HIGH SCHOOL EDITION
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Interplay of Exercise, Diet, and Energy Levels Among Low-SES Hispanic Teens in South Florida

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ABSTRACT

This study investigates the correlation between physical activity (PA), diet quality, and energy levels (ELs) among Hispanic teenagers, addressing a gap in research concerning this demographic. A cohort of Hispanic teens was monitored to compare habitual diet, exercise levels, and associated changes using various metrics, including Healthy Eating Index (HEI) and SmartPoints. The data revealed a statistically significant improvement in diet quality (p=0.037) and ELs (p=0.013) among those who increased their PA, although SmartPoint values did not significantly differ (p=0.394). Correlation analyses indicated weak positive relationships between ELs, HEI, and SmartPoints, suggesting a possible connection or interdependency between dietary patterns and exercise within this population. The findings emphasize the potential of exercise interventions to enhance diet quality and ELs, despite cultural and socioeconomic challenges. Limitations such as a small sample size, lack of a complementary exercise cessation group, and reliance on self-reported measures were acknowledged. Future research should expand on these findings with larger, more controlled studies, incorporating advanced monitoring techniques and culturally tailored interventions to better understand and promote healthy behaviors in Hispanic adolescents.

Introduction

The obesity epidemic in the US has gotten worse over time, becoming a health crisis that affects close to 40% of the population. It is widely associated with a higher risk of cardiovascular disease and type 2 diabetes (Alemán et al., 2023). The epidemic is most attributed to the widespread acquisition of sedentary lifestyles and Westernized dietary patterns defined by nutrient-poor, energy-dense foods adopted by children and adolescents. Teenagers adopting poor dietary choices helps explain the increase in childhood obesity, which is difficult to reverse and causes health problems later in life (D'Innocenzo et al., 2019). However, it is disproportionately higher in the Hispanic/Latino population status than non-Hispanics, which could be affected by the socioeconomic status and environments of Hispanics that cause food insecurity and higher physical inactivity in addition to the highly refined carbohydrates diet typical of Hispanic households (Alemán et al., 2023; Perreira & Allen, 2021). Thus, it is vital to study intervention strategies that Hispanic teenagers—in a prime time to build lifestyle habits— can take to combat these factors that are out of their control.

This paper's experiment's chosen 21-day duration is long enough to observe changes in energy levels (ELs) and eating habits but not so long that it becomes difficult to maintain the study over time. It avoids the challenges of prolonged studies, which might be impractical within time constraints and high school resource limits. The population studied is of Hispanic origin and is taken from Miami-Dade County (MDC), one of the counties with the highest Hispanic/Latino population concentration, getting close to 70% of its population share in 2020 (Pew Research Center, 2022). The Health Professional Shortage Area (HPSA) is designated to a majority of municipalities of MDC, which is due to them being a low-income population and thus low-socioeconomic status participants from these locations were chosen accordingly (Health Resources and Services Administration, 2023). Understanding the relationship between exercise and diet in this ethnic group can shed light on healthy food accessibility limitations. It will help explore how exercise can affect diet quality and quantity among youth, given their limited ability to choose what to eat, how much, and whether it is within their control. Furthermore, studying the mutually beneficial relationship between exercise, dietary patterns, and energy homeostasis would highlight the critical role of physical activity (PA) and a healthy diet in cultivating sustained ELs. In turn, this will allow higher energy expenditure and encourage a caloric balance skewed toward improved fitness results, subsequently reducing the risk of obesity through an equilibrium of reduced caloric consumption and increased caloric expenditure. Exploration of the association between these variables will determine whether diet and/or exercise influence ELs. One might choose to eat a certain type and amount of food because of mood and emotions, such as stress, or just because of familiarity, in which culture comes into play. Exercise helps reduce stress by changing the brain chemistry and releasing certain neurotransmitters[1], such as cortisol and epinephrine. Since exercise helps in coping with stress, it explains why exercise might decrease emotional eating and caloric intake, thus changing dietary patterns (Medical Professional, 2022; Dishman, 2020). While acknowledging the influence of numerous factors, this paper centers on examining how exercise, in relation to culture and income, initially affects these variables within a specific demographic group, under the assumption of relative homogeneity within these parameters. Within the specific ethnic group context, culture and socioeconomic status are recognized as significant modifiers of these factors. Hence, the paper aims to underscore the additional impact of culture and income within the targeted demographic.

To clarify, I will operationalize dietary patterns to account for the amount of food intake and the nutritional value of food. Adhering to the Mediterranean diet (MD) will define diet quality based on high consumption of vegetables, fruits, nuts, healthy fats, whole grains, and extra virgin olive oil. There is a moderate intake of seafood and lean protein sources such as chicken, eggs, and poultry, in addition to a limited consumption of sweets, red meat, and dairy products in this diet. The MD's association with decreased risk of cardiovascular deaths, type 2 diabetes, and, most critically, obesity highlights the role of the quality and quantity of food in weight gain and physical health, demonstrating that this diet is an effective preventive strategy (D'Innocenzo et al., 2019). Consumption of sweets, processed products with added sugar, and nutrient-poor, calorie-dense foods will define what an unhealthy diet, which promotes obesity, is like (D'Innocenzo et al., 2019). Although macronutrients, the building blocks of every organism obtained from food such as proteins, fats, and carbohydrates, fall into the definition of dietary patterns, this paper will not consider it (Wilson et al., 2002).

This study defines exercise as any kind of PA. It splits exercise type into two categories based on density: aerobic and anaerobic. Aerobic exercise, defined by the American College of Sports Medicine (ACSM), is any activity involving large muscle groups sustained over time at a steady pace. Muscle groups engaged in this kind of exercise rely on aerobic metabolism to produce adenosine triphosphate (ATP), which is the energy obtained from carbohydrates and oxygen (Patel et al., 2017). Cycling, walking, running, and swimming are a few forms of aerobic exercise. The other type is anaerobic exercise, defined by ACSM as vigorous PA that lasts for a brief period and does not use oxygen to perform, with examples ranging from high-intensity interval training (HIIT) to resistance training (Patel et al., 2017).

