Be Well Program: Baseline to End-of-Program Measurements Analysis

The Data

Variable list:

1. HbA1C: hba1c

2. Fasting Blood Glucose: fast_blood_gluc

3. Blood Pressure (Systolic): blood_press_sys

4. Weight

5. BMI

6. LDL

7. Triglycerides (indicators 13, 14, 17, 18, 20, 22, 25)

8. Vegetable Dervings : pa_21

9. Fruit Servings :pa_22

10. Soda Consumption: pa_23

11. Sugar-Sweetened Beverages Consumption: pa_24

12. Attitudes Toward Healthy Foods : healthy_eating_important

We will be renaming the time points in the 'time' variable as follows only for more convenience when analyzing the data:

'1' for baseline measurement

'2' for the end of the program assessment

'3' for the 6-month mark after the program

'4' for the 12-month mark after the program

'5' for the 24-month mark after the program

In this analysis, we will only be focusing on the baseline and EOP measurements.

Quick Inventory Check

The data has been filtered to include only: - People who have data for both baseline and EOP - Observations, for each health metric, that were recorded in both baseline and EOP. (Eg: if someone had only baseline triglycerides levels recorded, that observation is disregarded in this analysis by being turned into NA)

Total sample size:

[1] 194

Sample size for high participation: [1] 122

Plots and Graphs

Distributions of The Variables

In assessing the health program's impact, distribution plots were generated for key variables, combining data from both Time 1 (baseline) and Time 2 (EOP). This approach offers a comprehensive view of participant characteristics, facilitating a nuanced understanding of the program's potential influence. The distribution plots can aid in visually narrating the dataset's overall evolution, laying the groundwork for further detailed explorations of specific variables across the program's timeline.
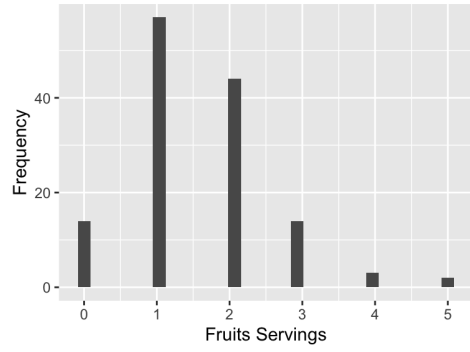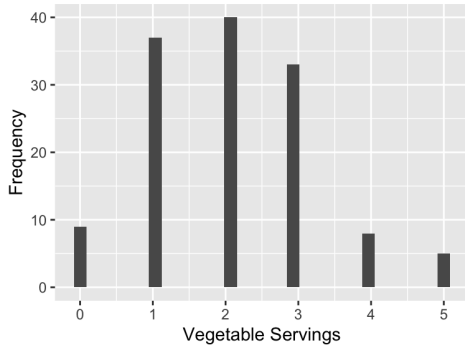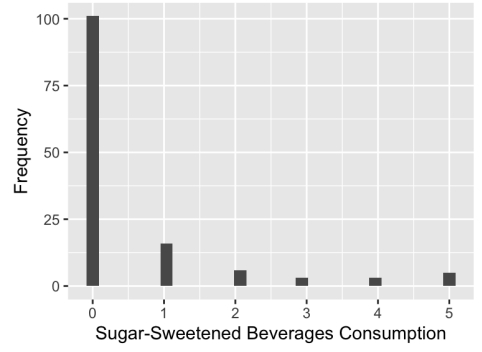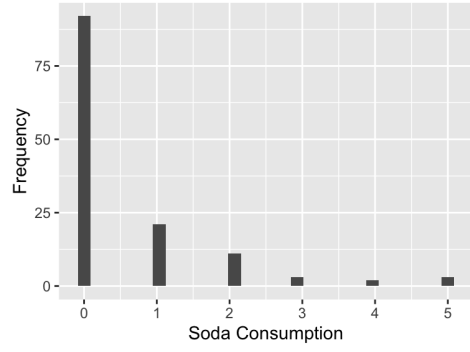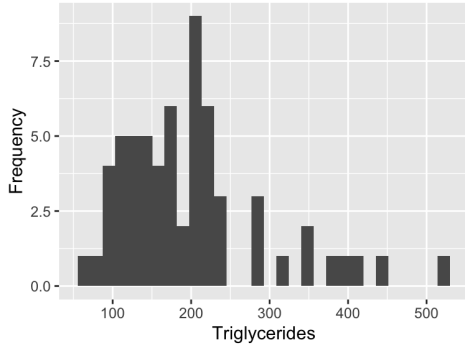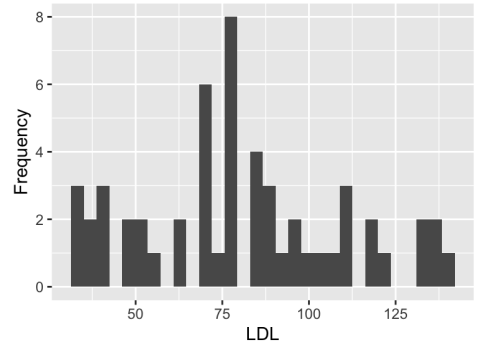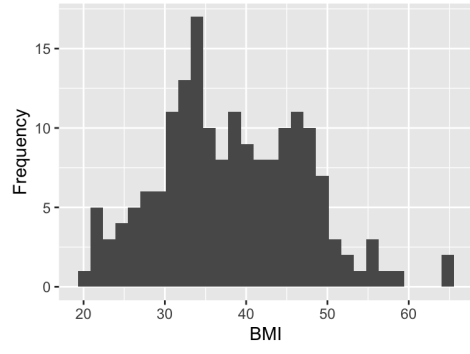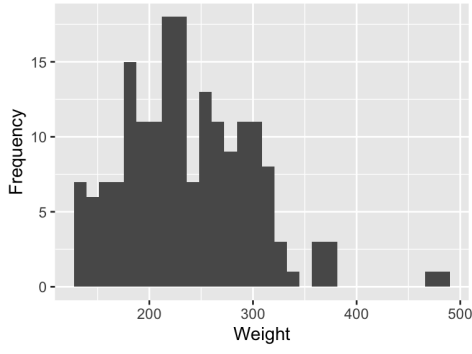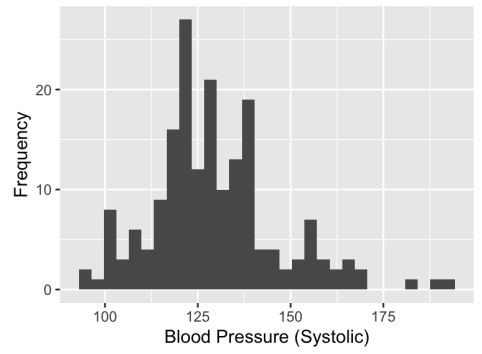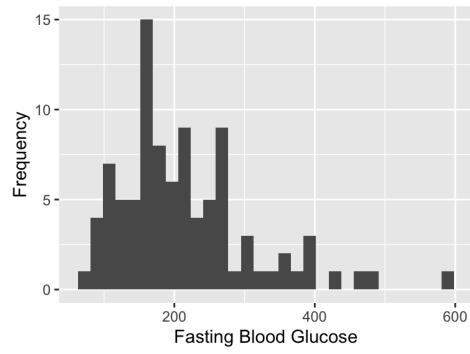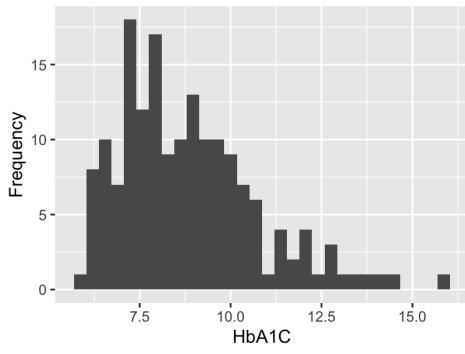
Box Plots: The Distribution of Each Variable at Each Time Point:
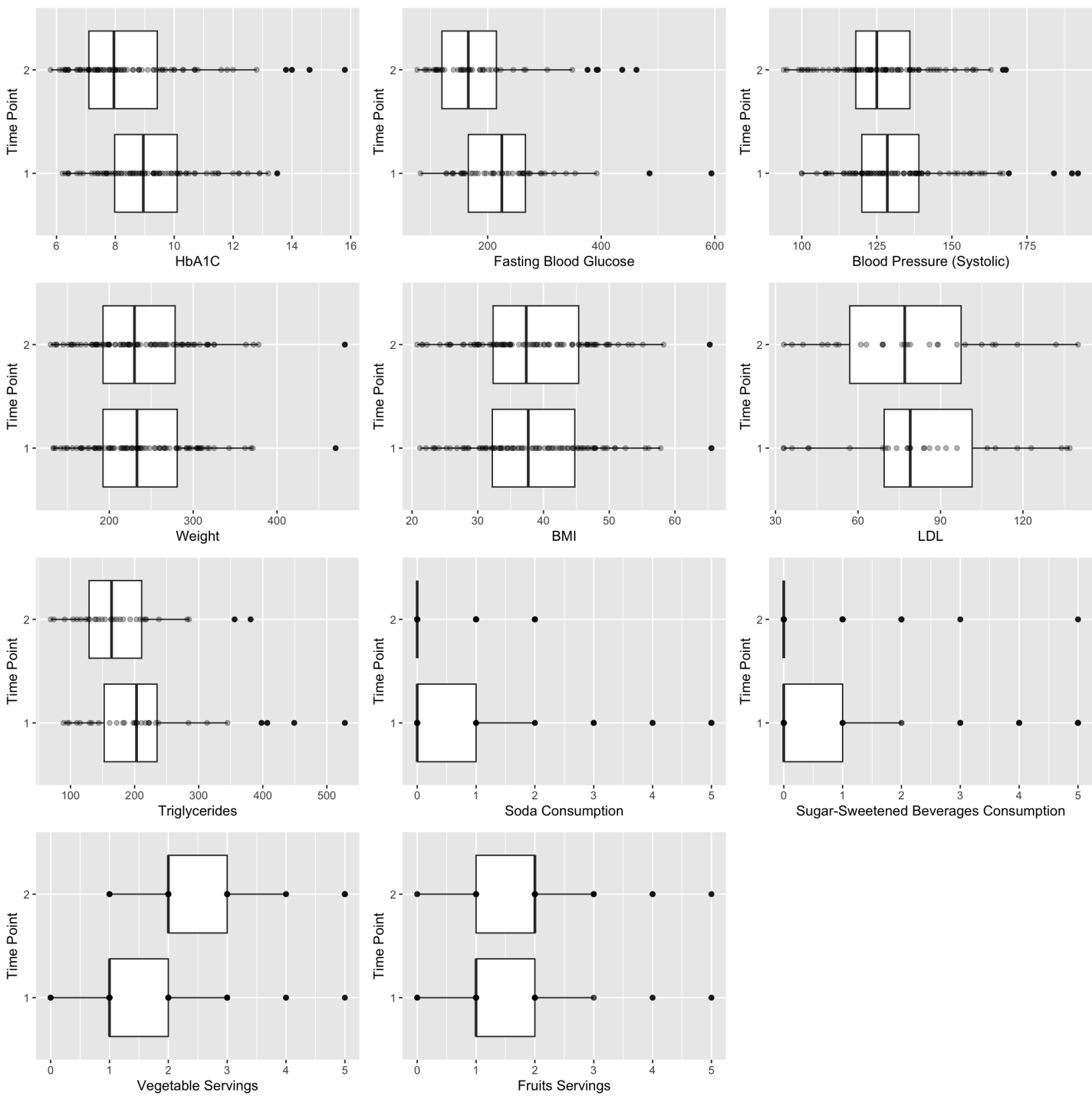
The box plots reaffirm the trends observed in mean values, with the addition of quartiles trends, offering a detailed portrayal of the data distribution.

