The Perceptions and Effects of Nutrition on Worker Health and Productivity in Construction

Matthew Howell
California Polytechnic State University
San Luis Obispo, California

Construction workers often have poor dietary habits due to poor nutrition education, lack of nutritious food options, and social stigma. These habits often lead to health problems like obesity, diabetes, and heart disease which can decrease productivity and put workers at risk of on-site injury. This preliminary study examines how nutrition impacts worker safety and productivity. A survey was distributed to six students involved in construction work for Cal Poly’s Residential Construction course. This survey identified their eating habits and inhibitors for healthy eating. Two meals, one with high nutritional value and one with low nutritional value, were given to the students before performing construction work. The students then filled out a survey rating their perceived levels of safety, alertness, and productivity. Results indicated that students who ate the healthy meal averaged 2.6% lower for safety, 10.6% higher for alertness, and 13.4% higher for productivity than those who ate the healthy meal. This aligns with research showing that diets low in fruit and vegetable intake and high in sodium can lead to decreases in productivity. Findings of this study could be applied in the field to improve worker diets, which would lead to increases in alertness and productivity.

Keywords: Nutrition, construction, diet, safety, productivity

Introduction

Nutrition is an important factor to consider when performing physical labor. On average, construction workers have very poor diets, which can lead to illness, lack of awareness, loss of motor function, and decreases in reaction time (Centers for Disease Control and Prevention, 2022). In turn, this can cause increased sick leave, decreased productivity, and increased accidents (Viester, 2014). Nutrition-based health issues can lead to major safety concerns for construction workers who sustain hours of physical activity daily. Poor dieting among construction workers has been attributed to poor nutrition education and social stigma in construction culture (Chung, 2019). This study aims to determine what types of diets would give the best nutrition for construction work, as well as how nutrition can affect the performance of workers in the field.
Literature Review

Nutritional Recommendations

In 2020, the United States Office of Disease Prevention and Health Promotion released dietary guidelines that outline the proper nutritional intake for a physically active adult male. For a 3,000-calorie diet, the recommended daily food intake is 4 cups of vegetables, 2 ½ cups of fruit, 10 oz of grains, 3 cups of dairy or dairy substitute, 7 oz (198.5 g) of protein foods, and 44 grams of oils (see Figure 1). The recommended limits of added sugars and saturated fat are 10% of total energy, totaling 300 kcal for each (see Figure 2). With one gram of sugar equaling 4 calories and one gram of saturated fat equaling 9 calories, the recommended daily intake is 75 grams of sugar and 33 grams of saturated fat. The daily limit of sodium is 2,300 mg (see Figure 2).