To differentiate between people who exercise and those who don't, this paper will use the moderate to vigorous intensity physical activity (MVPA) threshold. This threshold recommends at least 150 minutes of moderate to vigorous PA weekly to maintain good health. Participants who do exercise will be those who attest to vigorous to moderate exercise for at least 150 minutes per week (MacIntosh et al., 2021). Moderate-intensity PA is when you are breathing harder than usual, but you can still talk. Examples include brisk walking, cycling, or swimming. Vigorous intensity PA is when you are breathing hard and fast and can't say more than a few words without pausing for breath. Examples include running, fast cycling, or playing sports like basketball or soccer. Threshold formulas for defining moderate and vigorous PA will be given in the methods section. However, they will be based on target heart rate (THR), heart rate reverse (HRR), maximal heart rate (MHR), and

[1] Neurotransmitters are chemical messengers throughout the body that control daily functioning.

resting heart rate (RHR) of the individual. THR reflects how fast the heart should be beating in a person, depending on the intensity of their workout. HRR is the difference between MHR and RHR, giving an understanding of fitness levels and workout intensity (Davidson, 2022). RHR is the number of times the heart beats per minute when one is at rest, being an indicator of physical fitness. The more fit you are, the lower your resting heart rate (Johns Hopkins Medicine, 2021).

Gap

There is negligible to no research on the effect of exercise and its role in mediating dietary patterns and ELs, especially in Hispanic teens; thus, this study aims to address that gap in research. The fact that the grand majority of research on exercise's role in affecting dietary patterns and ELs focuses on adults with jobs— giving them full control of what they eat— of varying socioeconomic status and ethnicity is the disparity from which this study's purpose is highlighted: How are *Hispanic teenagers'* diet and ELs affected by PA, as most do not work for money and their diets are controlled by their parents. Furthermore, most studies are longitudinal, while this study focuses on seeing *acute effects,* which will give insight into differing effects of exercise depending on time. This study attempts to fill this observed gap in what is known about exercise's mediating role in dietary patterns and ELs. It will differ from other similar known literature as it will consider household culture, socioeconomic status, and time, which other studies fail to address. These factors might influence lifestyle choices; thus, it is important to consider them.

Literature Review

There is some literature on the effects of exercise and PA levels on dietary patterns and ELs, specifically in studies by people such as Jaehyun Joo, with a Ph.D. in nutritional sciences, that found that incorporating an exercise training regime in young adults of various ethnicities has seen improvements in diet quality as well as PA at home associated with better dietary practices in aged individuals (Joo et al., 2019; Garcia Carlini et al., 2023). High-intensity interval training (HIIT) training sessions consist of short periods of high-intensity exercise alternating with rest periods. In a study by Zeppa et al, HIIT increased spontaneous modulation of meal choices and dietary intake management in young adults, leading to a healthier diet (Donati Zeppa et al., 2020). HIIT includes aerobic and anaerobic training (Atakan et al., 2021). Reevaluating the widely held belief that exercise inevitably leads to increased caloric intake and appetite, the intuitive expectation would be that PA triggers a greater need for fuel, potentially causing a rise in hunger and calorie consumption. However, studies by scholars such as Thivel et al found a difference in consumption after PA differs for obese individuals, both adult and youth, having a negligible increase in calories consumed when taking on training regimes compared to reducing food intake on intense, short exercise sessions. In contrast, exercise in lean individuals does not affect energy consumption, leading to negative energy balance— meaning that more calories are used than consumed. This relieves fear about counterproductive effects on weight loss. The consumption of macronutrients seemed to have no change as well, with various studies getting mixed, contradictory results that are negligible in retrospect of impact, not being strong on either end of a decreasing or increasing change in macronutrient consumption (Thivel et al., 2016.; Beaulieu et al., 2021; Donnelly et al., 2014). Though all participants have been mostly adults, there have been fewer studies on obese children, with one by scholar Schwartz et al reporting PA intervention leading to a decrease in caloric intake and all macronutrients consumed (Schwartz et al., 2016). Several studies by Puetz et al and Ellingson et al report a positive association between a higher frequency of PA, be it moderate or not intense, in decreasing feelings of fatigue and low ELs in sedentary and fatigued adults (Puetz, 2006; Ellingson et al., 2014; Puetz et al., 2008).

A study by Dr. James Dorling et al found that regular PA made participants more sensitive to their appetite control system by making adequate changes per the food's content and energy density, which was independent of adiposity levels and sex (Dorling et al., 2018). In this context, greater sensitivity means that the body can accurately recognize changes in its energy homeostasis and modify appetite in accordance (Dorling et al., 2018). Greater sensitivity to appetite explains how one's fullness response to a meal is improved and thus makes one less likely to eat, positively impacting energy balance. A study by Tanya Halliday, a postdoctoral researcher, tested the effects of two exercise types: acute aerobic exercise and acute resistance exercise. In both exercise conditions, spontaneous caloric intake did not rise as compared to the sedentary control group, suggesting that both exercise modalities have effects that suppress appetite and caloric intake (Halliday et al., 2021). Since aerobic exercise seems to have the same effects as anaerobic exercise on these variables, due to the limitations of this paper, only an aerobic exercise training regime will be tested on subjects because it is convenient to perform and execute, giving high schoolers an increased likelihood to adhere to it.

Hypothesis

The main purpose behind this paper is to disprove or prove the hypothesis that exercise will *initially* increase ELs and lead to healthier dietary patterns within the teenage Hispanic community due to previous studies showing a positive correlation between exercise, ELs, and diet quality in other ethnic and age groups.

Research Design and Methodology

The study employed a combination of correlational and experimental research methods to comprehensively investigate the relationship between variables. In order to understand the role of exercise in how it affects ELs and diet, along with how these two relate to each other, a survey was given out to high school students in grades 9-12 to provide a broad understanding of the habits and behaviors of the target population. Random sampling was done by going into classrooms of various subjects and grades and asking them to fill the survey, along with spreading this survey around various club's group chats. Participants of the survey, with parental consent, were randomly selected and asked to be part of an experiment, in which they were separated into 3 groups: Group 1 (Exercisers) were students that do exercise and were asked to continue doing so as a control group. Group 2 (Non-Exercisers) were students that did not exercise and were asked to continue doing so as a control group. Group 3 (Exercise Adopters) were students that did not exercise and were asked to increase their PA throughout the 3-weeks, having a minimum of 150 minutes of PA each week, being the experimental group. Each group consisted of 3 participants, each having a fitness tracker to promote accountability and honesty. Participants were asked to fill out a survey each day of what they ate and their level of PA and energy. Even though it would have been better to have another group of people who exercised to stop exercising to truly evaluate the effects of exercise, students were either athletes or were not willing to disrupt their routine, thus there is only one experimental group. While the absence of a group of people who exercise to stop exercising does limit the ability to establish causality definitively, the experimental design with the inclusion of an experimental group still allows for some inference regarding cause and effect.

