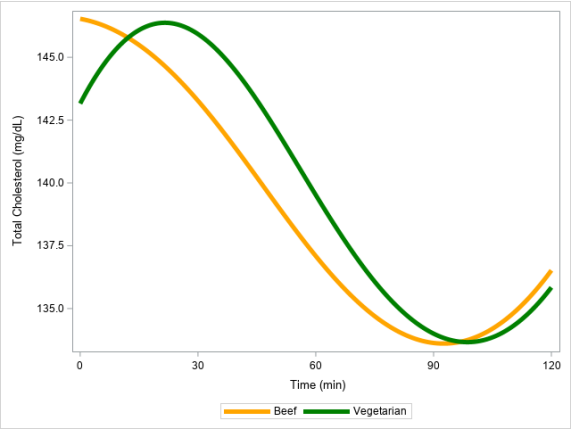

Figure 4. Average total cholesterol levels over 120 min (n=35).

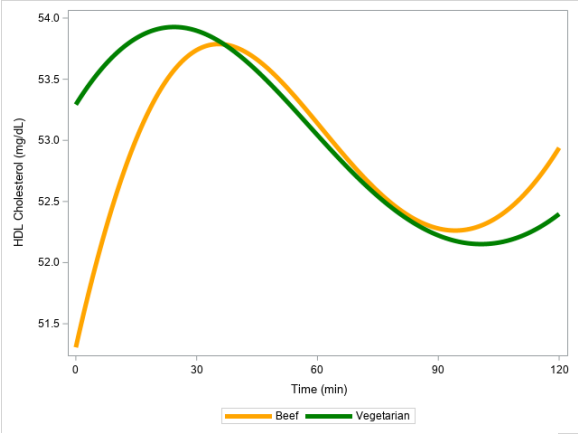

Figure 5. Average HDL cholesterol levels over 120 min (n=35).

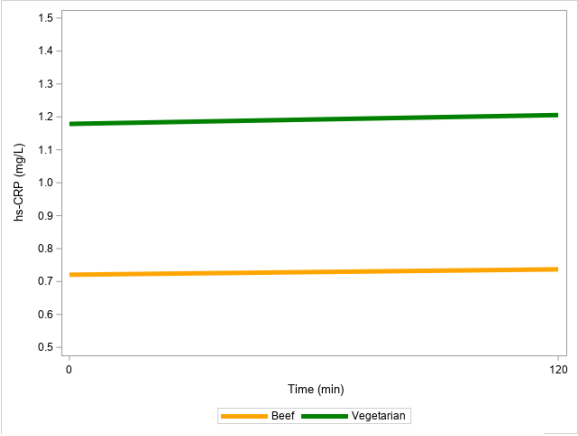

Figure 6. Average hs-CRP levels over 120 min (n=35).

Each of the participants were asked to attempt to identify the burger they had been given to eat. Their responses were compared against the actual burger they were given. Out of the 70 total responses, 43 responses (61%) were correct and 27 responses (39%) were incorrect (Figure 7).

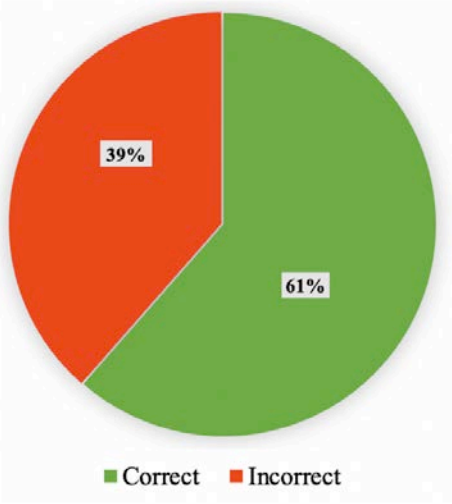

Figure 7. Percentage of correct attempts for burger identification (n=70).

After consumption of each burger, participants were also asked to rate the taste of the burgers on a scale from 1 (Strongly Dislike) to 5 (Strongly Like). More than 40% of participants Liked or Strongly Liked the vegetarian burger compared to the beef burger. The results of how participants rated the taste of each burger are shown in Table 2.

