Relations between Inflammation and Access to care, Treatment, and Diabetes in Older

Mexicans

Dominik Grätz[1], Rachel Miller-Moudgil[1], Amber Somarriba[1], Brittany Spinner[1], & Tian

Walker[1]

[1] University of Oregon

Author Note

List of group members ordered by alphabet.

Abstract

 Diabetes is a leading cause of death in Mexico and is closely linked to the obesity epidemic.
Previous studies indicate that inflammation predicts the development of diabetes and is
found to be a strong indicator of diabetes development and progression. However, there are
limited studies investigating the extent to which inflammation levels relate to the different
treatment options among those with diabetes among Mexicans. To gain insight on the extent
to which inflammation levels relate to medication, diet, and exercise we conducted a
cross-sectional, secondary analysis using linear regression modeling and Chi-square tests of
independence. Medication model fit parameter included (N = 357) $F_{(2,354)} = 1.06$, p= 0.35,
with $R2= 0.01$. Diet and exercise model fit parameters included (N=) $F_{(2, 354)} = 2.70$, p=
0.07 with $R2= 0.02$. And evaluating diet and exercise with access to care results included X2
results: $X2(1) = 0.57$, p= 0.45. Results indicate that among older Mexicans with diabetes
there were no direct effects of treatment and access to inflammation levels.

Keywords: Diabetes, access to care, inflammation, health, Mexico, China

Word count: X (this cannot easily be done automatically, we can also just leave it out)

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Mexicans

tion of Individuals 50yrs or older with Diabetes who saw a Doctor in the
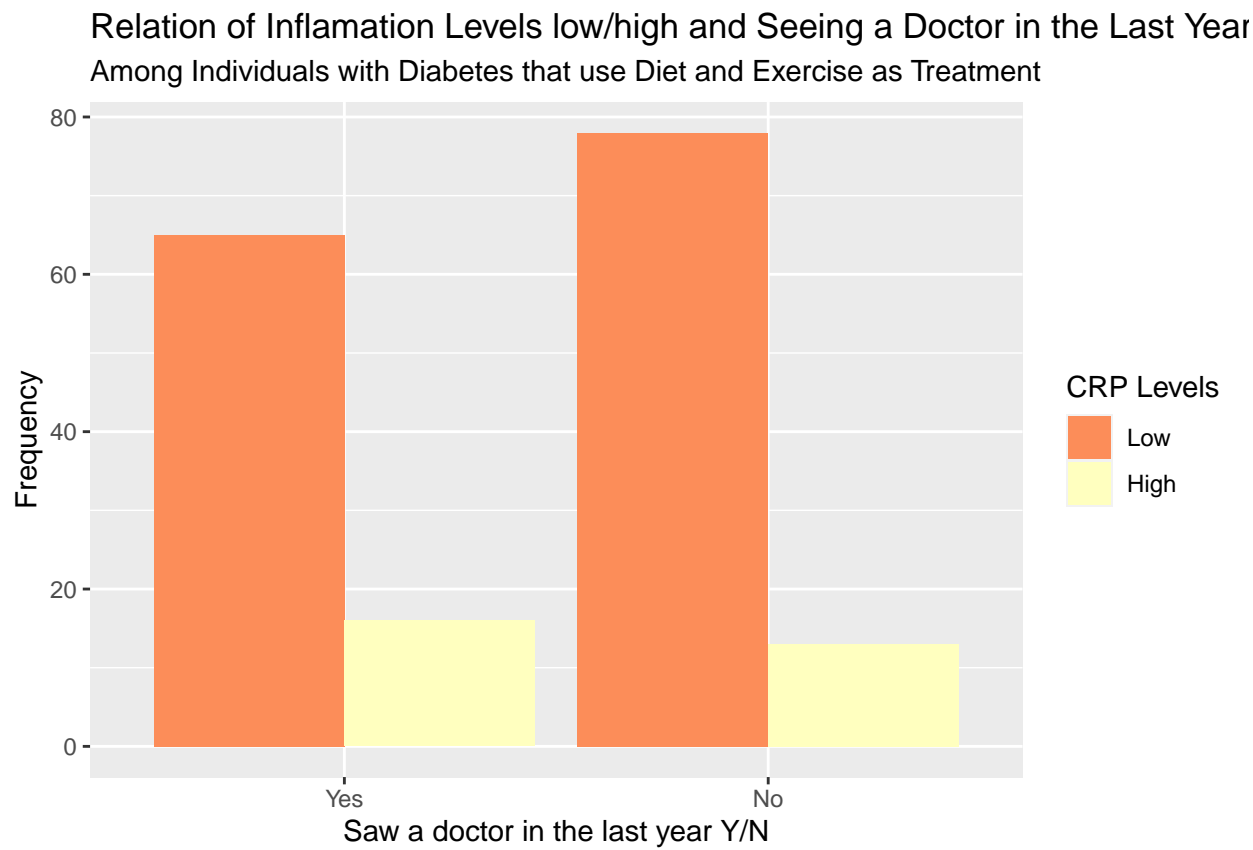