Target heart rate is calculated using the formula below:

THR = (HRR x % intensity) + RHR
MHR = 207 - (0.7 x age)
RHR = heartbeats per 30 seconds x2
HRR = MHR – RHR

Cardiovascular exercises of moderate intensity typically range from 40%-59% of your HRR, whereas high-intensity cardio exercises fall within the 60%-89% range (Davidson, 2022). Thus, the minimum threshold for HR to count as PA is if the intensity exceeds the THR value calculated for .4 intensity. This will make it so that walking around school is not considered. Participants were required to take a photo of their heart rate during their exercise sessions.

Data collection for diet was done by requiring participants to submit photos of what they ate and report any foods that they did not take a picture of. A quantitative system to evaluate the healthy level, in accord with the MD, of a participant's diet in a given day will be created exclusively for this paper. The Food Frequency Questionnaire is inspired on WeightWatchers's approach of assigning a point value to certain food groups. This is called the SmartPoints system, which assigns a point value to each food based on its calories, protein, saturated fat, and sugar content. The exact SmartPoints value of a food depends on its portion size and nutritional content (WeightWatchers, 2019). This system is tailored for the MD, adjusting for its weekly measurement approach. Unlike the diet's weekly assessment, this system is designed for daily consumption, assigning values based on recommended frequency intake, as shown below:

Table 1. Mediterranean Diet: SmartPoint Allocation By Food Group

Food Group	Max Estimated Portion Serving Size (MEPSS)	Dietary Constituents	Smart Points (below threshold)	SmartPoints (consumed above threshold)
High Consumption				
Vegetables	Unlimited	Leafy greens (e.g., spinach, kale, arugula), tomatoes, bell peppers, cucumbers	0	N/A
Fruits	Unlimited	Apples, Bananas, Oranges, Grapes, Melons, Peaches, Pears, Berries, etc	0	N/A
Herbs and Spices	Unlimited	Herbs (e.g., basil, oregano, thyme), spices (e.g., cumin, paprika, turmeric)	0	N/A
Whole Grains	3-6 Servings (1/2 cup cooked)	Quinoa, brown rice, whole wheat pasta/bread	1	2-3
Healthy Fats	2-3 Servings	Olive oil 1 tsp, nuts 1/4 cup (e.g., almonds, walnuts), avocado 1/4 slice	3	4-5
Moderate Consumption				
Proteins	3-4 oz	Lean poultry (e.g., skinless chicken breast, eggs)	1	2-3
Seafood and Plant Proteins	3-4 oz	fish (e.g., salmon, tuna), beans and legumes (e.g., chickpeas, lentils)	2	3-4
Low Fat Dairy	1 Serving size (3/4 cup or 6 oz)	Greek yogurt (non-fat or low-fat), feta cheese, cottage cheese	2	3-5
Refined Grains	oz. eq.	White Bread, Pasta, Rice, and cereal	4	6-8
Limited Consumption				
Processed products with added sugar	1-2 Serving Size, Small Slices/packs	Added Sugar (e.g., Chips, crackers, instant noodles, pizza, snacks, etc)	7	8-12
Sweets	1-2 Serving Size, Small Slices/packs	Refined sugar (e.g., Chocolate bar, Cake, Cookies, Ice Cream, Candy)	7	10-12
Red meat	3 oz, (cooked)	Beef Steak,Ground Beef, Pork Chop, Lamb	6	8-10
High-fat dairy products	1 Serving size	Full-fat Cheese (1 ounce), Whole Milk (1 cup), Butter (1 tablespoon):, Full-fat Yogurt (1 cup)	6	8-10
Fried Foods	(High calorie)1 piece/(Low calorie)1 cup	Fried egg, chicken, fish, fries, plantain, vegetables, cheese	8	10-12

To account for portion size and intake, higher values will be assigned if the food consumed passes a certain threshold that will be estimated through the pictures. This way, higher scores in a day count for both the healthy level of a food and the calories consumed, since unhealthy food groups tend to have high caloric density. In this case, lower points indicate higher nutritional value and lower calorific value of a food group. Differences in serving sizes for a food group were indicated in the dietary constituents, while defining what constitutes 1 serving that applies to the whole food group was left in the MEPSS column. To account for the instances in which SmartPoint values would be similar between a participant that may have eaten less, but unhealthier, and a participant that may have eaten more, but healthier, a Healthy Eating Index (HEI) value was considered:

Equation 1

$$\textbf{Healthy Eating Index} = \frac{\textbf{High Comsumption Foods} + \textbf{Moderate Consumption Foods}}{\textbf{Total Foods Eaten}}$$

A value closer to 1 indicates a healthier diet, directly correlating with better dietary habits.

Data Analysis

For each observed measure, a group mean was calculated by adding individual scores per day per group over the total number of values (63 per group). Statistical analysis was performed to compare pre-exercise values as a baseline (habitual diet and ELs) to post-starting exercise using paired t-test analysis. A p-value of less than 0.05 was considered statistically significant, as is the standard scientific norm. A Pearson correlation test examined the relation between diet and ELs, in order to also account for whether HEI and SmartPoints correlate as they should. If lower SmartPoints don't correlate as expected with a HEI value close to 1, they only reflect caloric differences. In addition, due to the absence of an experimental condition group to serve as a counterpart for comparison with group 1 (Exercisers), both control groups would be compared to assess the correlation between variables, though not conclusively. Using a two-sample T-test, significant differences between group 1 and 2 (Exercisers vs. Non-exercisers) were assessed on several variables.