Table 2. Taste comparison for the beef burger versus the vegetarian burger (n=35)

Burger Taste:	Beef Burger (%)	Vegetarian Burger (%)
5- Strongly Like	5 (7)	10 (14)
4- Like	21 (30)	18 (26)
3- Neither Like or Dislike	6 (9)	6 (9)
2- Dislike	3 (4)	1 (1)
1- Strongly Dislike	0 (0)	0 (0)

DISCUSSION

In this crossover study, an attempt was made to determine if differences in acute biomarkers resulted after consumption of a beef burger versus a vegetarian burger. Significant changes were observed in some serum lipids and glucose levels from baseline to 120 minutes. However, no significant differences were observed in these acute biomarkers between a beef burger and a vegetarian burger at 120 minutes postprandial. In recent years, there has been growing evidence, which suggests that high consumption of red meat is associated with an increased risk of chronic diseases (e.g. CVD, T2D, and coronary heart disease).[31] Many believe that plant-based products may be a healthier alternative to red meat products. The vegetarian (Impossible) burger is still a relatively new plant-based option on the market, so a limited number of studies have looked into its health benefits, if any, and its association with various chronic diseases.

TG is the major storage form of fat in the body and is responsible for transporting fatty acids and glycerol within the cells.[32] According to the nutrient composition, for a 4 oz burger patty, the beef burger patty used in the study contained 23g of total fat, while the vegetarian burger patty contained 14g of total fat.[33,34] Our results 120 min, after consumption of each type of burger. The increase in TG levels are expected due to TG being the major form of fat in the burgers. Miller et al., reported that serum TG levels are also affected by genetic factors, environment factors, and lifestyle factors.[33]

Moreover, after consumption of the vegetarian burger, the TG levels showed a significantly faster increase compared to consumption of the beef burger. This may be due to additional ingredients used to create the Impossible burger patty. Most of the fat used in the Impossible burger comes from coconut oil, which is high in medium-chain fatty acids (MCFA).[34] As per Wang et al., MCFA is rapidly broken down and absorbed into the portal circulation,

which leads to a more rapid increase in TG levels after consumption of the vegetarian burger.[35] Khaw et al., examined the effect of coconut oil, olive oil, and butter on blood lipids and other CVD risk factors in a randomized clinical trial conducted with healthy men and women.[36] They noted that the main fatty acids in coconut oil are lauric acid and myristic acid, which are MCFA that are rapidly absorbed and then oxidized to increase energy expenditure, which may be an explanation for why coconut oil shows a different dietary effect when compared with other saturated fats.[36]

LDL-C is known as a complex compound that transfers cholesterol, lipids, and fatty acids from the liver to peripheral tissues within the body. It is commonly used as an indicator to evaluate the health risk of CVD, coronary heart disease, and hyperglycemia.[37] The results of our study show that LDL-C significantly decreased over time after consumption of both burgers. This phenomenon is expected because of the type of blood analyzer used. Due to the type of analyzer, the LDL-C level was quantitated indirectly using the Friedewald equation.[38] LDL-C levels were calculated from TC, HDL-C, and TG. However, the Friedewald equation has some limitations. If TG levels are greater than 400 mg/dl, or affected by a recent meal, the calculated LDL-C will be artificially lower or non-valid. Although the LDL-C level was calculated, several studies have shown that indirect LDL-C level has a maximum correlation with direct LDL-C level.[38,39] Future studies may look at direct LDL-C tests or consider other blood tests, which may give a more accurate reading of LDL-C levels.

Glucose plays an important role in our bodies. It can be used as fuel for our brain and muscles. However, high glucose levels (hyperglycemia) can lead to insulin resistance and T2D.[40] According to the results of this study, glucose levels rose faster after consumption of the vegetarian burger compared to the beef burger. These results are expected because the vegetarian

patty contained carbohydrates (9 g of total carbohydrates based on the nutritional composition of the Impossible burger), while the beef patty contained 0 g of total carbohydrates.[34,41] Our study shows that the blood glucose levels started to rise around 10 min and decreased around 120 min. Anton et al., investigated the effects of different carbohydrates on postprandial glucose and found that it took between 5 to 30 min to raise blood glucose levels after consumption of a food item containing carbohydrates and around 120 min to decrease blood glucose levels.[42]