One noteworthy observation from the box plots is the reduction in extreme outliers at the end of the program (EOP) compared to the baseline. These outliers, indicative of poorer health conditions, appear to diminish post-program participation. This reduction underscores a potential mitigation of severe health issues among participants, aligning with the overarching goal of the health program.

This visual confirmation strengthens our earlier findings and reinforces the notion that the health program may be instrumental in fostering healthier conditions among participants.

The Distribution of Rates of Change in the Variables Before and After the

Program

HbA1C

Fasting Blood Glucose

Blood Pressure (Systolic)

Weight

BMI

LDL

Triglycerides

Soda Consumption

Sugar-Sweetened Beverages Consumption

Vegetable Servings

Fruits Servings

Attitudes Toward Healthy Foods
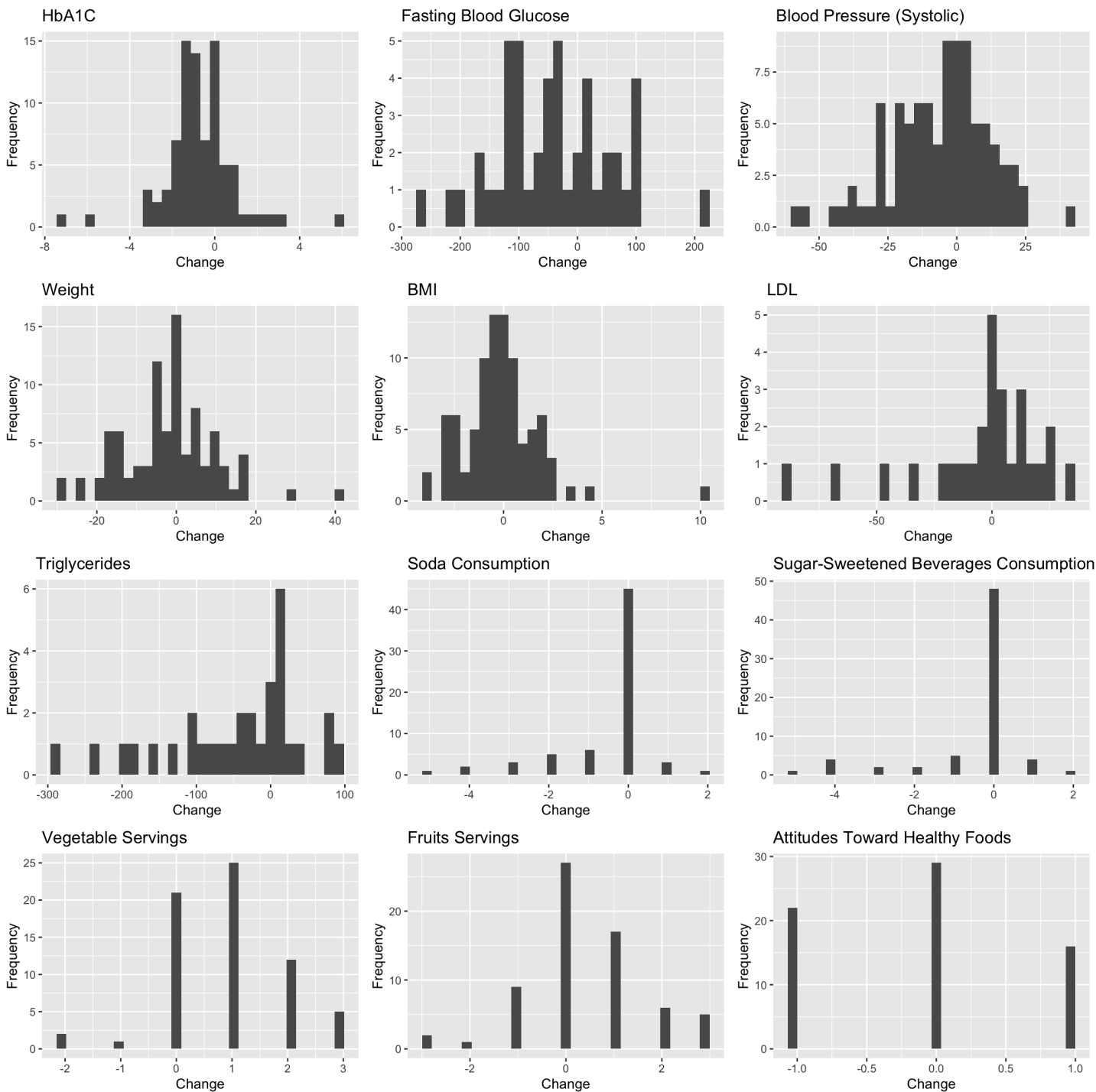
This analysis reveals a favorable trend, with the majority of variables showcasing decreases rather than increases.