Results

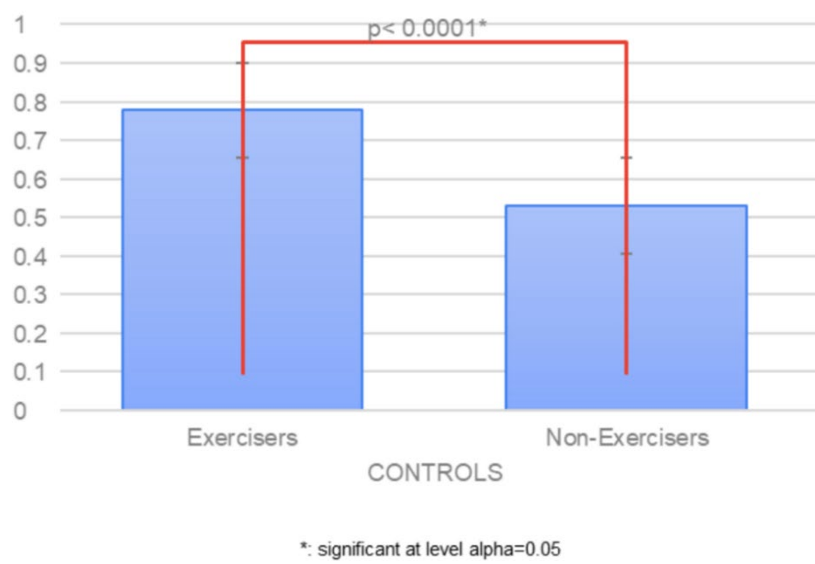

Figure 1. Healthy Eating Index (HEI).

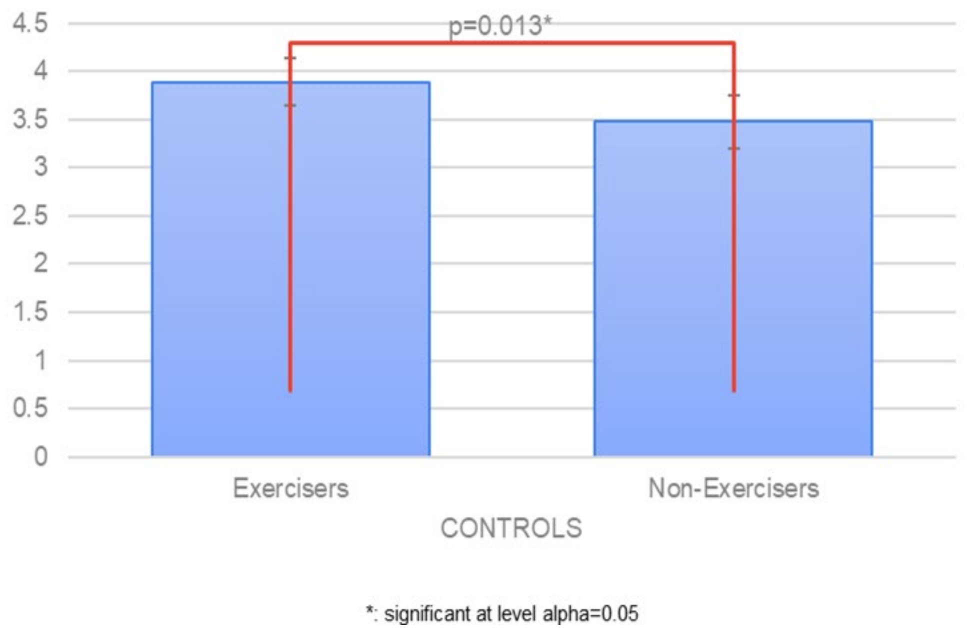

Figure 2. Energy Levels (Els) Ordinal Scale from 1-5.

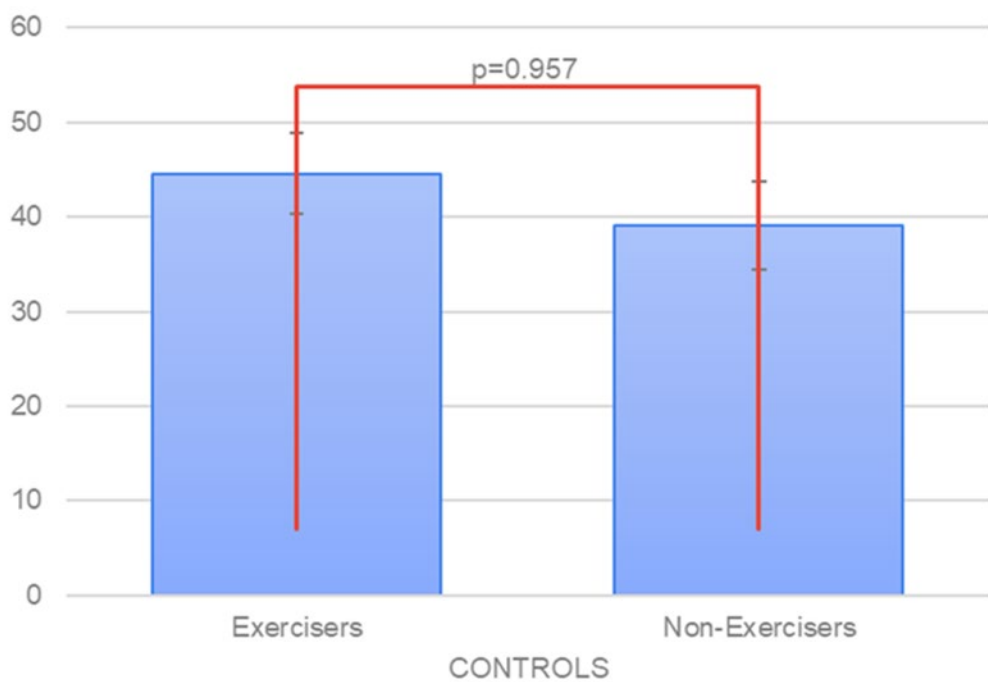

Figure 3. Mean SmartPoints.

Exercisers group's HEI was higher (Figure 1) but their SmartPoint value was also higher compared to Non-Exercisers (Figure 3). ELs were slightly better for the Exercisers group in Figure 2.