Cholesterol has numerous functions in the body, which include building cell membranes, cell structures, and synthesizing hormones.[43] TC level represents the total amount of cholesterol in the blood that includes VLDL-C, LDL-C, HDL-C, and TG. High blood cholesterol level is associated with an increased risk for heart disease, stroke, and other health issues.[44] In our study, we found that there was no significant difference in total cholesterol levels, but there was a slight decrease over 120 min after consumption of both the beef and vegetarian burgers. This trend was not expected, since both burgers contain different amounts of cholesterol. The beef patty contained 105 mg of cholesterol and the Impossible burger patty contained 0 mg of cholesterol.[34,41] Blesso et al., looked at the association between the intake of eggs (a cholesterol source) and CVD risk and noted a weak relationship between an individual's blood cholesterol level and the amount of cholesterol intake.[45] The mechanism is not very clear since there are many factors involved. Further studies are needed to investigate intestinal absorption of cholesterol from foods, and how cholesterol is regulated in the body.

HDL-C is responsible for reverse cholesterol and lipid peroxide transport as well as other beneficial functions, which can help lower the risk of CVD.[46] Consumption of foods high in saturated and trans fat, which are typically found in fast foods, has been found to increase LDL-C and TG levels, while decreasing HDL-C levels, thus, promoting the development of CVD.[47]

Our study found no significant difference in HDL-C levels after consumption of a beef burger and a vegetarian burger from baseline to 120 min. The results of HDL-C were expected because of the inverse relationship between LDL-C and HDL-C. Tianen et al., examined the effect of HDL-C on postprandial oxidative stress after consumption of a fatty meal (a standard hamburger meal) and found that HDL-C was negatively associated with the increase of oxidized LDL-C.[46] A review conducted by Rathnayake et al., also saw reduction in HDL-C levels after examining the acute effects of meal fat composition on postprandial lipemia in postmenopausal women.[48] Further studies are needed to examine how HDL-C levels change after consumption of a fatty meal.

Hs-CRP is a biomarker used to evaluate an individual's risk of CVD. Our study found that after consumption of a beef burger and a vegetarian burger, hs-CRP levels remained constant for 120 min (2 hours). These results were expected, as other studies have shown that hs-CRP levels typically do not change within 2 hours postprandial.[49,50] Although hs-CRP was not expected to change, we decided to use the Diazyme Smart 700-340 to determine if there was an acute response of hs-CRP after 2 hours postprandial. We believe this is the first study to examine whether the fat content of the beef and Impossible burger patties affects the inflammatory state of an individual using the Diazyme Smart 700-340. Devaraj et al., investigated how fast-food, typically high in fat, affects oxidative stress and inflammation, and found that it took between 5 to 6 hours to raise levels of inflammatory markers after consumption of a food item.[49]

The present study has several strengths. To our knowledge, it is the first randomized, double-blind, crossover study to examine the acute changes in serum lipids, glucose, and hs-CRP levels after consumption of beef burger and an Impossible burger. Our results are strengthened

by adequate power, and high compliance of participants. In addition, statistical models were used to assess the effect of adjusted covariates on selected biomarkers.

Some limitations of our study include limited funding and time constraints. Participants were only given one of each burger type to consume, one week apart, and we were limited to the number of blood tests and biomarkers we could conduct. Additionally, our study included a relatively small number of participants.

CONCLUSION

Based on our findings, and contrary to popular thought, consumption of a beef and vegetarian burger produces similar changes in acute blood biomarkers (serum lipid, glucose, and hs-CRP). Our study shows that there is not enough evidence to support whether consumption of a vegetarian (Impossible) burger would be a healthier alternative to a beef burger. Studies have shown that long term consumption of meat is related to cardiovascular disease, diabetes, and other health issues. Our study shows that short term changes in biomarkers occur similarly after consumption of each type of burger.

Further research is needed to determine whether consumption of an Impossible burger will increase the risk for chronic diseases similar to meat consumption. It would also be interesting to see how consumption of other processed plant-based products compare to beef products. Perhaps, future studies could look at other biomarkers that measure acute changes, which may be better predictors of long-term health outcomes.