<table>
<thead>
<tr>
<th>CALORIE LEVEL OF PATTERN</th>
<th>1,600</th>
<th>1,800</th>
<th>2,000</th>
<th>2,200</th>
<th>2,400</th>
<th>2,600</th>
<th>2,800</th>
<th>3,000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FOOD GROUP OR SUBGROUP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables (cup eq/day)</td>
<td>2</td>
<td>2 ½</td>
<td>2 ½</td>
<td>3</td>
<td>3</td>
<td>3 ½</td>
<td>3 ½</td>
<td>4</td>
</tr>
<tr>
<td>Vegetable Subgroups in Weekly Amounts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark Green Vegetables (cup eq/wk)</td>
<td>1 ½</td>
<td>1 ½</td>
<td>1 ½</td>
<td>2</td>
<td>2</td>
<td>2 ½</td>
<td>2 ½</td>
<td>2 ½</td>
</tr>
<tr>
<td>Red &amp; Orange Vegetables (cup eq/wk)</td>
<td>4</td>
<td>5 ½</td>
<td>5 ½</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>7 ½</td>
</tr>
<tr>
<td>Beans, Peas, Lentils (cup eq/wk)</td>
<td>1</td>
<td>1 ½</td>
<td>1 ½</td>
<td>2</td>
<td>2</td>
<td>2 ½</td>
<td>2 ½</td>
<td>3</td>
</tr>
<tr>
<td>Starchy Vegetables (cup eq/wk)</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Other Vegetables (cup eq/wk)</td>
<td>3 ½</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5 ½</td>
<td>5 ½</td>
<td>7</td>
</tr>
<tr>
<td>Fruits (cup eq/day)</td>
<td>1 ½</td>
<td>1 ½</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2 ½</td>
<td>2 ½</td>
<td>2 ½</td>
</tr>
<tr>
<td>Grains (ounce eq/day)</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Whole Grains (ounce eq/day)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3 ½</td>
<td>4</td>
<td>4 ½</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Refined Grains (ounce eq/day)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3 ½</td>
<td>4</td>
<td>4 ½</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Dairy (cup eq/day)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Protein Foods (ounce eq/day)</td>
<td>5</td>
<td>5</td>
<td>5 ½</td>
<td>6</td>
<td>6 ½</td>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Protein Foods Subgroups in Weekly Amounts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meats, Poultry, Eggs (ounce eq/wk)</td>
<td>23</td>
<td>23</td>
<td>26</td>
<td>28</td>
<td>31</td>
<td>31</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Seafood (ounce eq/wk)</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Nuts, Seeds, Soy Products (ounce eq/wk)</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Oils (grams/day)</td>
<td>22</td>
<td>24</td>
<td>27</td>
<td>29</td>
<td>31</td>
<td>34</td>
<td>36</td>
<td>44</td>
</tr>
<tr>
<td>Limit on Calories for Other Uses (kcal/day)</td>
<td>150</td>
<td>140</td>
<td>240</td>
<td>250</td>
<td>320</td>
<td>350</td>
<td>370</td>
<td>440</td>
</tr>
<tr>
<td>Limit on Calories for Other Uses (%/day)</td>
<td>6%</td>
<td>8%</td>
<td>12%</td>
<td>11%</td>
<td>13%</td>
<td>13%</td>
<td>13%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Figure 1. Healthy dietary patterns with daily amounts from food groups (U. S. Department of Agriculture, 2020)
Figure 2. Percent exceeding limits of added sugars, saturated fat, and sodium (U.S. Department of Agriculture, 2020)

**Sodium Intake**

Sodium is essential for restoring body water loss after exercise-induced dehydration (Anastasiou, 2009). However, large amounts of sodium can cause negative effects to a person’s health. A study done on laborers in Hong Kong found that the average worker regularly consumed food which contained twice the daily recommended levels of sodium as well as high levels of fat. Such levels were linked with higher occurrences of obesity and hypertension among construction workers when compared to the public (Chung, 2019).

Although manual labor causes a significant loss of sodium through sweat, high-sodium foods and drinks are not an effective way to replenish sodium. Anastasiou (2009) found that large amounts of sodium intake did not provide any advantage in preventing sodium-loss-related health issues. Instead, the study found consuming small amounts of sodium with fluids was the most effective way to combat sodium-loss-related health issues.

**Fruit and Vegetable Intake**

Lack of fruits and vegetables also contributes to the poor nutrition of construction workers. Research showed that fruit and vegetable consumption among a group of construction apprentices was more than one serving below the recommended guidelines (Chung, 2019). Often, workers would rely on convenient, high-calorie food choices that were easily found and consumed on-the-go. These included on-site food trucks, fast food, gas stations, and convenience store food items (Chung, 2019), which rarely provided the recommended daily allowances of fruits and vegetables necessary for physical labor.

**Social Stigma and Nutrition Education**

Social factors play a large role in dietary choices. Okoro (2017) wrote, “people make choices out of a need to gain and solidify social identity. In a way, this suggests that one can be peer-pressured into
eating healthily or unhealthily.” The social aspect of a construction jobsite can lead to unhealthy eating choices. In a study that surveyed 250 construction workers and included 80 interviews with both managers and workers, most participants believed that they were eating a healthy diet. But when presented with healthy eating guidelines, many dismissed them. “They thought that these guidelines related to other people such as white-collar workers and weren’t relevant to males doing physical labor” (Townsend, 2015).