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For the Exercise Adopters group, a certain baseline estimate was gathered in order to compare usual PA, diet, and ELs. This was done by tracking them for 3 days, then getting the average of those values. The following graphs compare the SmartPoint values and HEI assigned to Exercise Adopters group's participant's food dairy, accounting for estimated serving portion sizes, in addition to ELs. SmartPoints in participant's food diaries were taken per week and divided by 7 to give the average per day for that week as shown:

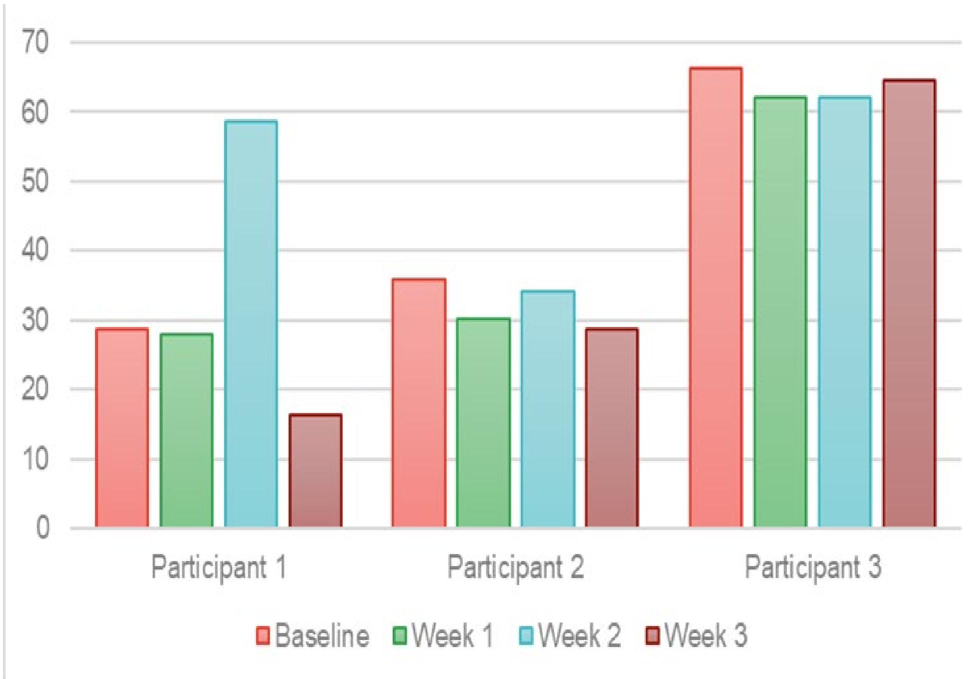

Figure 4. SmartPoints Comparison.

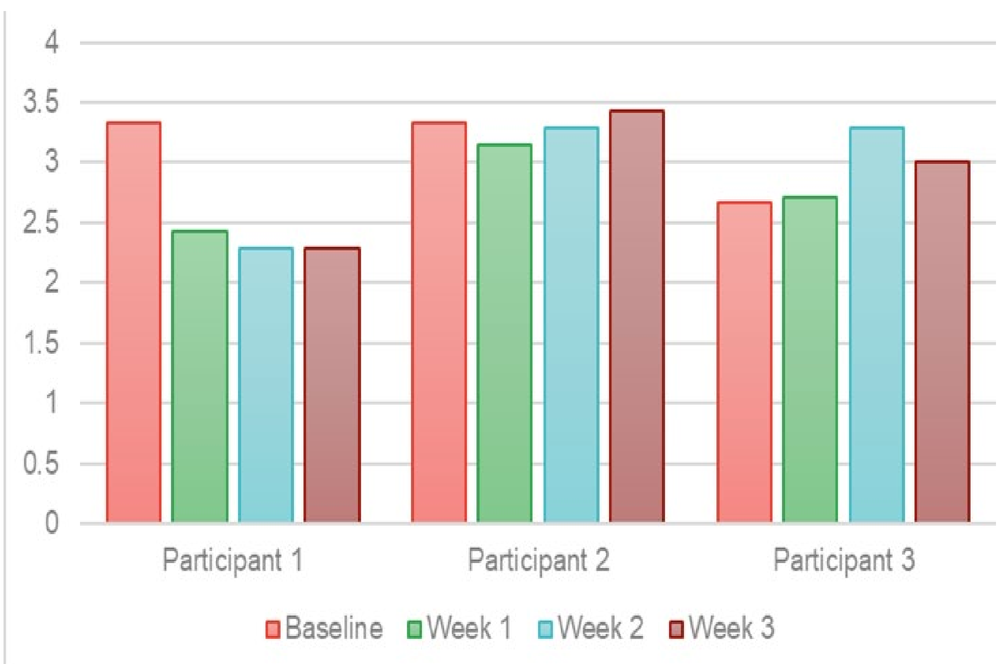

Figure 5. Els Comparison.

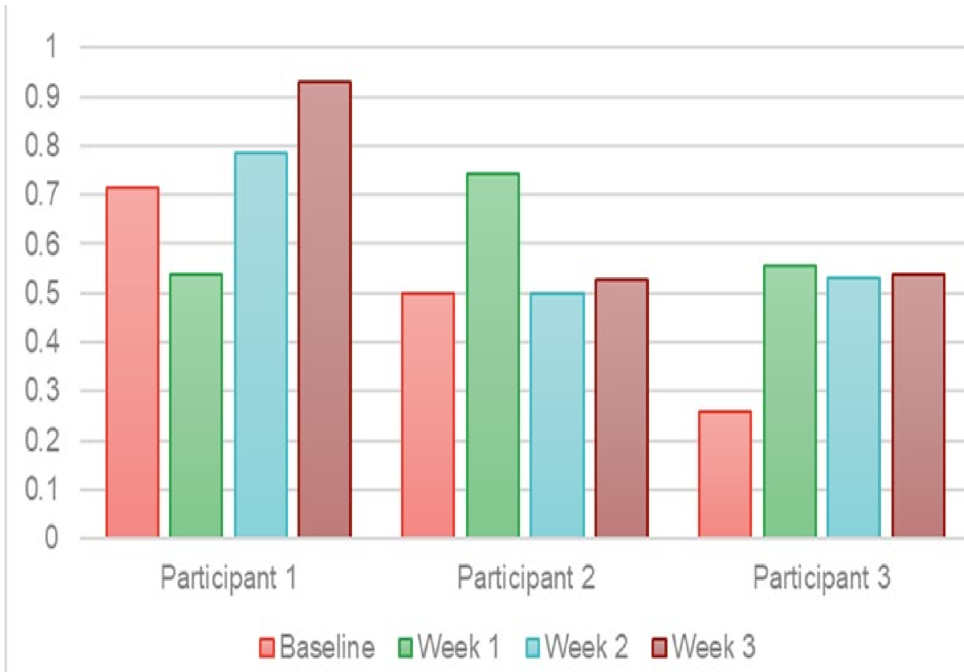

Figure 6. HEI Comparison.