Saw a doctor in the last year Y/N

Relation of Inflamation Levels low/high and Seeing a Doctor in the Last Year
Among Individuals with Diabetes that use Diet and Exercise as Treatment

FIGURE REFERENCES TO COPY

Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure **??** Figure 8
Figure 9 Figure **??** Figure 10 Figure 11 Figure 12 Figure 13 Figure 14

TABLE REFERENCES TO COPY

Table 1 (Regression Table 1)

Table 2 (Regression Table 2)

Table 3 (Descriptives Table)

Introduction

Diabetes and its insidious complications continue to expand as a global health burden
at an alarming rate. In 2021, there were approximately 537 million adults living with

diabetes in the world and this number is expected to jump to 783 million by 2045. A disproportionate percentage of these people live in low to middle income countries (LMICs). Given this predicted jump in incidence and in light of the COVID-19 pandemic, there is a heightened need in better understanding diabetes. During COVID-19, diabetes was found to both increase the severity of COVID-19 symptoms (in people with elevated a1c levels) and increase in incidence (Yang et al., 2020) (Rohm, Meier, Olefsky, & Donath, 2022). Additionally, diabetes is associated with a steep increase in cardiovascular disease risk and is a leading cause of death in many low to middle income countries (LMICs) including Mexico.

Although the precise classification of diabetes remains controversial because of the complex nature of its pathogenesis, there are three universally acknowledged subtypes: type 1 diabetes, type 2 diabetes, and gestational diabetes. Diabetes is a progressive disease in that the longer one has it, the more complications ensue. Therefore, it is helpful to conceptualize diabetes as a process that can be stopped, but not reversed. Research that contributes to slowing down or stopping the process can be extremely valuable to global health regardless of its contribution to cure and prevention because of the astronomical rates of diabetes in our world today.

Research shows that inflammation predicts the development of diabetes and is found to be a strong indicator of diabetes development and progression.(Dilys J. Freeman et al., 2002) (Dilys J. Freeman et al., 2001) (Schmidt et al., 1999). Specifically, trials for drugs directed at inflammation among people with type 2 diabetes have indicated that drugs targeted at inflammation may be a therapeutic option for preventing diabetes (Agrawal & Kant, 2014). In addition, retinopathy and focal neuropathy (Said, 2007) have also been linked to inflammatory processes. Conversely, when left untreated, the direct damage caused by high blood glucose leads to more inflammation and creates a nasty feedback loop wherein inflammation causes more insulin resistance which leads to high blood glucose. Furthermore, it has been found that the ability of cells to absorb insulin can be increased through diet,

exercise, and oral pills.

A current gap in literature exists investigating the relationship between inflammation
levels and the different treatments offered to those with diabetes, such as diet, exercise, and
medication. This study seeks to fill this gap by investigating the extent to which
inflammation levels relate to medication and diet and exercise among older Mexicans with
diabetes.

Methods

Data

To examine the extent to which inflammation relates to medication, diet, and exercise
among older Mexicans, we performed secondary data analyses using the two datasets from
from the Wave 1 Study on Global Ageing (SAGE) from the World Health Organization
(WHO). Cross-sectional baseline data was originally collected in 2016 through in-person
interviews lasting on average between 90-120 minutes among Mexicans (age range) in Mexico.

Procedures and Sample

357 participants were included in our analyses. Of those, 115 were assessed to be male
(32.20 %), 241 were identified to be female (67.50 %). Sex data for 1 participant was missing
(see Table 3). This indicates that females were overrepresented in our sample, assuming
binary sexes are represented equally in the population ($\chi^2(1) = 44.60$, $p < 0.0001$). The age
in our sample was $M = 68$ years (SD = 8.40 years). Because of missing values in the
variables of interest in some of our analyses, subjects were excluded. Thus, N is reported
separately for each analysis.