For health attributes that we aim to decrease, such as HbA1c and blood sugar levels, the prevalence and extremity of decreases in the rates of change are particularly encouraging. Although there are instances of participants recording higher measurements in certain health attributes, there are also even more notable decreases observed in the majority of variables.

This asymmetry in the distribution suggests that, on the whole, participants are experiencing improvements in key health indicators rather than deteriorations.

Summary Tables

These concise and generalized tables offer convenient summaries of the aforementioned graphs, encapsulating both the mean values of the variables and their respective distributions.

The Means of Each Variable Before and After the Program:

Variables legend:

fast_blood_gluc: Fasting Blood Glucose

blood_press_sys: Blood Pressure (Systolic)

pa_23: Soda Consumption

pa_24: Sugar-Sweetened Beverages Consumption

pa_21: Vegetable Servings

pa_22: Fruits Servings

healthy_eating_important: Attitudes Toward Healthy Foods

time	hba1c	fast_blood_gluc	blood_press_sys	weight	bmi	ldl	triglycerides	pa_23	pa_24	pa_21	pa_22
1	9.17	234.44	132.45	238.90	38.32	82.85	222.84	0.82	0.78	1.62	1.36
2	8.48	192.77	126.35	237.05	38.14	78.67	177.16	0.32	0.33	2.52	1.76

The Standard Deviations of Each Variable Before and After the Program:

time	hba1c	fast_blood_gluc	blood_press_sys	weight	bmi	ldl	triglycerides	pa_23	pa_24	pa_21	pa_22
1	1.71	93.09	18.26	62.28	8.96	30.80	107.27	1.38	1.49	1.13	0.93
2	2.04	95.72	15.91	62.43	8.99	28.58	73.71	0.61	0.84	1.06	1.02

Investigating With Thresholds

This section will visualize the number of people, if observed, whose certain health metrics are under or over (and equal to) a certain threshold at baseline and EOP. We will be using bar graphs for this purpose. Due to the nature of the function used in creating these graphs, there will be p-values and equations at the top of the graphs. This information will not be one of our focus points because this analysis only involves data visualization and not predictive modeling.

The data sets used to generate these graphs will be them same ones used for the mean plots to ensure consistent samples sizes for the 2 time points.

HbA1c

Fasting Blood Glucose
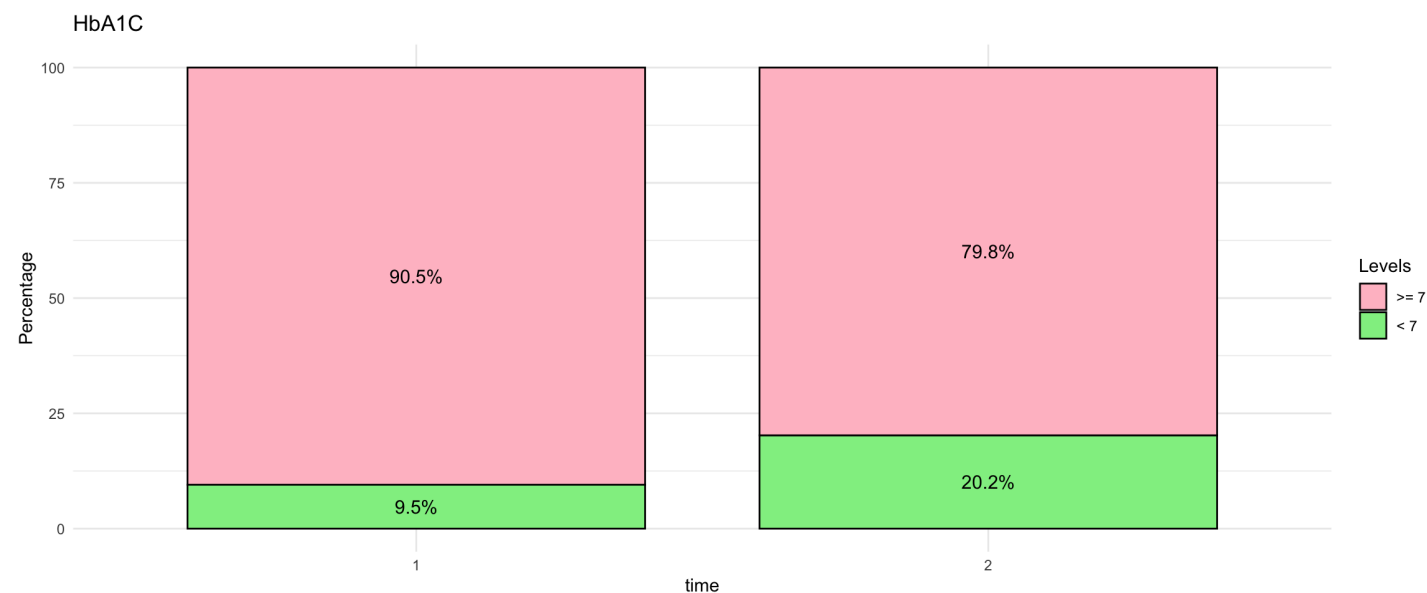
Fasting Blood Glucose
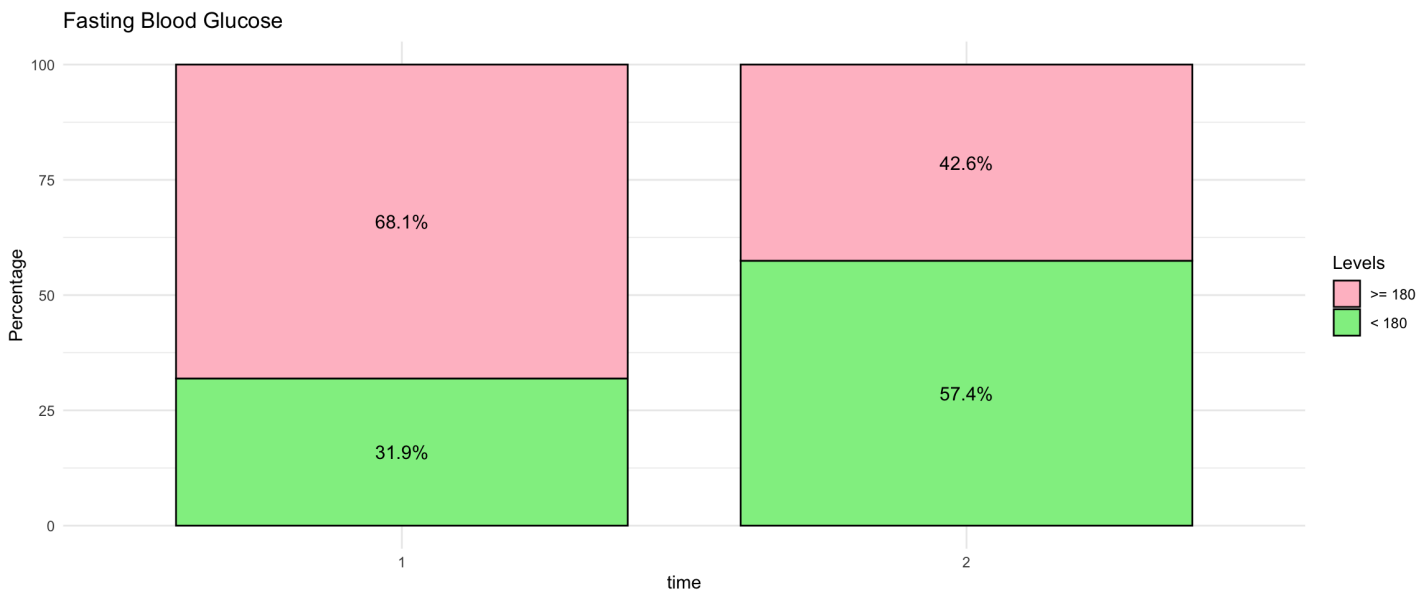
Blood Pressure