Although there is a social stigma around nutrition in the construction industry, studies have shown that education can improve nutritional intake. To evaluate the effectiveness of nutrition education on fruit and vegetable consumption, Chung (2019) enrolled thirty-six construction apprentices in two 1.5-hour nutrition programs. Twelve questions were administered to understand the apprentices’ current perceptions of healthy eating, which established a baseline to compare the effectiveness of the nutrition program. The same questions were distributed after the training program and at a three-month follow-up. Results from the follow-up surveys found nutritional knowledge and consumption of fruits and vegetables had increased to match the daily recommended servings for healthy adults (Chung, 2019).

How Poor Nutrition Can Affect Workers

Unhealthy eating has been correlated with unsafe working practices in construction. A study found that poor nutrition was directly linked with an increase in reduced cognitive capabilities (Okoro, 2016), which related to poorer performance on tasks that required attention, such as construction. This decreased awareness led to an increase of risk, most notably in safety-critical tasks such as electrical installation.

Unhealthy eating has also been linked with high occurrences of obesity and hypertension (Chung, 2019), which can reduce productivity for workers performing manual labor. Hypertension and obesity were attributed to more than 10% of sick leave and productivity losses, which could be the result of unhealthy eating (Viester, 2012).

Methodology

This study utilized a mixed methods approach, providing both quantitative and qualitative data for analysis. The study was implemented in three parts. First, 6 Cal Poly students completed an online questionnaire identifying their eating habits and inhibitors for healthy eating. Next, healthy and unhealthy meals were developed. Finally, students were fed healthy and unhealthy meals over two days while they were participating in construction work. They were asked to rate their safety, alertness, and productivity following the construction work.

To initiate the study, the qualitative portion of the study occurred in the form an online questionnaire. This questionnaire determined participants’ normal diet, eating habits, and anything that made it difficult for them to eat healthy food on a regular basis. Results of the questionnaire were sent to a professor in Cal Poly’s food science department.

An overnight oats recipe was developed for the healthy meal (see Figure 3). This meal provided 531 calories (17.7%) of the 3,000 daily calorie limit needed for construction work. It fulfilled ½ cup (20%) of the 2 ½ cups of fruit, ¼ cup (8.3%) of the 3 cups of dairy, 2 oz (20%) of the 10 oz of grains,
and 19 grams (9.5%) of the 7 oz (198.5 grams) of protein foods. It fulfilled 21 grams (36%) of the 75-gram limit for sugar and 1.7 grams (5.2%) of the 33-gram limit for saturated fat.

OVERNIGHT OATS
8 hours. 8 ingredients. 6 servings.

Ingredients
2 1/4 cups Oats
2 1/4 cups Soy Milk
1/3 cup All Natural Peanut Butter
3 tbsp Maple Syrup
1 1/2 tsp Cinnamon
3/4 cup Water
3 cups Blueberries
1 1/2 cups Silivered Almonds

Directions
1. Combine oats, almond milk, chia seeds, maple syrup, cinnamon, peanut butter and water together in a large tupperware container. Stir well to mix. Seal and place in the fridge overnight (or for at least 8 hours).
2. Remove oats from fridge. Use single-serving size mason jars and place a large spoonful of the oat mix in the bottom of each, then a layer of blueberries followed by a layer of silivered almonds. Repeat until all ingredients are used up. Store in the fridge until ready to eat. Enjoy hot or cold!

Notes
Refrigerate in an airtight container for up to four days.

Two donuts were served to each participant for the unhealthy meal. This meal was meant to simulate the average breakfast of a construction worker in the field. Due to the differences in nutritional value between each donut, the following data consists of averages of the three. The caloric intake fulfilled 533 calories (17.8%) of the 3,000 daily calorie limit. It did not fulfill any of the necessary intakes for fruit, dairy, or grains. It fulfilled 6 grams (3%) of the 7 oz (198.5 grams) of protein foods. It fulfilled 27 grams (36%) of the 75-gram limit for sugar, 15 grams (45%) of the 33-gram limit for saturated fat, and 270 milligrams (11.7%) of the 2,300-milligram limit for sodium (Figure 4).