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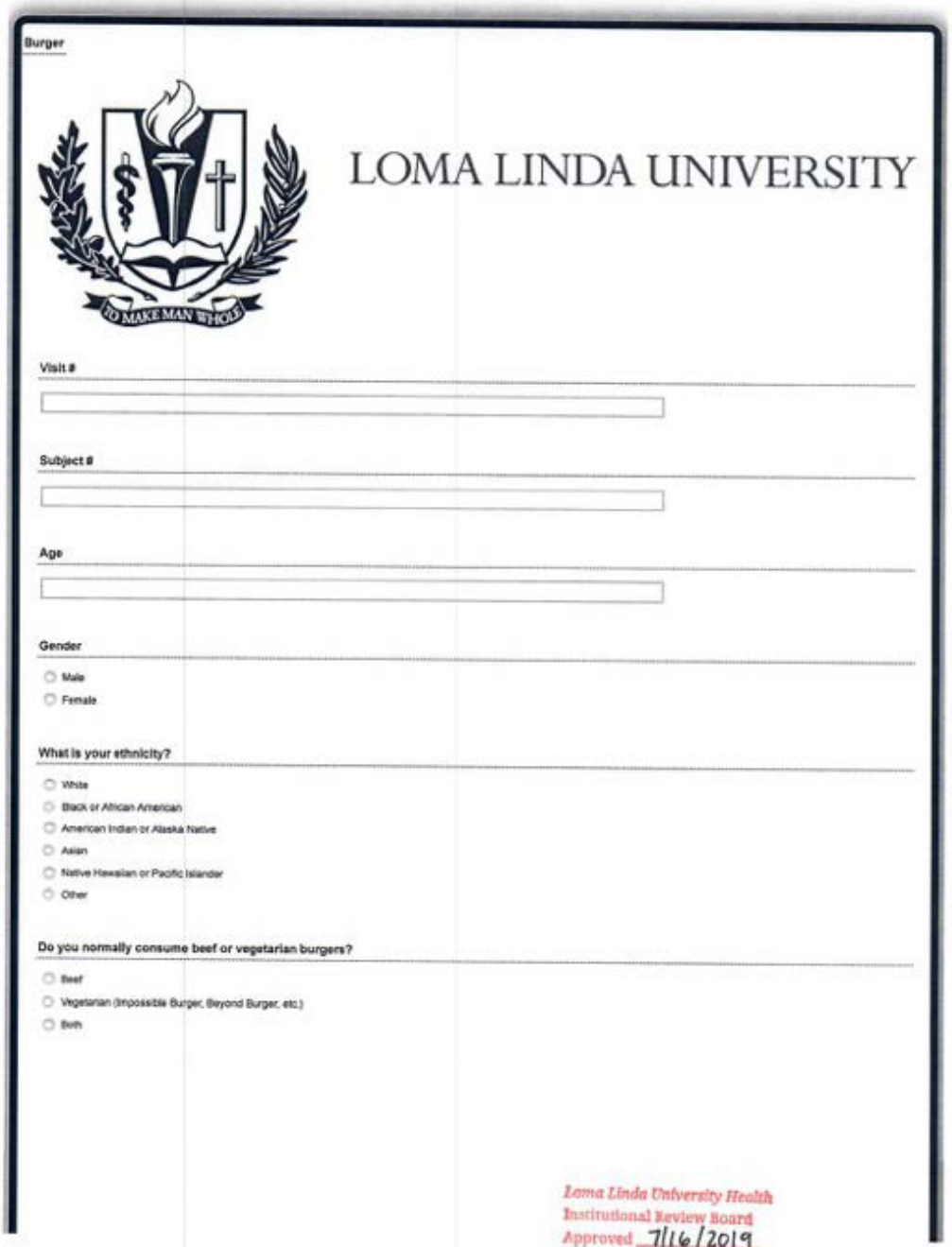
APPENDIX A

Questionnaire for Visit 1



Burger

LOMA LINDA UNIVERSITY

TO MAKE MAN WHOLE

Visit #

Subject #

Age

Gender

- Male
- Female

What is your ethnicity?

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Pacific Islander
- Other

Do you normally consume beef or vegetarian burgers?