Blood Pressure
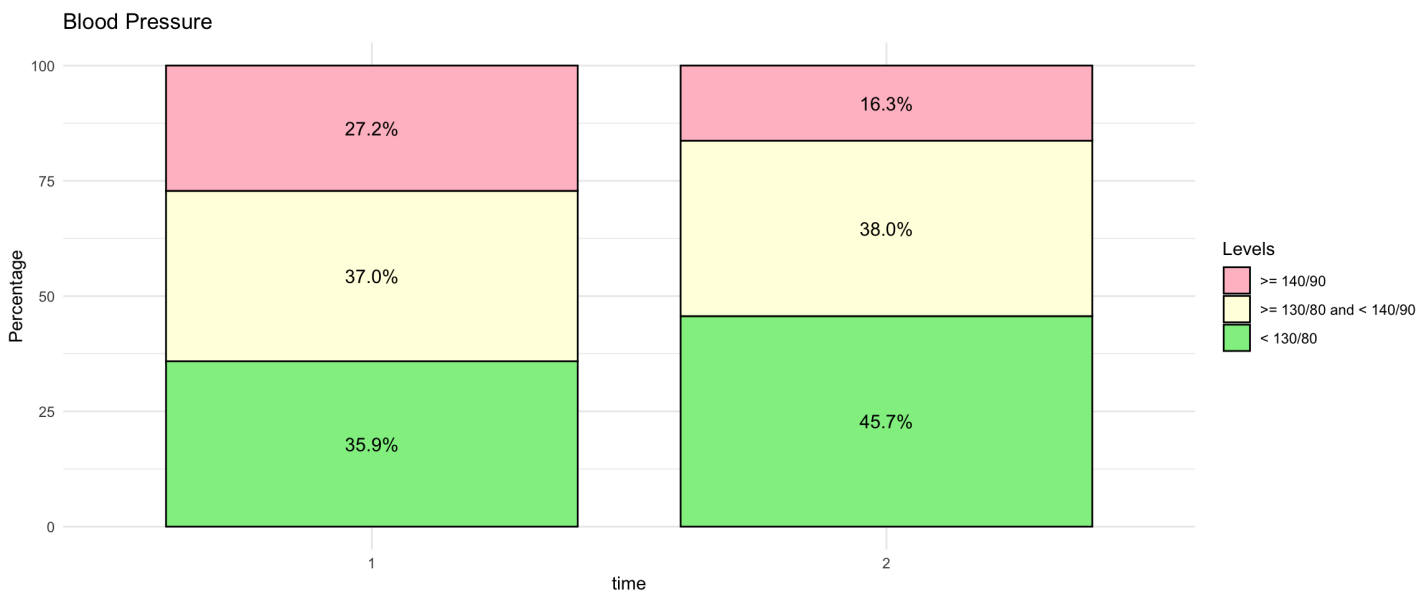
Note: 130/80 is the threshold for diabetics with pre-existing cardiovascular risk.

All three graphs depict a positive indication that the program potentially contributed to an increase in the proportion of individuals whose health metrics align with healthier thresholds.

Attitudes Toward Healthy Foods

We have delved into various health attributes and dietary intake variables, uncovering notable trends and shifts. As we pivot our focus, the next step involves examining a variable that captures individuals' perspectives on healthy eating.

Given that "Attitude Towards Healthy Eating" is represented by only two values, a transition to a visual representation, such as a bar graph, becomes particularly relevant. This graphical approach allows us to illustrate the proportions of each attitude value both at the baseline and the End-of-Program (EOP) marks. By doing so, we aim to provide a clear and insightful depiction of how participants' attitudes toward healthy foods may have evolved after the health program.