Variables

The original WHO dataset contains more than 1,600 variables, not all of which are
relevant to our research questions. Therefore, we have limited our analysis to 10 variables,

listed below in Table 1. In our analysis, we only included participants who reported that they already have a formal diabetes diagnosis from a doctor, since our research questions revolve around diabetes treatments. Figure (plot_all) shows the raw data and the data that we selected for our analysis (the colorful points on the far left).

Filtering.   A variable was created called "diabetes treatment" wherein anyone who answered yes to

[edit this to describe the three we use in our analysis] A variable was created to indicate whether or not someone fell into one of the four following categories: diagnosed and treated diabetes, diagnosed and untreated diabetes, undiagnosed diabetes, or no diabetes. This variable was created using 3 questions from the in-person survey portion of the study. If participants answered yes to "Have you ever been diagnosed with diabetes (high blood sugar)?" and also answered yes to either "Have you been taking insulin or other blood sugar lowering medications in the last 2 weeks?" or "Have you been following a special diet, exercise regime or weight control program for diabetes during the last 2 weeks?", then they were in the diagnosed and treated group (China: n = 448, Mexico: n = 165). If they answered yes to diagnosis, but no to both treatment questions then they were placed in the untreated diabetes group (China: n = 43, Mexico: n = 39). If they answered no to the diagnosis question and their HbA1c was under 6.5% then they were placed in the no diabetes group (China: n = 5,246, Mexico: n = 1,241). Lastly, if they answered no to the diagnosis question but their HbA1c was 6.5% or higher, then they were placed into the undiagnosed diabetes group (China: n = 444, Mexico: n = 181). There was a group of people in both countries who answered "no" to both treatment options but still had an HbA1c level below 6.5% (China: n = 29, Mexico: n = 17). These people were excluded from the analysis.

[This is good as is] A variable was then created that indicated "unknown treatment" if the diabetes treatment variable indicated that there was no treatment but hba1c was below 6.5 and otherwise "Known treatment" was indicated. All "unknown treatment" variables

were then removed (n = 17). See plot.all2 and plot.all_filtered to see the data before and
after these data points were filtered out.

Biomarkers.   Biomarkers.A subset of people participating in the SAGE study
underwentbiomarker analysis in Mexico (n = 1831) and in China (n = 12,077). Exclusions
included## people for incomplete data, ### people for having an elevated CRP value that
might indicate injury or infection. The sample was ##% female and ##% male.
Participant ages for this analysis ranged from 50 to 105 years old (M = 68.27, SD = 9.23).

Biomarkers were analyzed using dried blood spot (DBS) procedures, and collected via
standard venipuncture into an EDTA tube. In order to go from venous blood to DBS, the
samples of whole blood were homogenized and then pipetted in 20uL aliquots onto standard
Whatman 903 filter paper. The samples were left to dry for 24 hours at room temperature
before they were analyzed. We punched out a 6mm spot from the DBS card and used 250 uL
of PBS buffer pH = 7 to elute for 14 hours. The Abbott Architect CI8200 chemistry
analyzer was used to analyzed the DBS eluates in order to obtain CRP values and it was
used for HbA1c as well.

Hemoglobin A1c (HbA1c) is a measure of average blood glucose values over the past 3
months. HbA1c also required a 6 mm DBS punch. This one was eluted in 400uL
MULTIAGEN Hemoglobin Denaturant for 14 hours. The Architect blood chemistry analyzer
was loaded with a cuvette with eluent and was then used to determine HbA1c and total
hemoglobin by measuring absorbance at 700 for Hba1cnm and 604nm for total hemoglobin.
The analyzer's program calculated percent HbA1c using the following
formula:$[(\text{HbA1c}/\text{TotHb}) \times 100] - 3 + (0.2 \times \text{TotHb})$.

Self-report surveys conducted by trained interviewers.

Data are from the World Health Organization's Study on Adult Health and Ageing
(SAGE). Our data is from 1 of 5 countries where the data were collected.

