Analysis of Patterns in Dietary and Accelerometry Data in NHANES

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Customized Concentration

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Abstract

Objectives

Previous studies have shown how the timing of certain biological processes like eating can affect health outcomes. The objective of this study is to investigate how much additional information is in the discordance of the timing for energy intake and physical activity.

Methods:

We constructed indices modeling the concordance of activity timing and energy intake using data from the NHANES 2003-2004 cohort to model how the concordance affects BMI and self-reported health. Multiple linear regression models assessed the contribution of the concordance of activity timing and energy intake to BMI. Multiple Ordinal Regression Models assessed the contribution of the concordance of activity timing and energy intake to self-reported health status.

Results:

Overall, the concordance of activity timing and energy intake did not significantly affect BMI or health status. However, the linear regression models showed that TAC more significantly contributed to BMI than TEI.

Conclusions:

These results accept the null hypothesis that the concordance of activity timing and energy intake did not significantly affect BMI or health status. However, the findings suggest that the relative physical activity has a stronger relationship with BMI than energy intake. In contrast, total energy intake (TEI) had a stronger relationship with health status than total activity (TAC). These relationships should be further explored further using the NHANES accelerometer data as an objective proxy for physical activity.

Introduction

The timing of specific biological behaviors and processes in the body are necessary for healthy physiological function. Circadian physiology has evolved to promote certain behaviors like physical activity and eating during the day and others like sleeping and fasting during the night.[i]

Growing evidence suggests that the circadian timing can have health consequences in people as well. In a prospective cohort study by Marinac et. Al showed that prolonging the length of a nightly fasting interval could protect women from developing breast cancer[ii]. Numerous other previous studies in both human[iii] and animal models[iv] have shown that consumption of food during the circadian evening is associated with higher body mass index independent of risk factors like caloric intake and activity level[v]. The specific populations that are subject to consuming food at inappropriate circadian times are college students or rotating shift workers. These populations also have a higher incidence of weight gain and obesity suggesting a correlation between the two[vi].

A commonality across population studies, however, is the reliance on self-reported data – specifically physical activity levels. Population physical activity are usually collected in national health surveys through self-reports and usually categorical with categories such as leisure-time physical activity, some physical activity[vii]. These self-report data suffer from significant reporting bias due to reliance on recall ability and social desirability bias[viii]. Further, population studies have a limited number of questions used to assess a specific behavior. Objective measurement devices such as pedometers, which measure steps, and accelerometers, which measure movement intensity, offer a potential solution to problems with self-reported data[ix]

In 2003, with support from the National Cancer Institute of the National Institutes of Health, objective assessment of physical activity with accelerometers was implemented in the National Health and Nutrition Examination Survey (NHANES). The accelerometer data from NHANES 2003-2004 provide the first objective measures of physical activity for the U.S. population[x].

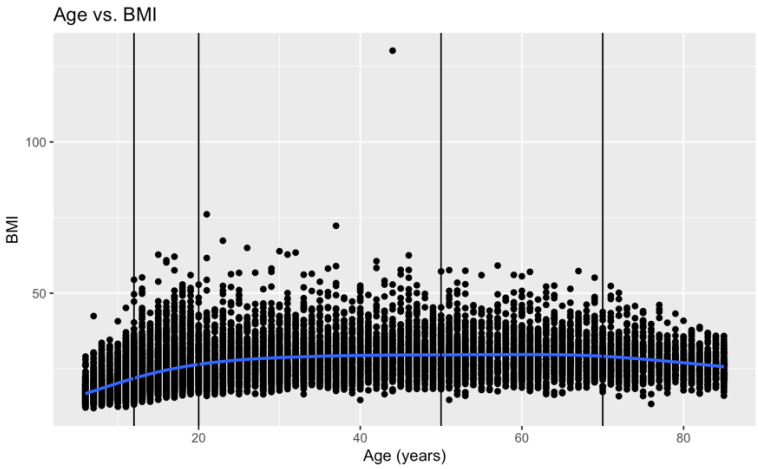
Previous studies have used the NHANES ActiGraph data to show the relationship between health status and physical activity like a study investigating the activity level of cancer survivors[xi], however none have used the NHANES data to investigate the temporal discordance of physical activity and energy intake.

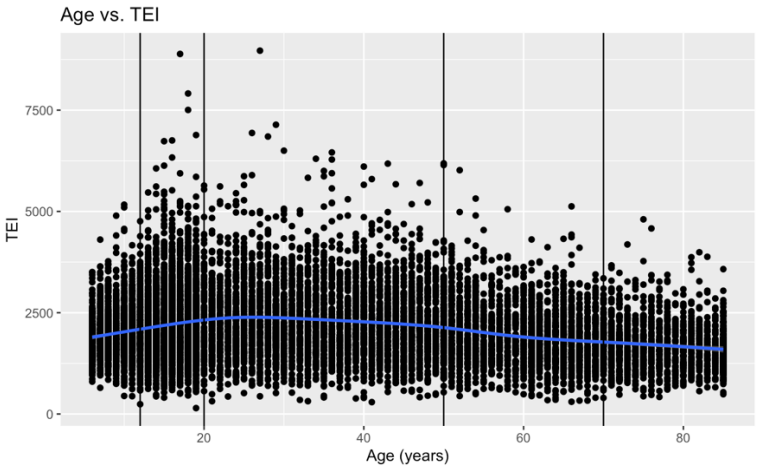
This study takes advantage of the ActiGRaph data from the NHANES 2003-2004 cohort to investigate both the relative amount of physical activity as well as the timing of physical activity in relation to the timing of energy intake. In this study we compare how much additional information is in the discordance of the timing for energy intake and physical activity.