Attitudes Towards Healthy Eating
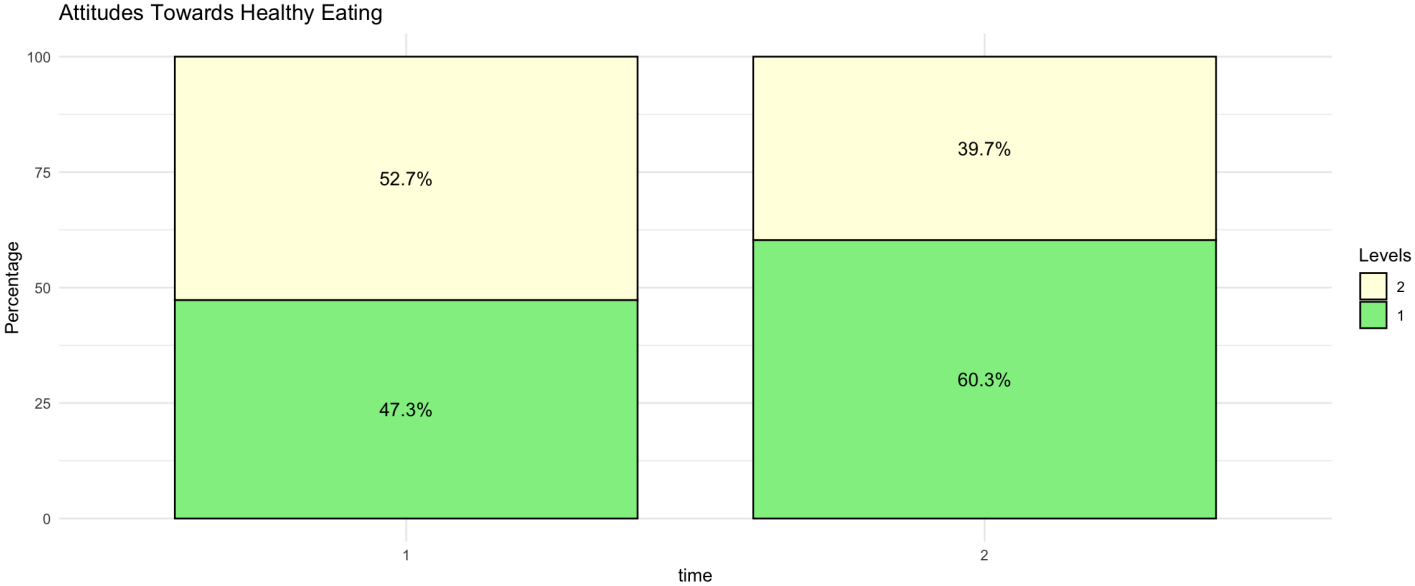
Comparison Between Participation Levels (Number of

Classes Attended)
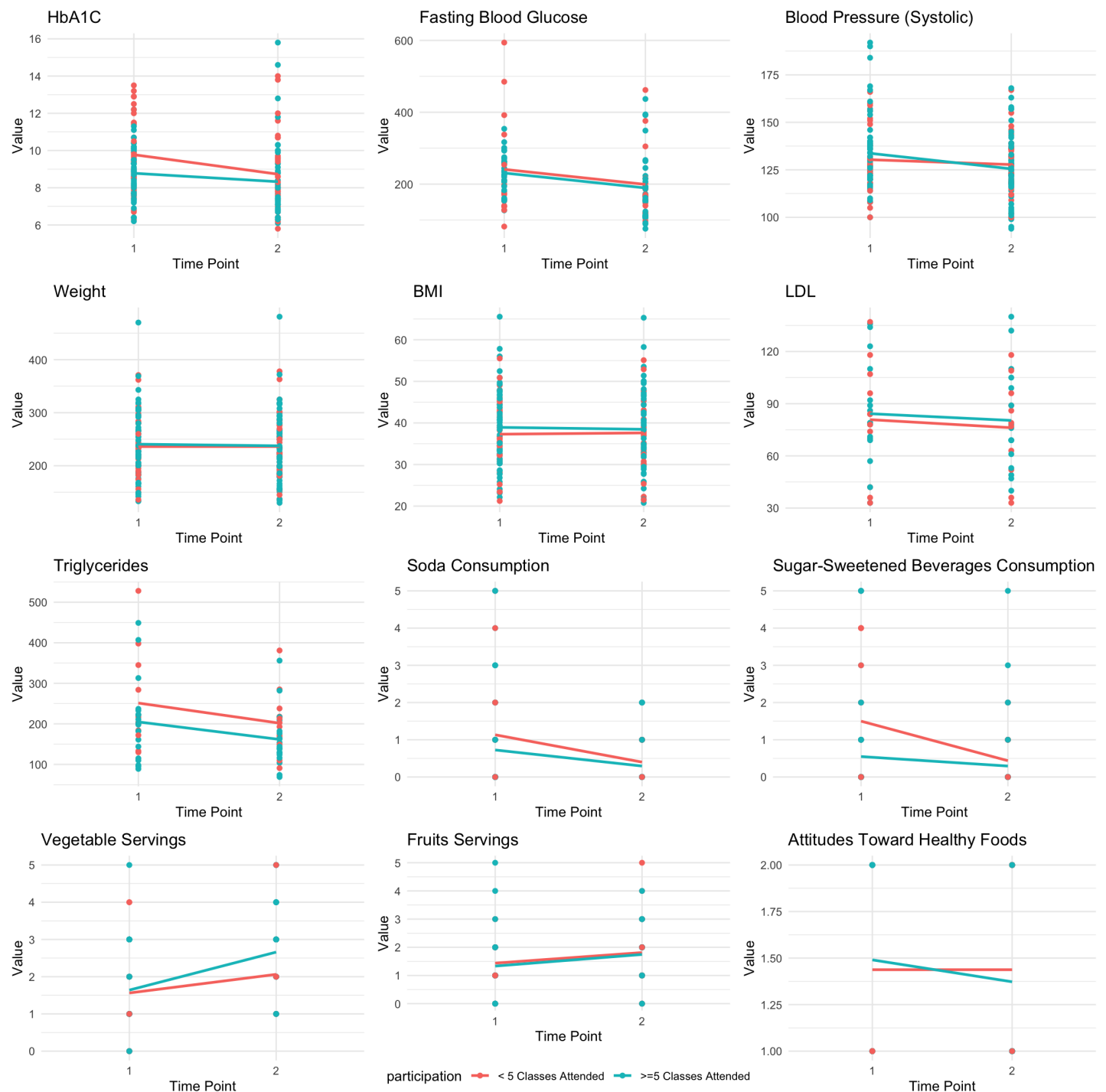
Linear Mixed Effects Models

The models aim to provide rates of change in the response variable from the baseline to the target time point.

We have chosen to treat the 'time' variable as a categorical factor rather than a numeric variable, even though it has been transformed into sequential numbers (1, 2, 3, 4, 5), for several reasons. First, our decision is rooted in the recognition that the rates of change in the response variables over time may not be linear and continuous. Representing 'time' as a numeric variable could potentially mislead by implying a linear relationship between time points and response changes that might not accurately reflect the underlying dynamics.

Secondly, treating 'time' categorically helps avoid extrapolation or interpolation beyond the provided time points. Using 'time' as a factor acknowledges that the observations at our specific time points are the only reliable data we have, and we should refrain from assuming relationships outside these intervals. This approach can be helpful in maintaining the integrity of our findings and prevent unwarranted assumptions about the program's effects at unobserved time points.

In our model, we will have time points 1 and 2 for baseline and EOP. The summaries of our models will be presented in forms of tables that include the following columns that we will be analyzing further with each variable: - effect: this column indicates whether a variable is a fixed or random effect. In our analysis, the investigated variables will be the fixed effect and the participant id will be the random effect, accounting for the relationship between different observations of the same participant. - term: the coefficient, or in this case, the time point (baseline and EOP as Intercept and time2) - estimate: the average difference in the investigated variable between baseline and EOP - p.value: suggests whether there is evidence that the observed change is based on pure chance or potential effects from the program.

Interaction Terms and Their General Interpretations

- 'time' and 'participation': the `participation` variable was derived from the `classes_attended` variable, with values categorized as '>=5 Classes Attended' and '<5 Classes Attended'. The interaction term between the `time` variable and the `participation` variable captures whether the effect of time on the outcome differs depending on the level of participation in the program. A significant interaction would imply that the relationship between time and the outcome varies depending on the level of participation.

- 'time' and 'classes_attended': the interaction term between the `time` variable and the `classes_attended` variable quantifies whether the effect of time on the outcome changes based on the number of classes attended. Essentially, it examines whether individuals who attended more classes experienced different changes in their outcomes over time compared to those who attended fewer classes.