All analyses were conducted in R with the following packages: here (Müller, 2020),

rio(**chanRioSwissarmyKnife2021?**), tidyverse[re], ggpubr

(**kassambaraGgpubrGgplot2Based2022?**),bibtex

(**francoisBibtexBibtexParser2022?**),papaja

(**austPapajaPrepareReproducible2022?**), psych

(**revellePsychProceduresPsychological2022?**),and forcats

(**wickhamForcatsToolsWorking2022?**).

Results

We see the expected relationships between diabetes status and HbA1c (see Figure 12).

However, with CRP we see a relatively similar level of CRP between people without diabetes

and those with diagnosed diabetes (see Figure 13). Thus, we explored whether medication

may be responsible for lowering CRP. In Figure 14 we see that those who are using diet and

exercise as treatment have higher CRP levels than those taking medication and those not on

treatment. We explored this further statistically.

Regression 1

For our first research question, does taking medication lower inflammation levels, we

found that this regression model (Table 1) using 357 participants was not significant $F(2,$

$354) = 1.06$, $p = 0.35$ with $R^2 = 0.01$. The regression coefficient for age was b_{age} = -0.01

$(SE = 0.01, p = 0.36)$, and for use of medication $b_{medication} = 0.20$ $(SE = 0.18, p = 0.28)$.

Therefore, based on these results we fail to reject our null hypothesis and we cannot conclude

that there is a relationship between medication and inflammation levels on average in this

population.

Regression 2

Our research question two looked at diet and exercise as a treatment for diabetes on

predicting inflammation levels. We found that this regression model (Table 2) using 357

participants was not significant $F(2, 354) = 2.70$, $p = 0.07$ with $R^2 = 0.01$. The regression

coefficient for age was $b_{age} = $ -0.01 ($SE = 0.01$, $p = 0.41$), and for diet and exercise $b_{Diet} = $

-0.24 ($SE = 0.12$, $p < 0.05$). Based on these results, fail to reject our null hypothesis and

conclude that diet and exercise does not predict inflammation levels on average in this

population.

Chi Square Test

To better understand differences in outcomes in health among those partaking in diet

and exercise versus those that are not to treat diabetes, we seek to understand if there is

difference in those that accessed health care in the last year and those that use diet and

exercise as a treatment option for diabetes. χ^2 results: ($\chi^2(1) = 0.57$, $p = 0.45$). Based on

these results we fail to reject the null hypothesis, and cannot conclude seeing a doctor in the

last year relates to individuals using diet and exercise as treatment for diabetes in this

population sample.

Looking at individuals who partake in diet and exercise only as a treatment for

diabetes, we seek to answer the extent to which seeing a doctor in the last year relates to

inflammation levels. χ^2 results: ($\chi^2(1) = 0.57$, $p = 0.45$). Based on these results, we fail to

reject our null hypothesis and cannot conclude that seeing a doctor in the last year relates to

inflammation levels in this populaiton sample.

Discussion

We see diet and exercise predicting CRP over and above the effects of age such that

those who said that they do diet and exercise (insert direction based in RQ2 results).

Ultimately we see that inflammation is impacted by diabetes treatments. Access to

care does not appear to explain (summarize baed on RQ3). However, it is important that

further exploration between diabetes, inflammation, and diabetes treatments take place.

Limitations

Among the different treatment options for diabetes, medication can mean either pills or insulin. There are different implications for these representative treatment options for inflammation and diabetes. However, we were not able to look at pills and insulin separately, or medication combinations, and some of their effects have the potential to cancel each other out.Given that we do not know exactly which medication people were taking, combination therapy is a possibility we could not account for. In addition, the sex variable was established through interviewer discernment and was not self reported.

Because data analyzed are from cross-sectional studies only, we cannot infer causality and there are likely many factors that account for significant differences in inflammation levels among older Mexicans.

Appendix

Despite the documented limitations of the World Health Organization Health State
Description scale (**asadaMedicalTechnologiesNonhuman2005?**), it is worth exploring
in future studies whether or not this scale captures diabetes complications in such a way that
we might be able to analyze connections between inflammation and diabetes complications
cross-sectionally in the SAGE data.

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Tables and Figures

Table 1

Effect of Medication on CRP, controlling for Age.