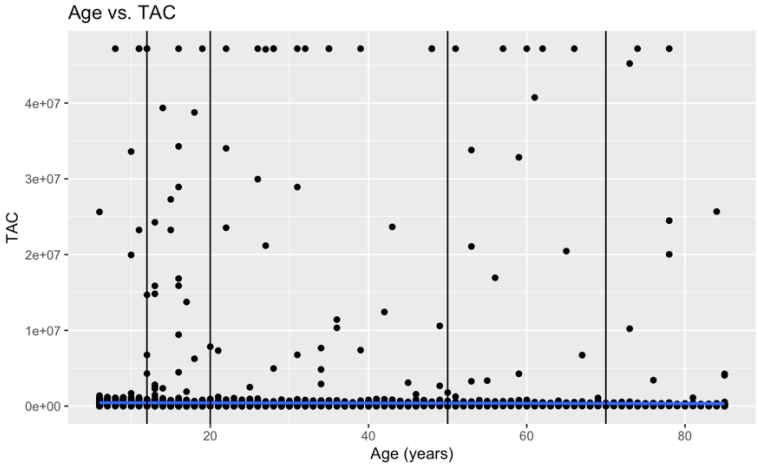
In this study, pTEI represented the Total Energy Intake and the temporal 24 hour pattern of the proportion of the total energy consumed by time t calculated as a curve starting at zero and ending at one. To analyze the temporal pattern of the proportion of the total energy expenditure vs. intake, three variables were created. Similarly, the Total Volume of Physical Activity was quantified via pTAC(t) as the proportion of the total PA spent by time t. Then concordance between pTAC and pTEI was calculated in three different ways, the activity curve minus the energy intake curve (AminE), activity curve over energy intake curve (AOE), and then the activity curve minus the energy intake curve over the energy intake curve (AMOE).

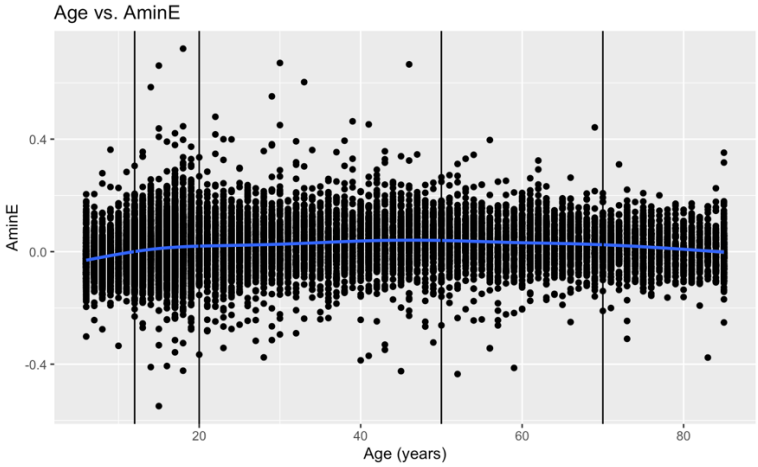
Below are plots of these key variables over age with vertical lines dividing the points by age group:

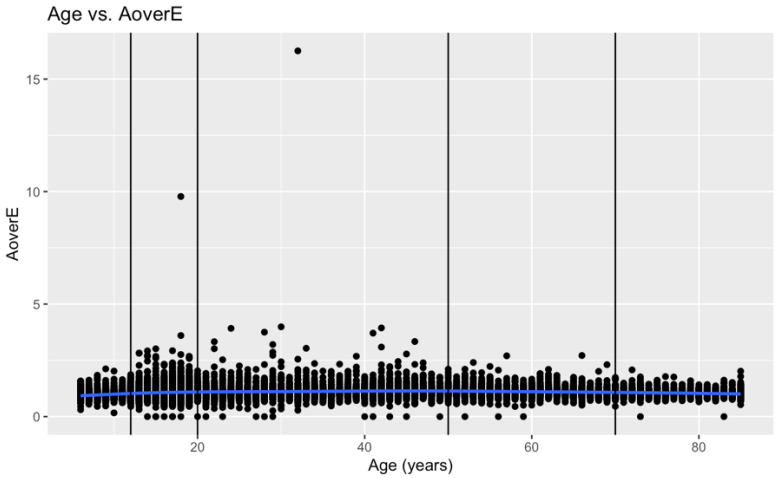
Figure 1

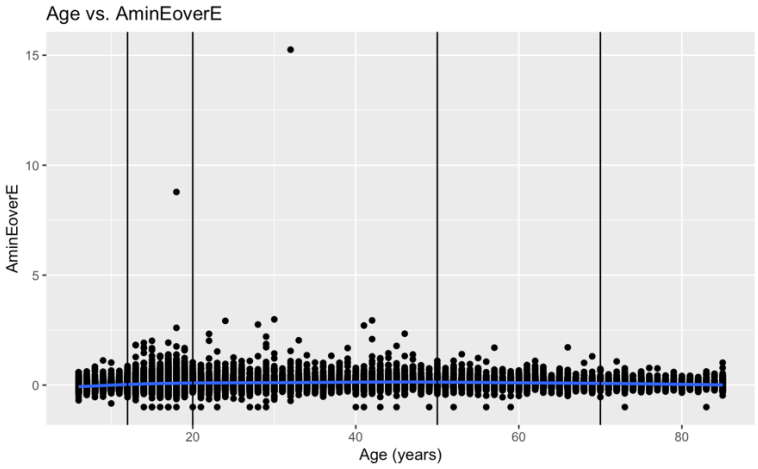

Age vs. BMI
BMI
100
50
20
40
60
80
Age (years)


Age vs. TEI
TEI
7500
5000
2500
0
20
40
60
80
Age (years)


Age vs. TAC
TAC
4e+07
3e+07
2e+07
1e+07
0e+00
20
40
60
80
Age (years)


Age vs. AminE
AminE
0.4
0.0
-0.4
20
40
60
80
Age (years)

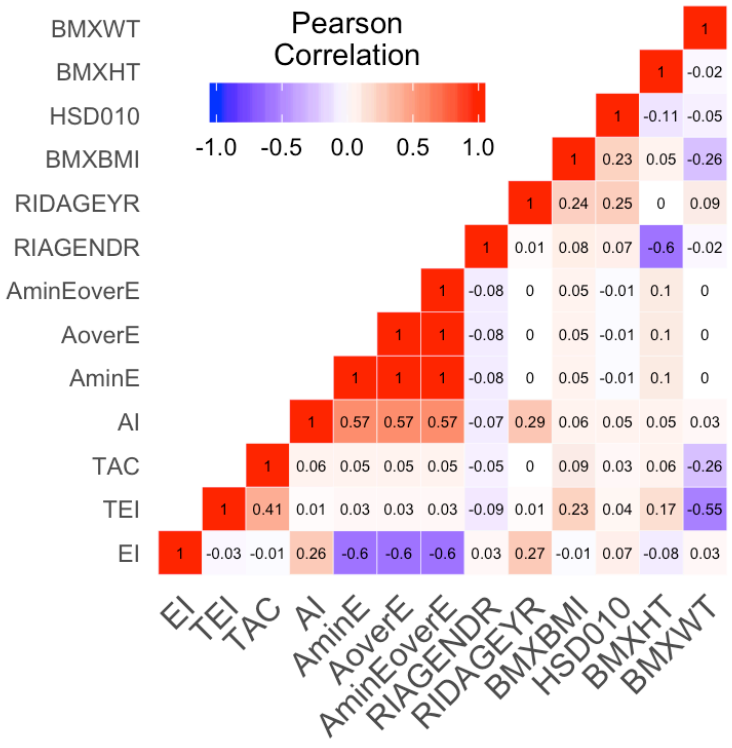

Age vs. AoverE
AoverE
15
10
5
0
20
40
60
80
Age (years)


Age vs. AminEoverE
AminEoverE
15
10
5
0
20
40
60
80
Age (years)

The concordance indices as well as total activity seem to remain constant over age whereas BMI and total energy intake show a slight sigmoidal relationship to age. There are obvious outliers and they have been omitted for the analysis.

A correlation heatmap of the key variables shows that there are weak positive relationships between the concordance indices and BMI and a weak negative relationship between Current Health Status and the concordance indices. The heatmap also shows that TEI has a moderately strong positive relationship with BMI and TAC shows a weaker positive relationship.

Figure 2



Methods

NHANES Methodology

This study makes use of the National Health and Nutrition Examination Survey (NHANES)[xii], a survey research program conducted by the Nation Center for Health Statistics to assess the nutritional status and health of adults and children in the US. The survey includes interviews, physical examinations, and laboratory test.[xiii] NHANES uses a multistage probability sampling design to select a sample that is representative of the civilian noninstitutionalized household (both adult and children) population of the United States. In 2003-2004, NHANES added accelerometer-measured physical activity data.

NHANES survey participants were interviewed in their homes and then received a physical examination in mobile examination centers. For physical activity, all of the examined participants ages 6 years and older were asked to wear an ActiGraph (ActiGraph, LLC; Ft. Walton Beach, FL) model 7164 accelerometers over the right hip on an elasticized belt for the seven days following their examination.

Participants were asked to wear the device while they were awake and to take it off for swimming or bathing. After the seven days, ActiGraph monitors were returned by mail to the NHANES contractor, where data were downloaded and the device was checked to determine whether it was still within the manufacturer's calibration specifications, using an Actigraph calibrator. Details of the accelerometer protocol are available on the NCHS website[xiv]. The uniaxial Actigraph measures and records vertical acceleration as "counts," providing an indication of the intensity of physical activity associated with locomotion (33). Data were

recorded in 1-min epochs for up to 1 wk.[xv] Data from NHANES is made publicly available to researchers on the NCHS website[xvi]

Data Analysis

All analyses were conducted in R Studio using tidy-verse and ggplot2 packages. After omitting missing data, there were 6855 subjects. To account for survey sampling, analysis was stratified by age group. Table 1 shows the sample size per age group.