The p-values associated with these interaction terms indicate the strength of evidence for these relationship; lower p-values suggest stronger evidence for an interaction effect between each pair of variables.

P-Value Scale:

For convenience, we can refer to this P-Value scale when determining if an observed trend statistically has strong evidence or is possibly due to random chance.

$p < 0.001$: Extremely strong evidence.

$0.001 \leq p < 0.01$: Very strong evidence.

$0.01 \leq p < 0.05$: Strong evidence.

$0.05 \leq p < 0.1$: Moderate evidence.

$p \geq 0.1$: Not considered statistically significant.

HbA1C

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	9.7757576	0.3234701	30.221514	120.9452	0.000000
fixed	NA	time2	-1.0454545	0.2905311	-3.598426	82.0000	0.000546
fixed	NA	participation>=5 Classes Attended	-0.9973262	0.4151344	-2.402417	120.9452	0.017808
fixed	NA	time2:participation>=5 Classes Attended	0.5925134	0.3728612	1.589099	82.0000	0.115887
random	record_id	sd__(Intercept)	1.4353222	NA	NA	NA	NA

$$\text{Score} = 9.776 - 1.045 \times \text{time2} \quad \text{(for participation} < 5 \text{ classes attended)}$$
$$\text{Score} = 8.779 - 0.452 \times \text{time2} \quad \text{(for participation} \geq 5 \text{ classes attended)}$$
$$\text{p-value (interaction)} = 0.116$$

The p-value suggests that the interaction effect between "time2" and "participation >= 5 classes attended" may not reliably contribute to explaining the variation in the outcome (score) compared to the main effects of time2 and participation alone.

Fasting Blood Glucose

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	241.1437500	23.83261	10.1182283	72.99861	0.000000

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	time2	-41.8875000	24.24381	-1.7277605	45.00000	0.090889
fixed	NA	participation>=5 Classes Attended	-10.1695565	29.34537	-0.3465472	72.99861	0.729928
fixed	NA	time2:participation>=5 Classes Attended	0.3326613	29.85169	0.0111438	45.00000	0.991158
random	record_id	sd__(Intercept)	66.2253026	NA	NA	NA	NA

$$\text{Score} = 241.14 - 41.888 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 230.97 - 41.555 \times \text{time2} \quad \text{(for participation} \geq 5 \text{ classes attended)}$$
$$\text{p-value (interaction)} = 0.991$$

The p-value indicates that the interaction effect between "time2" and "participation >= 5 classes attended" may not reliably contribute to explaining the variation in the outcome compared to the main effects of time2 and participation alone.

Blood Pressure (Systolic)

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	130.323529	2.943655	44.2726853	148.8874	0.000000
fixed	NA	time2	-2.558823	3.067256	-0.8342387	90.0000	0.406355
fixed	NA	participation>=5 Classes Attended	3.366126	3.707378	0.9079532	148.8874	0.365370
fixed	NA	time2:participation>=5 Classes Attended	-5.613590	3.863046	-1.4531512	90.0000	0.149660
random	record_id	sd__(Intercept)	11.605027	NA	NA	NA	NA

$$\text{Score} = 130.324 - 2.559 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 133.690 - 8.172 \times \text{time2} \quad \text{(for participation} \geq 5 \text{ classes attended)}$$
$$\text{p-value (interaction)} = 0.150$$

The p-value for the interaction (0.150) suggests that the interaction effect between "time2" and "participation >= 5 classes attended" may not be statistically significant, although the evidence is not too strong Considering the limited data we have, after filtering and carefully selecting, a p-value like this could be expected.

Weight

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	236.0588235	10.749702	21.9595695	90.57534	0.000000
fixed	NA	time2	0.1235294	2.013763	0.0613426	89.00000	0.951224
fixed	NA	participation>=5 Classes Attended	4.5376677	13.582499	0.3340819	90.57534	0.739090
fixed	NA	time2:participation>=5 Classes Attended	-3.1551084	2.544437	-1.2400026	89.00000	0.218234
random	record_id	sd__(Intercept)	62.1286398	NA	NA	NA	NA

$$\text{Score} = 236.059 + 0.124 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 240.596 - 3.032 \times \text{time2} \quad \text{(for participation} \geq 5 \text{ classes attended)}$$
$$\text{p-value (interaction)} = 0.218$$

The p-value for the interaction suggests that the interaction effect between "time2" and "participation >= 5 classes attended" may not be statistically significant.

Something worth noting is the second coefficient is actually positive, indicating an upward trend in weight after the program. However, the p-value here (0.95) is incredibly high and advises even more caution when interpreting it.

BMI

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	37.2969697	1.5671379	23.7994174	88.02842	0.000000
fixed	NA	time2	0.3057576	0.3384087	0.9035158	86.00002	0.368776
fixed	NA	participation>=5 Classes Attended	1.6372121	1.9822901	0.8259195	88.02842	0.411083
fixed	NA	time2:participation>=5 Classes Attended	-0.7697576	0.4280569	-1.7982600	86.00002	0.075645
random	record_id	sd__(Intercept)	8.8969554	NA	NA	NA	NA

$$\text{Score} = 37.297 + 0.306 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 38.934 - 0.464 \times \text{time2} \quad \text{(for participation} \geq \text{5 classes attended)}$$
$$\text{p-value (interaction)} = 0.076$$

The p-value for the interaction is actually low enough to provide some evidence that its effect might not be due to pure chance.

However, we see something similar to the weight variable, where the second coefficient is positive.

LDL

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	80.8181818	9.116620	8.8649277	37.80698	0.000000
fixed	NA	time2	-4.6363636	8.475053	-0.5470601	25.00000	0.589188
fixed	NA	participation>=5 Classes Attended	3.4318182	11.842837	0.2897801	37.80698	0.773568
fixed	NA	time2:participation>=5 Classes Attended	0.7613636	11.009417	0.0691557	25.00000	0.945416
random	record_id	sd__(Intercept)	22.7858412	NA	NA	NA	NA

$$\text{Score} = 80.818 - 4.636 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 84.250 - 3.875 \times \text{time2} \quad \text{(for participation} \geq \text{5 classes attended)}$$
$$\text{p-value (interaction)} = 0.945$$

Triglycerides

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	251.333333	26.27436	9.5657278	48.05275	0.000000
fixed	NA	time2	-49.583333	27.43174	-1.8075171	29.00000	0.081066
fixed	NA	participation>=5 Classes Attended	-46.491228	33.56109	-1.3852715	48.05275	0.172367
fixed	NA	time2:participation>=5 Classes Attended	6.372807	35.03946	0.1818752	29.00000	0.856946
random	record_id	sd__(Intercept)	61.392996	NA	NA	NA	NA

$$\text{Score} = 251.333 - 49.583 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 204.842 - 43.210 \times \text{time2} \quad \text{(for participation} \geq \text{5 classes attended)}$$
$$\text{p-value (interaction)} = 0.857$$