Since HEI seems to be a better correlator with diet quality, associations between ELs and HEI were graphed in a time series on Figure 7 in order to assess their role within the experimental group. Association between HEI, SmartPoints, and ELs was further analyzed using a scatter plot graph in Figure 8. Red circles indicate that as one variable increases, the other tends to increase. This would help indicate the type and strength of the relationship between the two variables being compared.

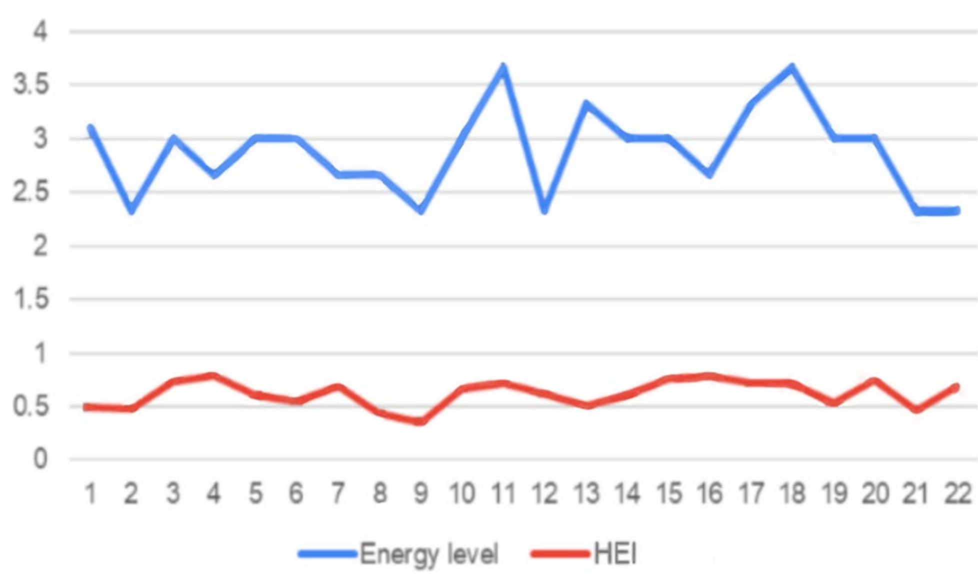

Figure 7. Average EL & HEI Over Time.

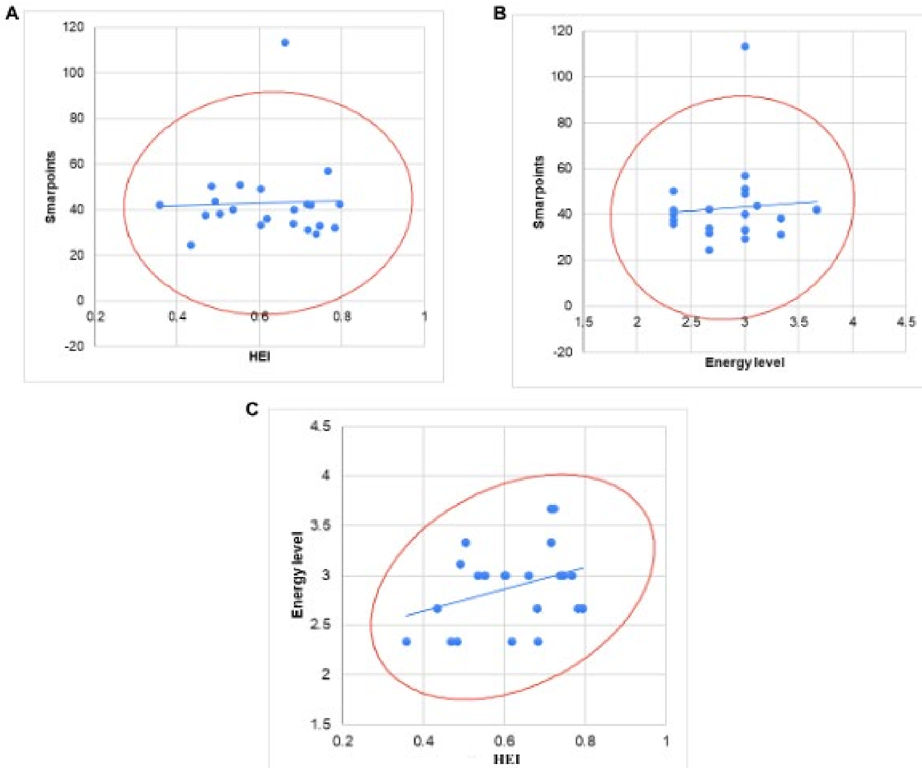

Figure 8. Scatter Plots Showing Correlation Between Variables. As seen in figure 8A, there exists a weak positive correlation between Smartpoints and HEI with a correlation coefficient of 0.002. In figure 8B, Els and Smartpoints had a weal positive correlation with a correlation coefficient of 0.007. Figure 8C still shows a weak positive correlation between Els and HEI, with a correlation coefficient of 0.116.

Table 2. Mean Variable Values.

Variable	Baseline (Mean)	Weeks 1-3 (Mean)	P Value
SmartPoints (Mean)	43.66666667	42.80952381	0.394
Energy Level (Mean)	3.111111111	2.873015873	0.967
HEI (Mean)	0.491181658	0.627074953	**0.037†**

†Statistically significant difference

Discussion

This investigation explored the correlation between exercise and diet quality, quantity, and ELs among hispanic teens. The study demonstrated a statistically significant improvement in diet quality (27.67% increase, p=0.037) when participant's increased PA as compared to standard pre-exercise score. The findings of this study highlight the impact of PA in an understudied population, such as Latino teens, who need to implement interventions that battle obesity-related diseases by increasing behaviors that promote weight loss.