Table 1: Sample Size

Age Group	Sample Size
6-11	829
12-19	1555
20-50	1781
51-70	1068
71+	695

Table 2

	Summary of Continuous Variables by Age Group				
	6-11	12-19	20-50	51-70	71+
BMI	Mean: 18.94 SD: 4.52	Mean: 23.87 SD: 6.26	Mean: 28.75 SD: 6.87	Mean: 29.67 SD: 6.38	Mean: 27.39 SD: 5.05
TEI	Mean: 1998	Mean: 2165.5	Mean: 2322	Mean: 1930	Mean: 1691

	SD: 581.28	SD: 856.78	SD: 904.04	SD: 734.87	SD: 589.63
TAC	Mean: 529,133 SD:2271840	Mean: 410,764 SD: 2182594	Mean: 408,811 SD: 2570275	Mean: 404,336 SD: 2736325	Mean:314,993 SD: 2564588
AOE	Mean: 0.9649 SD: 0.172	Mean: 1.0605 SD: 0.269	Mean: 1.1089 SD: 0.271	Mean: 1.1043 SD: 0.214	Mean: 1.0400 SD: 0.169
AMinE	Mean: -0.01874 SD: 0.0654	Mean: 0.06045 SD: 0.269	Mean: 0.1089 SD: 0.271	Mean: 0.10427 SD: 0.214	Mean: 0.0399 SD: 0.169
AMOE	Mean: -0.03515 SD: 0.0.172	Mean: 0.06045 SD: 0.269	Mean: 0.1089 SD: 0.271	Mean: 0.10427 SD: 0.214	Mean: 0.0399 SD: 0.169

Table 3

Summary of Current Health Status by Age Group					
Age	1 - Excellent	2 - Very Good	3 - Good	4 - Fair	5 - Poor
12-19	18.43%	0.58%	14.74%	36.01%	25.52%
20-50	33.98%	12.69%	1.44%	22.37%	37.60%
50-70	38.09%	32.99%	9.81%	5.65%	24.00%
70+	8.93%	38.15%	26.16%	8.08%	4.80%

The primary outcomes investigated are BMX-BMI – BMI and HSD010 – likert scale self-reported health status. HSD010 data was unavailable for the 6-11 age group so they were omitted for that analysis.

Total Energy Intake and the temporal 24 hour pattern of the proportion of the total energy consumed by time t (pTEI) was calculated as a curve starting at zero and ending at one.

To analyze the temporal pattern of the proportion of the total energy expenditure vs. intake, three variables were created. Similarly, the Total Volume of Physical Activity was quantified via pTAC(t) as the proportion of the total PA spent by time t. Then concordance between pTAC and pTEI was calculated in three different ways, the activity curve minus the energy intake curve (AminE), activity curve over energy intake curve (AOE), and then the activity curve minus the energy intake curve over the energy intake curve (AMOE).

For each age group the following linear regressions were modeled in R:

Bmi = total activity level + sex + age + total intake level

Bmi = total activity level + sex + age + total intake level + AminE

Bmi = total activity level + sex + age + total intake level + AOE

Bmi = total activity level + sex + age + total intake level + AMOE

Then for age groups 12-19, 20-50, 51-70, 70+ the following multinomial logistics regressions wre modeled in R:

Log(HSD010) = total activity level + sex + age + total intake level

Log(HSD010) = total activity level + sex + age + total intake level + AminE

Log(HSD010) = total activity level + sex + age + total intake level + AOE

Log(HSD010) = total activity level + sex + age + total intake level + AMOE

Results

BMI Models

Null Model

In the null model, the activity (TAC) had a significantly negative effect on BMI in the 6-11 age group[coefficient: -0.861, P: 8.25e-09], the 12-19 age group [coefficient: -0.613 , P-Value: 0.009], the 20-50 age group [coefficient: -2.41, 1.17e-13], the 51-70 age group [coefficient: 2.98, P-Value: 3.27e-10], and the 70+ age group [coefficient: -2.84, P-Value: 1.62e-05].

In the null model, the energy intake (TEI) had a significantly positive effect on BMI in the the 20-50 age group [coefficient: 0.05527, P-Value: 0.025]. TEI had a significantly negative effect in BMI for the 12-19 age group [coefficient: -0.137, P-Value: 6.44e-10] and the 50-70 age group [coefficient: -0.073, P-Value: 0.034].