Soda Consumption

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	1.1333333	0.2758306	4.1088021	116.1609	0.000074
fixed	NA	time2	-0.7333333	0.3218487	-2.2785032	64.0000	0.026043
fixed	NA	participation>=5 Classes Attended	-0.4078431	0.3137829	-1.2997620	116.1609	0.196256
fixed	NA	time2:participation>=5 Classes Attended	0.3019608	0.3661328	0.8247302	64.0000	0.412588

effect	group	term	estimate	std.error	t-value	df	p.value
random	record_id	sd__(Intercept)	0.6036044	NA	NA	NA	NA

$$\text{Score} = 1.133 - 0.733 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 0.725 - 0.431 \times \text{time2} \quad \text{(for participation} \geq 5 \text{ classes attended)}$$
$$\text{p-value (interaction)} = 0.413$$

Sugar-Sweetened Beverages Consumption

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	1.5000000	0.2951150	5.082764	111.1811	0.000002
fixed	NA	time2	-1.0625000	0.3201919	-3.318322	65.0000	0.001487
fixed	NA	participation>=5 Classes Attended	-0.9509804	0.3382545	-2.811434	111.1811	0.005831
fixed	NA	time2:participation>=5 Classes Attended	0.8075980	0.3669971	2.200557	65.0000	0.031326
random	record_id	sd__(Intercept)	0.7571679	NA	NA	NA	NA

$$\text{Score} = 1.500 - 1.062 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 0.549 - 0.254 \times \text{time2} \quad \text{(for participation} \geq 5 \text{ classes attended)}$$
$$\text{p-value (interaction)} = 0.031$$

Vegetable Servings

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	1.5625000	0.2720836	5.7427205	99.78253	0.000000
fixed	NA	time2	0.5000000	0.2632844	1.8990872	63.99850	0.062062
fixed	NA	participation>=5 Classes Attended	0.0775000	0.3126002	0.2479205	99.78253	0.804705
fixed	NA	time2:participation>=5 Classes Attended	0.5200000	0.3024907	1.7190610	63.99850	0.090437
random	record_id	sd__(Intercept)	0.7936765	NA	NA	NA	NA

$$\text{Score} = 1.5625 + 0.5000 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 1.6400 + 1.0200 \times \text{time2} \quad \text{(for participation} \geq 5 \text{ classes attended)}$$
$$\text{p-value (interaction)} = 0.090$$

Fruits Servings

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	1.4375000	0.2455318	5.8546386	126.9942	0.000000
fixed	NA	time2	0.3750000	0.3194089	1.1740436	65.0000	0.244661
fixed	NA	participation>=5 Classes Attended	-0.1041667	0.2814233	-0.3701423	126.9942	0.711893
fixed	NA	time2:participation>=5 Classes Attended	0.0367647	0.3660997	0.1004227	65.0000	0.920318
random	record_id	sd__(Intercept)	0.3852239	NA	NA	NA	NA

$$\text{Score} = 1.4375 + 0.3750 \times \text{time2} \quad \text{(for participation < 5 classes attended)}$$
$$\text{Score} = 1.3333 + 0.4118 \times \text{time2} \quad \text{(for participation} \geq 5 \text{ classes attended)}$$
$$\text{p-value (interaction)} = 0.920$$

Interaction Term with Numerical Variable 'classes_attended'

The interaction between time and classes_attended suggests that the effect of time on the outcome variable varies depending on the number of classes attended.

HbA1C

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	9.9012804	0.3410799	29.029209	122.4429	0.000000
fixed	NA	time2	-0.9568303	0.3116431	-3.070276	82.0000	0.002900
fixed	NA	classes_attended	-0.1183190	0.0446078	-2.652428	122.4429	0.009050
fixed	NA	time2:classes_attended	0.0438801	0.0407579	1.076601	82.0000	0.284816
random	record_id	sd__(Intercept)	1.4056091	NA	NA	NA	NA

$$\text{Score} = 9.9013 - 0.9568 \times \text{time2} - 0.1183 \times \text{classes\_attended}$$
$$+ 0.0439 \times \text{time2} \times \text{classes\_attended}$$
$$\text{p-value (interaction)} = 0.285$$

For people who attended more classes, the change in the HbA1c over time is slightly more positive compared to those who attended fewer classes. However, the p-value associated with this interaction term (0.285) indicates that this effect is not statistically significant. Therefore, we do not have sufficient evidence to conclude that the relationship between time and the outcome variable differs significantly based on the number of classes attended.

Fasting Blood Glucose

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	245.9742447	25.085963	9.8052543	73.00078	0.000000
fixed	NA	time2	-47.3698253	25.519730	-1.8562041	45.00000	0.069979
fixed	NA	classes_attended	-1.7270366	3.126405	-0.5524034	73.00078	0.582360
fixed	NA	time2:classes_attended	0.8534452	3.180464	0.2683398	45.00000	0.789664
random	record_id	sd__(Intercept)	66.1674430	NA	NA	NA	NA

Equations:

$$\text{Fasting Blood Glucose} = 245.97 - 47.37 \times \text{time2} - 1.73 \times \text{classes\_attended} + 0.85 \times \text{time2} \times \text{classes\_attended}$$
$$\text{p-value (interaction)} = 0.790$$

For fasting blood glucose, the interaction between time and classes attended suggests a slight increase in the change of blood glucose levels over time for individuals who attended more classes compared to those who attended fewer classes. However, the p-value associated with this interaction term (0.790) indicates that this effect is not statistically significant. Therefore, we do not have sufficient evidence to conclude that this relationship is not due to random chance.

Blood Pressure (Systolic)

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	129.2604461	3.1100247	41.5625141	147.6705	0.000000
fixed	NA	time2	-0.4206427	3.2083049	-0.1311106	90.0000	0.895980
fixed	NA	classes_attended	0.4992146	0.3993738	1.2499933	147.6705	0.213279
fixed	NA	time2:classes_attended	-0.8897800	0.4119945	-2.1596893	90.0000	0.033455
random	record_id	sd__(Intercept)	11.6981784	NA	NA	NA	NA

$$\text{Systolic Blood Pressure} = 129.26 - 0.42 \times \text{time2} + 0.50 \times \text{classes\_attended} - 0.89 \times \text{time2} \times \text{classes\_attended}$$
$$\text{p-value (interaction)} = 0.033$$

For systolic blood pressure, the interaction between time and classes attended suggests that the change in blood pressure over time differs based on the number of classes attended. Specifically, the decrease is more pronounced for individuals who attended more classes compared to those who attended fewer classes. This finding is supported by a p-value of 0.033, which falls within the range of moderate evidence, indicating that this effect is statistically significant. Therefore, we have evidence to suggest that the relationship between time and systolic blood pressure is influenced by the number of classes attended.

Weight

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	235.3556997	11.4233237	20.6030841	90.58452	0.000000
fixed	NA	time2	-0.0566466	2.1461244	-0.0263949	89.00000	0.979001
fixed	NA	classes_attended	0.5620755	1.4815440	0.3793849	90.58452	0.705290
fixed	NA	time2:classes_attended	-0.2847477	0.2783409	-1.0230178	89.00000	0.309072
random	record_id	sd__(Intercept)	62.1154978	NA	NA	NA	NA

$$\text{Weight} = 235.36 - 0.06 \times \text{time2} + 0.56 \times \text{classes\_attended} - 0.28 \times \text{time2} \times \text{classes\_attended}$$
$$\text{p-value (interaction)} = 0.309$$

The coefficient for the interaction term suggests that the effect of time on weight change varies depending on the number of classes attended. However, the p-value associated with this interaction (0.309) indicates that this effect is not statistically significant. Therefore, we do not have sufficient evidence to conclude that the relationship between time, classes attended, and weight change differs significantly.