Exercisers group and 2's comparison demonstrated a statistically significant difference in ELs and HEI when testing for the null hypothesis. HEI in the Exercisers group is greater than Non-Exercisers by 0.247 ($p<0.0001$), indicating better diet quality. ELs in the Exercisers group are greater than Non-Exercisers by 0.413 ($p=0.013$), indicating better ELs from an energy scale daily questionnaire. However, SmartPoint value increased for the Exercisers group when originally accounting for diet quality, indicating a higher caloric consumption for individuals who exercise in contrast to those who do not, even though it was not statistically significant ($p=0.957$). This is explained by higher energy expenditure allowing higher energy intake. Furthermore, the finding that SmartPoint values increased for Exercisers group, indicating higher caloric consumption despite exercise, might be influenced by cultural factors such as the Hispanic dietary habits, which often include calorie-dense foods. This could suggest that even with increased exercise, individuals from Hispanic backgrounds may still consume higher calorie diets due to a combination of cultural norms, acculturation, and pressures to eat abundantly (Hernandez-Garbanzo & Chavez-Martinez, 1970). In contrast, SmartPoint values for the Exercise Adopters group fluctuate during weeks 1-2, but in the 3rd week it was lower than the baseline (Figure 4). This suggests that underlying trends better explaining the causes to these variables should be further looked at with a higher sample size and longer study period. Table 2 underscores this when a negligible decrease in SmartPoint values resulted, although not statistically significant ($p=0.394$). ELs decreased for 1 participant yet increased in the other two (Figure 5). This exemplifies a phenomenon that explains the lower EL score in weeks 1-3 on table 2, indicating more fatigue because of exercise, due to the body's adaptation to exercise after a period of inactivity ($p=0.967$). When individuals resume exercising after a break, they may initially experience increased fatigue and less energy due to the body's need to readjust to the physical demands. However, as they continue to exercise, their bodies adapt, leading to improved ELs and endurance (Wender et al., 2022). Finally, HEI initially decreased then increased significantly for one participant (Figure 6). Another experienced a higher score and then leveled out close to their baseline score, though it was slightly higher. The third participant had their diet improve throughout all 3 weeks, suggesting changing cases and explaining possible trends that may explain behaviors in the demographic, which could highly potentially result in better dietary practices. The fluctuation in SmartPoint values and HEI throughout the study period, particularly in the Exercise Adopters group, could be attributed to the myriad of factors that affect dietary patterns within the Hispanic culture. The pressure to eat a lot, coupled with limited access to healthier food options due to socioeconomic constraints, may lead to inconsistent dietary behaviors among participants. Additionally, the observed initial decrease in ELs followed by an increase over time could reflect the adaptation of the body to exercise, which might be more pronounced in individuals from low socioeconomic backgrounds due to differences in baseline fitness levels and access to resources for recovery and nutrition.

Regarding the relationship between variables, thus uncovering exercise's role in variables tested for while discovering their predictive qualities, ELs and diet quality were contrasted in figure 7. Between days 1-3 and 7-21, with slight lagging in the latter, the graph's trend tends to directly correlate. This correlation is better explored in figure 8C, where a red circle between these variables corresponds to a positive correlation, but not enough to be statistically significant (p=0.121). Additionally, the correlation coefficient is 0.116, which suggests a weak positive linear relationship. In figure 8A, comparison between SmartPoints and HEI were to see their relationship as they are supposed to measure one variable in common. Despite this and their positive correlation, their correlation coefficient is 0.002, suggesting no linear relationship exists (p=0.861). This seems to be the same case for the correlation between ELs and SmartPoints in figure 8B with a correlation coefficient of 0.007 (p=0.721), suggesting that SmartPoint values aren't reliable to predict the behavior in diet quality or ELs. The weak correlations observed between ELs, diet quality measures, and SmartPoint values highlight the multifaceted relationship between exercise, diet, and ELs in this demographic given the lack of similarity to other studies. Cultural factors, socioeconomic status, and individual dietary preferences might be at play.

Conclusion and Implications

This study delved into the correlation between exercise, diet quality, and ELs among Hispanic teens, aiming to address a critical gap in research concerning this demographic, revealing several significant findings that contribute to our understanding of their interplay with several implications. Firstly, the hypothesis posited that exercise would initially enhance diet quality and ELs among Hispanic teens, aligning with previous research findings. While aspects of this hypothesis were supported by the data, the study also uncovered other insights that merit attention from its disparity to the initial hypothesis. For one, the use of SmartPoints to measure diet seemed to not correlate well with HEI, which indirectly calls for a critique of WeightWatchers approach to weight loss and the need to consider a variety of macronutrients in one's diet, given the value being based solely on calories that are not all created equal. While calories play a role in weight management, the quality of those calories is equally crucial for overall health. For example, foods with a high glycemic index (GI) can cause rapid spikes in blood sugar levels, leading to increased hunger and potentially contributing to weight gain over time. This is because high-GI foods can trigger fluctuations in insulin levels, which may promote fat storage and inhibit fat burning (Vega-López et al., 2018). Therefore, solely focusing on calorie intake without considering the glycemic index and other nutritional factors may not effectively support weight loss or promote overall health. However, it does suggest the extent of the impact of cultural factors on calorie intake given the difference in results for previous studies, such as Tanya Halliday's findings of which categorize exercise as an appetite-suppressor (Halliday et al., 2021).

Other results indicated a statistically significant improvement in diet quality among participants who increased their PA levels, highlighting the potential of exercise interventions to positively influence dietary behaviors in this population. Moreover, the comparison between groups demonstrated notable disparities in ELs and diet quality, with participants engaging in regular exercise exhibiting higher ELs and healthier dietary habits, indicating that cultural and socioeconomic limitations may be overcome or may not be a significant hindrance. This finding aligns with existing literature on the beneficial effects of PA on overall health outcomes. However, despite the overall trend suggesting a positive correlation between exercise, diet quality, and ELs, the subjects who increased their exercise time experienced lower ELs, indicating that exercise won't immediately fix fatigue, insinuating a gradual process that would need to be researched as it didn't support the second part of the hypothesis. Overall, these findings emphasize the need for further research to elucidate the underlying factors of these relationships and identify variables that may influence the effectiveness of exercise interventions in promoting healthy behaviors among adolescents.