Table 4: Null Model Results - BMI

6-11 Age Group			
	Coefficient	P-Value	R2
Intercept	-1.43	<2 e-16	0.159
TAC	-2.02	3.25e-16	
Gender	0.011	0.778	Adjusted R2
Age	0.139	<2 e-16	0.156
TEI	0.049	0.0232	
12-19 Age Group			
	Coefficient	P-Value	R2
Intercept	-1.73	<2 e-16	0.074
TAC	-1.092	2.28e-05	
Gender	-0.033	0.234	Adjusted R2
Age	-0.073	<2 e-16	0.073
TEI	-0.125	5.77e-15	
20-50 Age Group			

	Coefficient	P-Value	R2
Intercept	-0.646	1.22e-15	0.049
TAC	-2.78	<2 e-16	
Gender	-0.011	0.717	Adjusted R2
Age	0.017	<2 e-16	0.048
TEI	0.021	0.200	
50-70 Age Group			
	Coefficient	P-Value	R2
Intercept	0.039	0.844	0.052
TAC	-4.62	<2 e-16	
Gender	-0.005	0.894	Adjusted R2
Age	-0.002	0.557	0.050
TEI	-0.026	0.307	
70+ Age Group			
	Coefficient	P-Value	R2
Intercept	2.022	6.07e-11	0.059
TAC	-3.65	2.58e-07	
Gender	-0.04	0.258	Adjusted R2
Age	-0.31	6.95e-14	0.055
TEI	-0.04	0.174	

AminE

All age groups showed no significant association with AminE on BMI. TAC still showed a significant negative effect on BMI for the 6-11 age group [coefficient: -0.85, P-Value: 4.77e-08], the 12-19 age group [coefficient: -0.658 , P-Value: 0.008], the 20-50 age group [coefficient: -2.54, 5.17e-14], the 51-70 age group [coefficient: -3.25, P-Value: 3.52e-11], and the 70+ age group [coefficient: -3.28, P-Value: 7.19e-9].

The energy intake (TEI) still had a significantly positive effect on BMI in the 20-50 age group [coefficient: 0.05, P-Value: 0.0017]. TEI still had a significantly negative effect in BMI for the 12-19 age group [-0.1.37, P-Value: 2.12e-09. The 51-70 age group no longer showed a significant relationship.

Table 5: Amin E Model Results - BMI

6-11 Age Group			
	Coefficient	P-Value	R2
Intercept	-1.41	<2 e-16	0.159
TAC	-1.96	4.12e-14	
Gender	0.011	0.749	Adjusted R2
Age	0.124	<2 e-16	0.156
TEI	0.047	0.0388	
AminE	0.04	0.072	
12-19 Age Group			
	Coefficient	P-Value	R2
Intercept	-1.71	<2 e-16	0.075
TAC	-1.11	3.56e-05	
Gender	-0.032	0.267	Adjusted R2
Age	0.077	<2 e-16	0.074
TEI	-0.129	3.67e-15	
AminE	0.032	0.059	
20-50 Age Group			
	Coefficient	P-Value	R2
Intercept	-6.75e-01	2.42e-16	0.052
TAC	-2.97	<2 e-16	
Gender	-1.49e-02	0.646	Adjusted R2
Age	1.813e-02	<2 e-16	0.056
TEI	2.204e-02	0.185	
AminE	3.2-05	0.999	
50-70 Age Group			
	Coefficient	P-Value	R2
Intercept	0.058	0.722	0.056
TAC	-4.78	<2 e-16	
Gender	-0.01	0.817	Adjusted R2
Age	-0.002	0.488	0.053
TEI	-0.026	0.317	
AminE	-0.023	0.392	
70+ Age Group			
	Coefficient	P-Value	R2
Intercept	1.99	1.49e-10	0.066
TAC	-4.105	1.36e-08	
Gender	-0.036	0.360	Adjusted R2
Age	--0.0356	5.64e-14	0.062
TEI	-0.041	0.204	
AminE	0.052	0.108	

AOE

All age groups showed no significant association with AOE on BMI. TAC still showed a significant negative effect on BMI for the 6-11 age group [coefficient: -0.86, P-Value: 9.75e-08], the 12-19 age group [coefficient: -0.65 , P-Value: 0.008], the 20-50 age group [coefficient: -2.54, 5.17e-14], the 51-70 age group [coefficient: -3.25, P-Value: 3.53e-11], and the 70+ age group [coefficient: -3.29, P-Value: 8.92e-07].

The energy intake (TEI) still had a significantly positive effect on BMI in the 20-50 age group [coefficient: 0.06, P-Value: 0.0018]. TEI still had a significantly negative effect in BMI for the 12-19 age group [-0.1.37, P-Value: 2.12e-09. The 51-70 age group no longer showed a significant relationship.

Table 6: A Over E Model Results - BMI

6-11 Age Group			
	Coefficient	P-Value	R2
Intercept	-1.38	<2 e-16	0.159
TAC	-1.97	3.37e-14	
Gender	0.011	0.783	Adjusted R2
Age	0.134	<2 e-16	0.156
TEI	0.052	0.0188	
AoverE	0.044	0.0768	
12-19 Age Group			
	Coefficient	P-Value	R2
Intercept	-1.71	<2 e-16	0.075
TAC	-1.11	3.56e-05	
Gender	-0.032	0.268	Adjusted R2
Age	0.072	<2 e-16	0.074

TEI	-0.129	3.67e-15	
AoverE	0.032	0.059	
20-50 Age Group			
	Coefficient	P-Value	R2
Intercept	-6.75e-01	2.42e-16	0.054
TAC	-2.97	<2 e-16	
Gender	-1.49e-02	0.646	Adjusted R2
Age	1.813e-02	<2 e-16	0.053
TEI	2.204e-02	0.185	
AoverE	3.2-05	0.999	
50-70 Age Group			
	Coefficient	P-Value	R2
Intercept	0.058	0.722	0.056
TAC	-4.78	<2 e-16	
Gender	-0.01	0.817	Adjusted R2
Age	-0.002	0.488	0.053
TEI	-0.026	0.317	
AoverE	-0.023	0.392	
70+ Age Group			
	Coefficient	P-Value	R2
Intercept	1.99	1.49e-10	0.066
TAC	-4.105	1.36e-08	
Gender	-0.036	0.360	Adjusted R2
Age	--0.0356	5.64e-14	0.062
TEI	-0.041	0.204	
AoverE	0.052	0.108	