- Beef
- Vegetarian (Impossible Burger, Beyond Burger, etc.)
- Both

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How often do you consume burgers?

- ○ Daily
- ○ Once a week
- ○ 2-3 times a week
- ○ 4-6 times a week
- ○ Once a month
- ○ Never

What is your level of physical activity?

- ○ Sedentary
- ○ Moderately Active
- ○ Very Active
- ○ Extremely Active

Are you allergic to any of the following food items?

	Please check Yes or No	
	Yes	No
Gluten	○	○
Lettuce	○	○
Soy	○	○
Tomatoes	○	○
Vegan Mayonnaise	○	○

Do you have a known history of any of the following medical conditions?

	Please check Yes or No	
	Yes	No
Dyslipidemia	○	○
Diabetes	○	○
Arthritis	○	○

How many hours did you sleep last night?

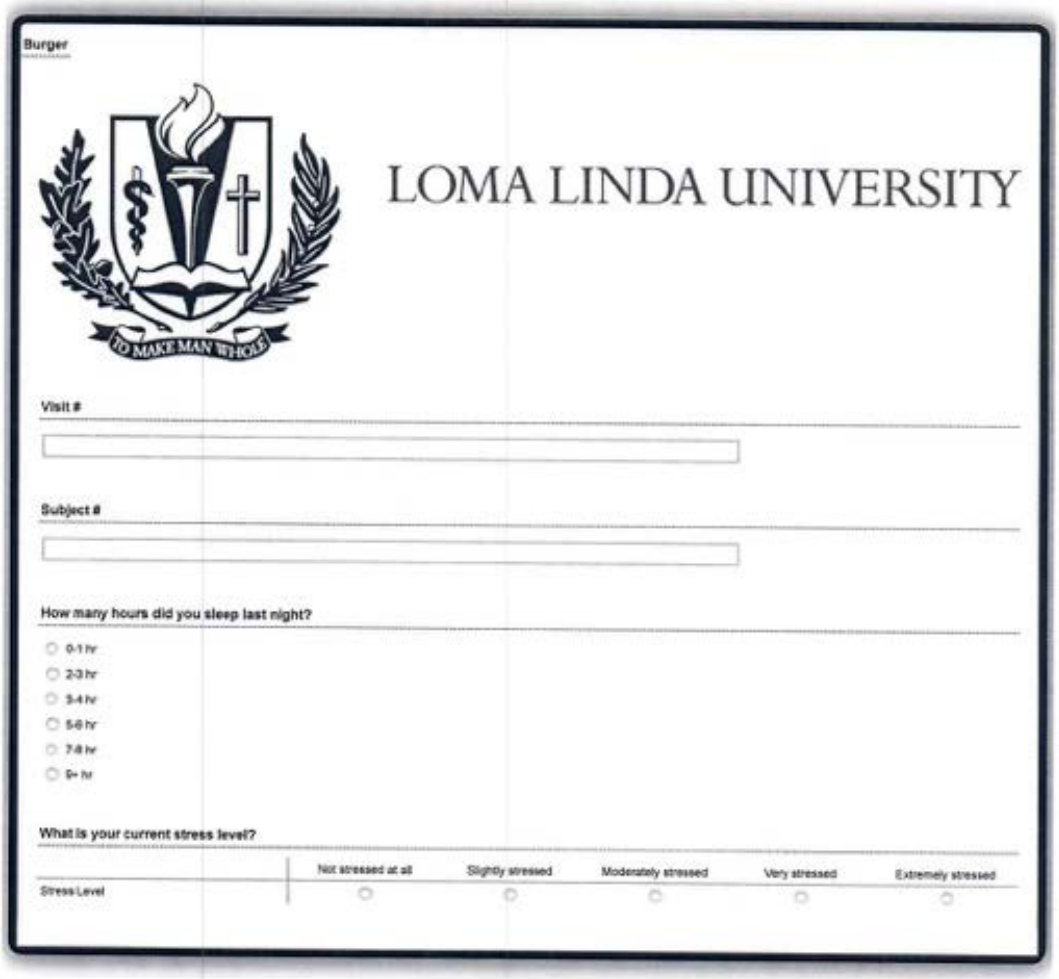
- ○ 0-1 hr
- ○ 2-3 hr
- ○ 3-4 hr
- ○ 5-6 hr
- ○ 7-8 hr
- ○ 9+ hr

What is your current stress level?