Limitations

Due to the provided circumstances of this study, there are a myriad of limitations stemming from a scarcity of resources. Primarily, a lack of research companions, time, and ability to reach out could only allow for a small sample size for the demographic, constrained by the parameters of one of South Florida's schools, limiting the database. Were there to be an organized team with the appropriate resources and time to gather willing participants, increased by appropriate compensations, the sample size would have extended to more teens in other schools, making the results less biased. While the study had a notably small sample size, it makes up for it by the highly specific target demographic compared to Joo et al whose pool of 2680 young adults, despite being big, represents a much broader spectrum of individuals (Joo et al., 2019). Furthermore, there was an apparent lack of an experimental group that complements the one that does exercise (Exercisers): a group where individuals who were exercising stop doing so. This absence limits the ability to fully understand the effects of ceasing exercise on diet and ELs and how it contrasts with starting or continuing an exercise regimen.

Additionally, inadequate clinical control and inconsistent subject meetings limited our study to relying solely on self-reported measures as participants conducted their daily activities. This reliance on self-reporting introduces the potential for recall bias, where participants may inaccurately remember or overestimate their ELs or food. Even though the ability to document food intake was restricted to photographs, resulting in estimations for proportion size, another section was added to ask of any foods that participants may have missed to take a picture of and the quantity. This method lacks precision and may introduce errors in estimating nutritional intake, potentially leading to misinterpretation of dietary patterns and their impact on study outcomes. Additionally, calories and macronutrients could not be measured in respect to dietary patterns. In a clinical study, employing more accurate methods such as food diaries or dietary recalls, where participants record their food intake in real-time or are interviewed by trained professionals, could improve the accuracy and reliability of nutritional data collection. Although fitness trackers provided precise data on PA, participants exclusively engaged in an array of aerobic exercises, given the freedom to choose how and when to perform them. In a clinical study, it is crucial to ensure that participants engage in a standardized exercise regimen that accurately represents their typical activity patterns at a given time of day, several days a week, which would be applied to all participants. This could involve in-person supervision during exercise sessions, allowing researchers to monitor participants' activity levels and ensure adherence to a predetermined exercise protocol. By implementing a consistent exercise regimen monitored in real-time, researchers can mitigate the risk of participants disproportionately exercising during specific periods, such as weekends, which may skew results and fail to demonstrate the MVPA threshold reliably. Additionally, incorporating a variety of more accurate PA monitoring methods, such as accelerometers or heart rate monitors, alongside in-person supervision, can provide a more accurate and comprehensive understanding of participants' activity patterns, given that this study limited its budget to low-quality trackers.

Future Studies

Concluding, there is a need for research with enhanced financial resources to tackle and surpass the limitations identified in this study. Ideally, a collaborative effort between skilled nutritionists, experienced data analysts (given the immense amount of data that an inexperienced high schooler had to manage by condensing and eliminating irrelevant information that could have been useful with the right expertise) and personal trainers along with the use of advanced clinical-grade heart rate monitors could be employed to replicate key aspects of my experimental design on a significant cohort of Hispanic students. This collaborative approach would offer enhanced insights into the research question at hand, modifying my use of the MD chart and HEI as a quantification for healthy food as seen as needed. Additionally, future studies can incorporate macronutrient percentage and caloric intake to provide a more comprehensive understanding of dietary patterns among Hispanic teenagers.

An accurate way to tell if an individual exercises regularly is through their Vo2 Max, which was not calculated for this study (Cleveland Clinic, 2022). Future studies can implement this measure and gather participants with similar Vo2 Max ranges in accord with their assigned group, like in this study. Given the narrow scope of my demographic, future steps can dig in deeper through conducting interviews of the participants to understand better the reason for their choices of food, whether it has cultural significance, and to what extent their socioeconomic status affects these choices. This study could not include stress, biological functions, and emotional eating as important considerations in understanding the relationship between exercise and diet due to time constraints. In future studies, it would be prudent to consider the interplay of all these factors comprehensively to develop more effective strategies for promoting healthy lifestyles and reducing the risk of obesity within the ethnic group. Studying the acute effect of exercise would not be necessary to replicate exclusively, as it was implemented here due to resources and time constraints. A long-term study would be a better fit to find more insightful results.

Furthermore, given the need to understand why teens in this demographic make food choices in order to promote a better diet through efficient interference, there needs to be an establishment of the extent to which exercise improving diet and ELs has to do with psychological or biological factors. Through interviews, an understanding of how certain values in Hispanic culture may motivate exercising and, in turn, better nutrition, can be further studied. Biological insight would require advanced clinical techniques, such as Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET), coupled with blood sample analysis, which offer avenues for investigating the molecular and neurochemical processes involved. These techniques enable us to explore the roles of hormones and neurotransmitters in regulating appetite, mood, and ELs, shedding light on how exercise may impact these physiological mechanisms. There are already insights by Joel C. of the biochemical mechanisms that may enhance cellular promotion i.e ELs, though not on this demographic nor does it consider its connection to diet (Eissenberg, 2022; Toni Golen & Hope Ricciotti, 2021; Dishman, 2020). By elucidating the biochemical pathways through which exercise influences dietary behaviors and energy regulation, researchers can develop pharmacological interventions that mimic the beneficial effects of exercise. This could offer alternative strategies for individuals unable to engage in regular PA due to medical conditions or socioeconomic constraints. For example, of an intervention applying this knowledge, community-based programs that incorporate culturally relevant activities and emphasize the importance of family support in adopting healthy lifestyle habits have shown promising results in promoting dietary changes and increasing PA levels among Hispanic youth (Sanchez et al., 2021). These interventions leverage cultural values and social networks to create supportive environments conducive to behavior change, ultimately improving health outcomes within the community. Thus, further steps in this research can promote such interventions, being more effective by being specific to this group's needs.

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