AMOE

No age group showed a significant association with AMOE on BMI. TAC still showed a significant negative effect on BMI for the 6-11 age group [coefficient: -1.34, P-Value: 1.27e-14], the 12-19 age group [coefficient: -0.658 , P-Value: 0.008], the 20-50 age group [coefficient: -2.54, 5.17e-14], the 51-70 age group [coefficient: -3.25, P-Value: 3.52e-11], and the 70+ age group [coefficient: -3.29, P-Value: 7.19e-9].

The energy intake (TEI) still had a significantly positive effect on BMI in the 20-50 age group [coefficient: 0.06, P-Value: 0.0018]. TEI still had a significantly negative effect in BMI for the 12-19 age group [-0.137, P-Value: 2.12e-09. The 51-70 age group no longer showed a significant relationship. The activity/energy intake concordance indices had no effect on BMI.

Table 7: A Minus E Over E Model Results - BMI

6-11 Age Group			
	Coefficient	P-Value	R2
Intercept	-1.38	<2 e-16	0.159
TAC	-1.97	3.37e-14	
Gender	0.011	0.783	Adjusted R2
Age	0.134	<2 e-16	0.156
TEI	0.052	0.0188	
AMOE	0.044	0.0768	
12-19 Age Group			
	Coefficient	P-Value	R2
Intercept	-1.71	<2 e-16	0.075
TAC	-1.11	3.56e-05	
Gender	-0.032	0.268	Adjusted R2
Age	0.072	<2 e-16	0.074
TEI	-0.129	3.67e-15	
AMOE	0.032	0.059	
20-50 Age Group			
	Coefficient	P-Value	R2
Intercept	-6.75e-01	2.42e-16	0.054
TAC	-2.97	<2 e-16	
Gender	-1.49e-02	0.646	Adjusted R2
Age	1.813e-02	<2 e-16	0.053
TEI	2.204e-02	0.185	
AMOE	3.2-05	0.999	
50-70 Age Group			
	Coefficient	P-Value	R2
Intercept	0.058	0.722	0.056
TAC	-4.78	<2 e-16	
Gender	-0.01	0.817	Adjusted R2
Age	-0.002	0.488	0.053
TEI	-0.026	0.317	
AMOE	-0.023	0.392	
70+ Age Group			
	Coefficient	P-Value	R2
Intercept	1.99	1.49e-10	0.066

TAC	-4.105	1.36e-08	
Gender	-0.036	0.360	Adjusted R2
Age	--0.0356	5.64e-14	0.062
TEI	-0.041	0.204	
AMOE	0.052	0.108	

Health Status Models

In the null model, the activity (TAC) had a significant effect on health status in the 21-50 age group, the 51-70 age group, and the 70+ age group. TEI had a significant effect on health status in the 21-50 age group and the 51-70 age group. None of the concordance indices showed had a significant effect on health status.

These results accept the null hypothesis that the concordance of physical activity and energy intake timing does not contribute to BMI or self-reported health status.

Table 8: Significance Results for Null Model -HSD010

12-19 Age Group				
	TAC	Gender	Age	TEI
2	0.735	0.448	0.036	0.389
3	0.315	0.026	0.004	0.016
4	0.013	0.094	0.009	0.035
5	0.880	0.068	0.683	0.547
20-50 Age Group				
	TAC	Gender	Age	TEI
2	2.86-02	0.557	3.45e-01	0.662
3	3.16e-05	0.087	8.81e-04	0.241
4	5.01e-08	0.055	2.47e-08	0.0004
5	9.24e-07	0.174	1.61e-06	0.0022
50-70 Age Group				

	TAC	Gender	Age	TEI
2	6.19e-03	0.288	0.658	0.660
3	6.59e-09	0.202	0.787	0.346
4	2.89e-15	0.472	0.929	0.0003
5	6.44e-15	0.852	0.275	0.004
70+ Age Group				
	TAC	Gender	Age	TEI
2	0.739	0.011	0.701	0.059
3	0.0005	0.368	0.965	0.319
4	0.0	0.202	0.016	0.956
5	0.0	0.484	0.301	0.509

Table 9: Coefficients for Null Model -HSD010

12-19 Age Group				
	TAC	Gender	Age	TEI
2	-0.397	0.089	0.059	-0.057
3	-1.05	0.256	0.0799	-0.156
4	-3.811	0.275	0.131	-0.198
5	0.748	1.048	0.051	-0.187
20-50 Age Group				
	TAC	Gender	Age	TEI
2	-2.58	-0.074	0.006	-0.028
3	-4.79	-0.213	0.021	-0.074
4	-7.59	-0.281	0.043	-0.27
5	-17.22	-0.44	0.087	-0.56
50-70 Age Group				
	TAC	Gender	Age	TEI
2	-5.82	0.199	-0.006	-0.053
3	-12.11	0.232	0.004	-0.109
4	-18.24	0.139	-0.001	-0.455
5	-26.52	0.049	-0.023	-0.491
70+ Age Group				
	TAC	Gender	Age	TEI
2	-0.619	0.255	0.025	0.212
3	-5.95	0.243	0.024	0.203
4	-18.41	0.255	0.025	0.214
5	-48.49	0.363	0.035	0.314