BMI

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	37.4453019	1.6580849	22.5834644	88.05461	0.000000
fixed	NA	time2	0.2337417	0.3603213	0.6487034	86.00000	0.518259
fixed	NA	classes_attended	0.1397340	0.2158435	0.6473858	88.05461	0.519067
fixed	NA	time2:classes_attended	-0.0653344	0.0469053	-1.3928999	86.00000	0.167240
random	record_id	sd__(Intercept)	8.9042510	NA	NA	NA	NA

Equation:

$$\text{BMI} = 37.45 + 0.23 \times \text{time2} + 0.14 \times \text{classes\_attended} - 0.07 \times \text{time2} \times \text{classes\_attended}$$
$$\text{p-value (interaction)} = 0.167$$

The coefficient for the interaction term suggests that the effect of time on BMI change varies depending on the number of classes attended. However, the p-value associated with this interaction (0.167) indicates that this effect is not statistically significant. Therefore, we do not have sufficient evidence to conclude that the relationship between time, classes attended, and BMI change differs significantly.

LDL

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	81.6479529	9.822838	8.3120534	37.73801	0.000000
fixed	NA	time2	-2.8061414	9.109101	-0.3080591	25.00000	0.760590
fixed	NA	classes_attended	0.2110732	1.386082	0.1522804	37.73801	0.879777
fixed	NA	time2:classes_attended	-0.2417804	1.285368	-0.1881020	25.00000	0.852315

effect	group	term	estimate	std.error	t-value	df	p.value
random	record_id	sd__(Intercept)	22.8707346	NA	NA	NA	NA

Equation:

$$LDL = 81.65 - 2.81 \times time2 + 0.21 \times classes\_attended - 0.24 \times time2 \times classes\_attended$$
$$(\text{p-value interaction}) = 0.852$$

The coefficient for the interaction term suggests that the effect of time on LDL levels varies depending on the number of classes attended. However, the p-value associated with this interaction (0.852) indicates that this effect is not statistically significant. Therefore, we do not have sufficient evidence to conclude that the relationship between time, classes attended, and LDL levels differs significantly.

Triglycerides

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	226.5807093	28.344838	7.9937203	46.97121	0.000000
fixed	NA	time2	-33.1818705	28.779141	-1.1529834	29.00000	0.258333
fixed	NA	classes_attended	-0.6137671	3.752243	-0.1635734	46.97121	0.870769
fixed	NA	time2:classes_attended	-2.0495345	3.809735	-0.5379730	29.00000	0.594701
random	record_id	sd__(Intercept)	64.8642366	NA	NA	NA	NA

$$Triglycerides = 226.58 - 33.18 \times time2 - 0.61 \times classes\_attended - 2.05 \times time2 \times classes\_attended$$
$$(\text{p-value interaction}) = 0.595$$

The coefficient for the interaction term suggests that the effect of time on triglyceride levels varies depending on the number of classes attended. However, the p-value associated with this interaction (0.595) indicates that this effect is not statistically significant. Therefore, we do not have sufficient evidence to conclude that the relationship between time, classes attended, and triglyceride levels differs significantly.

Soda Consumption

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	1.6410856	0.2791177	5.879547	115.9798	0.000000
fixed	NA	time2	-1.1888161	0.3250415	-3.657428	64.0000	0.000517
fixed	NA	classes_attended	-0.1060774	0.0320426	-3.310518	115.9798	0.001242
fixed	NA	time2:classes_attended	0.0887927	0.0373146	2.379571	64.0000	0.020324
random	record_id	sd__(Intercept)	0.5852141	NA	NA	NA	NA

$$Soda\ Consumption = 1.64 - 1.19 \times time2 - 0.11 \times classes\_attended + 0.09 \times time2 \times classes\_attended$$
$$(\text{p-value interaction}) = 0.020$$

The coefficient for the interaction term indicates that the effect of time on soda consumption varies depending on the number of classes attended. The statistically significant p-value associated with this interaction (0.020) suggests that this effect is likely not due to chance. Therefore, we have evidence to suggest that the relationship between time, classes attended, and soda consumption differs significantly.

Sugar-Sweetened Beverages Consumption

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	1.7844553	0.3092789	5.769728	110.4378	0.000000
fixed	NA	time2	-1.3282352	0.3328533	-3.990452	65.0000	0.000170
fixed	NA	classes_attended	-0.1309273	0.0357160	-3.665788	110.4378	0.000381

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	time2:classes_attended	0.1143251	0.0384384	2.974241	65.0000	0.004118
random	record_id	sd__(Intercept)	0.7508246	NA	NA	NA	NA

$$\text{Sugar-Sweetened Beverages Consumption} = 1.78 - 1.33 \times \text{time2} - 0.13 \times \text{classes\_attended} + 0.11 \times \text{time2} \times \text{classes\_attended}$$
$$(\text{p-value interaction}) = 0.004$$

The coefficient for the interaction term suggests that the effect of time on consumption of sugar-sweetened beverages varies depending on the number of classes attended. With a statistically significant p-value for the interaction (0.004), we have evidence to suggest that this relationship is unlikely to be due to chance. Thus, the interaction between time, classes attended, and sugar-sweetened beverages consumption is significant, indicating a potential moderating effect of classes attended on the change in consumption over time.

Vegetable Servings

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	1.4055240	0.2898099	4.8498137	100.9877	0.000004
fixed	NA	time2	0.5878699	0.2847856	2.0642541	64.0000	0.043052
fixed	NA	classes_attended	0.0281889	0.0336244	0.8383482	100.9877	0.403815
fixed	NA	time2:classes_attended	0.0400012	0.0330414	1.2106360	64.0000	0.230487
random	record_id	sd__(Intercept)	0.7794393	NA	NA	NA	NA

$$\text{Vegetable Servings} = 1.41 + 0.59 \times \text{time2} + 0.03 \times \text{classes\_attended} + 0.04 \times \text{time2} \times \text{classes\_attended}$$
$$(\text{p-value interaction}) = 0.230$$

The coefficient for the interaction term indicates the change in vegetable servings over time is slightly influenced by the number of classes attended, but this effect is not statistically significant, as evidenced by the non-significant p-value for the interaction (0.230). Therefore, we do not have sufficient evidence to conclude that the relationship between time, classes attended, and vegetable servings significantly differs.

Fruits Servings

effect	group	term	estimate	std.error	t-value	df	p.value
fixed	NA	(Intercept)	1.4816921	0.2621940	5.6511291	126.7981	0.000000
fixed	NA	time2	0.1825108	0.3400629	0.5366972	65.0000	0.593309
fixed	NA	classes_attended	-0.0160337	0.0302786	-0.5295383	126.7981	0.597358
fixed	NA	time2:classes_attended	0.0286275	0.0392710	0.7289725	65.0000	0.468637
random	record_id	sd__(Intercept)	0.3911201	NA	NA	NA	NA

$$\text{Fruits Servings} = 1.48 + 0.18 \times \text{time2} - 0.02 \times \text{classes\_attended} + 0.03 \times \text{time2} \times \text{classes\_attended}$$
$$(\text{p-value interaction}) = 0.469$$

The coefficient for the interaction term suggests that the change in fruit servings over time may be influenced by the number of classes attended, although this effect is not statistically significant, as indicated by the non-significant p-value for the interaction (0.469). Thus, we do not have sufficient evidence to conclude that the relationship between time, classes attended, and fruit servings significantly differs.