Figure 3. Healthy meal in the form of overnight oats (Kari Pilolla, personal communication, November 8, 2022)

Figure 4. Unhealthy meal in the form of Smart & Final donuts
The quantitative portion of the study occurred next. Over two days, surveys were administered to 6 participants: 5 males and 1 female. All participants were enrolled in the same construction management class and performed similar construction activities such as framing, electrical installation, and waterproofing. On each of the days, half of the participants were given the healthy meal and half were given the unhealthy meal. The participants then completed a survey at the end of each day to document their safety, alertness, and perceived productivity using a five-point Likert scale (with 1 being very poor and 5 being very good).

### Results and Analysis

After eating the healthy meal, participants reported a mean of 3.83 out of 5 for safety, 3.83 out of 5 for alertness, and 4.17 out of 5 for productivity (See Figure 5), indicating average safety and alertness, and above average productivity. After eating the unhealthy meal, participants reported a mean response of 4 out of 5 for safety, 3.3 out of 5 for alertness, and 3.5 out of 5 for productivity (See Figure 6) indicating above average safety, below average alertness, and average productivity.

Figure 5. Ratings of mood, safety, alertness, and productivity for students eating healthy meal
Comparing the two data sets shows that there is a variance of 0.13 between the healthy and unhealthy safety means, with those who ate the unhealthy meal rating their safety high than those who ate the healthy one. The variance between the alertness means was 0.53, with the healthy mean scoring higher, and the variance between the productivity means was 0.67, with the healthy mean scoring higher.

This study’s findings suggest that workers who eat nutritious food will see increases in their perceived productivity and alertness. This aligns with previous research, which found that food choices and obesity contributed to more than 10% of sick leave and productivity loss (Viester, 2014). The decrease in the mean for safety defies what Okoro found. Okoro (2016) contributed high occurrences of fatigue and impaired concentration partly to unhealthy eating, which in turn could result in accidents and injuries.

Differences between this study and previous research may be due to the limited nature of the data collection. 6 students are likely not an accurate representation of the construction industry’s workforce, especially considering the differences in work environment between the classroom and a jobsite. Students were working for a maximum of 4 hours in the classroom setting, while construction workers often work 8-hour plus days (Chung, 2019). Additionally, differences between research and this study’s results could be contributed to outside factors. A question on the daily survey asked, “Are there any other factors that might be affecting your productivity, safety, or alertness?” Four students responded that midterms that week were causing them stress and a lack of sleep. This could be a possible reason for participants rating their safety lower despite eating the healthier meal.

Figure 6. Ratings of mood, safety, alertness, and productivity for students eating unhealthy meal
Conclusion

Poor nutrition has been directly linked with high occurrences of hypertension and obesity (Chung, 2019). These diseases can lead to increased accidents and decreased productivity on construction jobsites (Viester, 2014). This study aimed to determine how nutrition can affect the self-perceived performance of workers in the field. This was done by measuring the self-perceived performance of construction management students completing construction work during two separate class sessions. Students were fed healthy and unhealthy meals on two separate days and then asked to rate their safety, alertness, and productivity. Results show a significant increase in alertness and productivity for those that ate the healthy meal, and a slight increase in safety for those that ate the unhealthy meal.

Future Research

This study was likely not on a large enough scale to come to make any definitive conclusions on the effects of nutrition on construction workers. However, this study’s methodology could be transferred to operate on an actual jobsite. This would allow for data collection to involve more participants over a longer time frame. Data points would be much more numerous, so statistics would more accurately reflect the effect that meals had on workers. Trends would be able to be recognized for individuals, and subsequent meals could be altered to see how it affected the individual. This would benefit both construction managers and teams in the field. Management would get valuable information on what conditions their teams worked best under, and teams would get personalized data about what they needed to fuel their bodies.

References