	Not stressed at all	Slightly stressed	Moderately stressed	Very stressed	Extremely stressed
Stress Level	○	○	○	○	○

APPENDIX B

Questionnaire for Visit 2



Burger

LOMA LINDA UNIVERSITY

TO MAKE MAN WHOLE

Visit #

Subject #

How many hours did you sleep last night?

- 0-1 hr
- 2-3 hr
- 3-4 hr
- 5-6 hr
- 7-8 hr
- 9+ hr

What is your current stress level?

	Not stressed at all	Slightly stressed	Moderately stressed	Very stressed	Extremely stressed
Stress Level					

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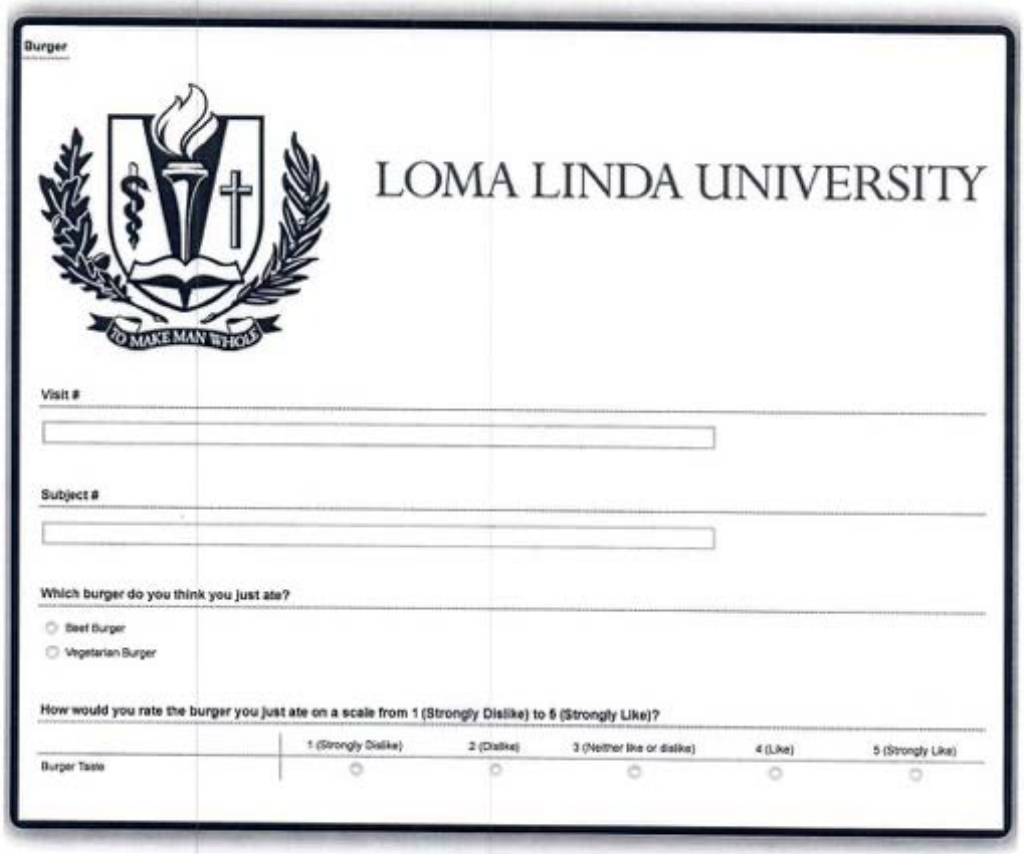
APPENDIX C

Burger Identification &Taste Questionnaire



Burger

LOMA LINDA UNIVERSITY

TO MAKE MAN WHOLE

Visit #

Subject #

Which burger do you think you just ate?

- Beef Burger
- Vegetarian Burger

How would you rate the burger you just ate on a scale from 1 (Strongly Dislike) to 5 (Strongly Like)?

	1 (Strongly Dislike)	2 (Dislike)	3 (Neither like or dislike)	4 (Like)	5 (Strongly Like)
Burger Taste	○	○	○	○	○

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