Table 10: Significance Results for A Minus E Model -HSD010

12-19 Age Group					
	TAC	Gender	Age	TEI	AminE
2	0.660	0.622	0.029	0.499	0.545
3	0.297	0.035	0.005	0.035	0.243
4	0.027	0.092	0.002	0.049	0.035
5	0.957	0.083	0.659	0.544	0.729
20-50 Age Group					
	TAC	Gender	Age	TEI	AminE
2	1.18e-02	0.597	2.62e-01	0.547	0.285
3	7.27e-06	0.087	5.62e-04	0.212	0.283
4	8.89e-10	0.031	2.78e-08	0.0003	0.718
5	2.05e-7	0.130	2.94-07	0.0019	0.864
51-70 Age Group					
	TAC	Gender	Age	TEI	AminE
2	1.47e-03	0.253	0.509	0.947	0.956
3	3.51e-19	0.143	0.834	0.665	0.905
4	8.88e-16	0.567	0.863	0.012	0.448
5	2.22e-16	0.866	0.145	0.011	0.353
70+ Age Group					
	TAC	Gender	Age	TEI	AminE
2	2.68e-01	0.0384	0.955	0.035	0.661
3	3.42e-05	0.654	0.696	0.194	0.325
4	0	0.355	0.091	0.725	0.240
5	0	0.718	0.210	0.544	0.801

Table 11: Coefficients Results for A Minus E Model -HSD010

12-19 Age Group					
	TAC	Gender	Age	TEI	AminE
2	-0.482	0.059	0.063	-0.046	0.043
3	-1.13	0.248	0.0799	-0.141	0.081
4	-3.53	0.285	0.126	-0.190	0.205
5	0.271	1.00	0.055	-0.190	0.106
20-50 Age Group					
	TAC	Gender	Age	TEI	AminE
2	-3.049	-0.069	0.008	-0.039	0.078
3	-5.37	-0.219	0.023	-0.081	0.077
4	-8.89	-0.325	0.436	-0.285	-0.031
5	-19.29	-0.502	0.097	-0.581	0.032
51-70 Age Group					
	TAC	Gender	Age	TEI	AminE
2	-7.00	0.221	-0.01	-0.008	-0.007

3	-13.59	0.274	0.003	-0.052	0.015
4	-19.25	0.114	-0.003	-0.427	-0.102
5	-28.93	0.045	-0.31	-0.457	-0.166
70+ Age Group					
	TAC	Gender	Age	TEI	AminE
2	-2.11	0.540	0.001	0.461	-0.096
3	-7.29	0.112	-0.009	0.273	-0.206
4	-18.99	0.242	-0.069	0.078	-0.259
5	-50.09	0.134	-0.046	-0.196	-0.076

Table 12: Significance Results for A Over E Model -HSD010

12-19 Age Group					
	TAC	Gender	Age	TEI	AOE
2	0.660	0.622	0.029	0.499	0.545
3	0.297	0.035	0.005	0.035	0.243
4	0.027	0.092	0.002	0.049	0.035
5	0.957	0.083	0.659	0.544	0.729
20-50 Age Group					
	TAC	Gender	Age	TEI	AOE
2	1.18e-02	0.597	2.62e-01	0.547	0.285
3	7.27e-06	0.087	5.62e-04	0.212	0.283
4	8.89e-10	0.031	2.78e-08	0.0003	0.718
5	2.05e-7	0.130	2.94-07	0.0019	0.864
51-70 Age Group					
	TAC	Gender	Age	TEI	AOE
2	1.47e-03	0.253	0.509	0.947	0.956
3	3.51e-19	0.143	0.834	0.665	0.905
4	8.88e-16	0.567	0.863	0.012	0.448
5	2.22e-16	0.866	0.145	0.011	0.353
70+ Age Group					
	TAC	Gender	Age	TEI	AOE
2	2.68e-01	0.0384	0.955	0.035	0.661
3	3.42e-05	0.654	0.696	0.194	0.325
4	0	0.355	0.091	0.725	0.240
5	0	0.718	0.210	0.544	0.801

Table 13: Coefficients Results for A Over E Model -HSD010

12-19 Age Group					
	TAC	Gender	Age	TEI	AOE

2	-0.482	0.059	0.063	-0.046	0.043
3	-1.13	0.248	0.0799	-0.141	0.081
4	-3.53	0.285	0.126	-0.190	0.205
5	0.271	1.00	0.055	-0.190	0.106
20-50 Age Group					
	TAC	Gender	Age	TEI	AOE
2	-3.049	-0.069	0.008	-0.039	0.078
3	-5.37	-0.219	0.023	-0.081	0.077
4	-8.89	-0.325	0.436	-0.285	-0.031
5	-19.29	-0.502	0.097	-0.581	0.032
51-70 Age Group					
	TAC	Gender	Age	TEI	AOE
2	-7.00	0.221	-0.01	-0.008	-0.007
3	-13.59	0.274	0.003	-0.052	0.015
4	-19.25	0.114	-0.003	-0.427	-0.102
5	-28.93	0.045	-0.31	-0.457	-0.166
70+ Age Group					
	TAC	Gender	Age	TEI	AOE
2	-2.11	0.540	0.001	0.461	-0.096
3	-7.29	0.112	-0.009	0.273	-0.206
4	-18.99	0.242	-0.069	0.078	-0.259
5	-50.09	0.134	-0.046	-0.196	-0.076

Table 14: Significance Results for A Minus E Over E Model -HSD010

12-19 Age Group					
	TAC	Gender	Age	TEI	AminEoverE
2	0.660	0.622	0.029	0.499	0.545
3	0.297	0.035	0.005	0.035	0.243
4	0.027	0.092	0.002	0.049	0.035
5	0.957	0.083	0.659	0.544	0.729
20-50 Age Group					
	TAC	Gender	Age	TEI	AminEoverE
2	1.18e-02	0.597	2.62e-01	0.547	0.285
3	7.27e-06	0.087	5.62e-04	0.212	0.283
4	8.89e-10	0.031	2.78e-08	0.0003	0.718
5	2.05e-7	0.130	2.94-07	0.0019	0.864
51-70 Age Group					
	TAC	Gender	Age	TEI	AminEoverE
2	1.47e-03	0.253	0.509	0.947	0.956
3	3.51e-19	0.143	0.834	0.665	0.905
4	8.88e-16	0.567	0.863	0.012	0.448

5	2.22e-16	0.866	0.145	0.011	0.353
70+ Age Group					
	TAC	Gender	Age	TEI	AminEoverE
2	2.68e-01	0.0384	0.955	0.035	0.661
3	3.42e-05	0.654	0.696	0.194	0.325
4	0	0.355	0.091	0.725	0.240
5	0	0.718	0.210	0.544	0.801

Table 15: Coefficients Results A Minus E Over E Model -HSD010

12-19 Age Group					
	TAC	Gender	Age	TEI	AMOE
2	-0.482	0.059	0.063	-0.046	0.043
3	-1.13	0.248	0.0799	-0.141	0.081
4	-3.53	0.285	0.126	-0.190	0.205
5	0.271	1.00	0.055	-0.190	0.106
20-50 Age Group					
	TAC	Gender	Age	TEI	AMOE
2	-3.049	-0.069	0.008	-0.039	0.078
3	-5.37	-0.219	0.023	-0.081	0.077
4	-8.89	-0.325	0.436	-0.285	-0.031
5	-19.29	-0.502	0.097	-0.581	0.032
51-70 Age Group					
	TAC	Gender	Age	TEI	AMOE
2	-7.00	0.221	-0.01	-0.008	-0.007
3	-13.59	0.274	0.003	-0.052	0.015
4	-19.25	0.114	-0.003	-0.427	-0.102
5	-28.93	0.045	-0.31	-0.457	-0.166
70+ Age Group					
	TAC	Gender	Age	TEI	AMOE
2	-2.11	0.540	0.001	0.461	-0.096
3	-7.29	0.112	-0.009	0.273	-0.206
4	-18.99	0.242	-0.069	0.078	-0.259
5	-50.09	0.134	-0.046	-0.196	-0.076

Discussion

The results indicate that there is no significant relationship between the concordance of physical activity and energy intake and BMI or health status. This suggests that whether a person consumed energy at the same time as they expend energy does not affect major health outcomes.

However, the analysis showed that the activity level of an individual is a stronger predictor of BMI than the total energy intake.

There are many strengths to this study. Strong measurement methods were used; the ActiGraph is a reliable, objective and valid of physical activity that limits the error and inherent biases often associated with subjective measures. Further, accelerometers do a better job of capturing light-intensity physical activity and sedentary behavior than do self-report data.[xvii] In addition, the 24 hour recall method for gathering nutritional intake data is a fairly reliable estimate of dietary patterns.

This study also had several limitations. The study does not account for quality of nutrition or intensity of physical activity. In addition, the study does not consider other covariates such as SES, occupation, or other health statuses.

In summary, the use of objective measures of physical activity and the development of indices to describe the discordance of activity and intake timing prove

These findings suggest that temporal discordance of physical activity and energy intake do not have an effect on health status like BMI. However, the findings suggest that the relative physical activity has a stronger relationship with BMI than energy intake. In contrast, total energy intake (TEI) had a stronger relationship with health status than total activity (TAC). These relationships should be further explored further using the NHANES accelerometer data as an objective proxy for physical activity.

MPH Goals Analysis

Learning quantitative analysis skills is one of the main reasons I decided to pursue a MPH and has been my major goal for this program. This capstone helped me achieve my goal to increase my quantitative analysis skills. Prior to beginning work on this capstone, I was unfamiliar with R and had not worked with a dataset like NHANES before. I learned how to use basic data science tools like the tidyverse and learned how to develop regression models in R. In addition, I will be pursuing a PhD in information sciences after graduation and this was an introduction on the use of tools like accelerometers in health studies.

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