Predictor	b	95% CI	$t(354)$	p
Intercept	2.00	[1.06, 2.94]	4.18	$< .001$
Age	-0.01	[−0.02, 0.01]	-0.91	.362
Medication	0.20	[−0.17, 0.56]	1.07	.284

Note. Model fit: $F(2, 354) = 1.06$, $p = 0.35$, $R^2 = 0.01$.

Table 2

Effect of Diet and Exercise on CRP, controlling for Age.

Predictor	b	95% CI	$t(354)$	p
Intercept	2.10	[1.17, 3.04]	4.43	$< .001$
Age	-0.01	$[-0.02, 0.01]$	-0.83	.408
Diet and Exercise	-0.25	$[-0.47, -0.02]$	-2.11	.036

Note. Model fit: $F(2, 354) = 2.71$, $p = 0.07$, $R^2 = 0.02$.

Table 3

Descriptive statistics.

	Mexico
N_{total}	357
Sex	
male	115 (32.20 %)
female	241 (67.50 %)
unknown	1 (0.30 %)
Age	68 ($SD = 8.40$)
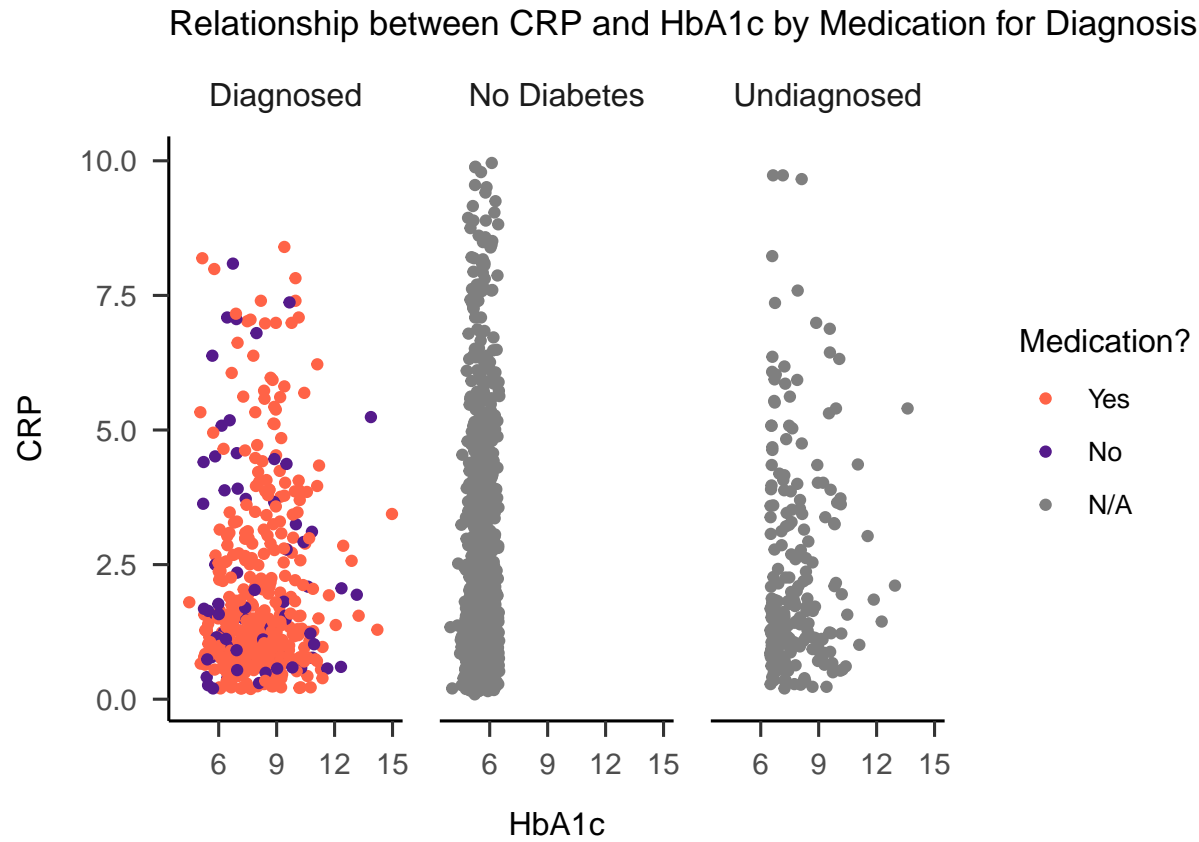
Figure 1. Figure caption goes here.
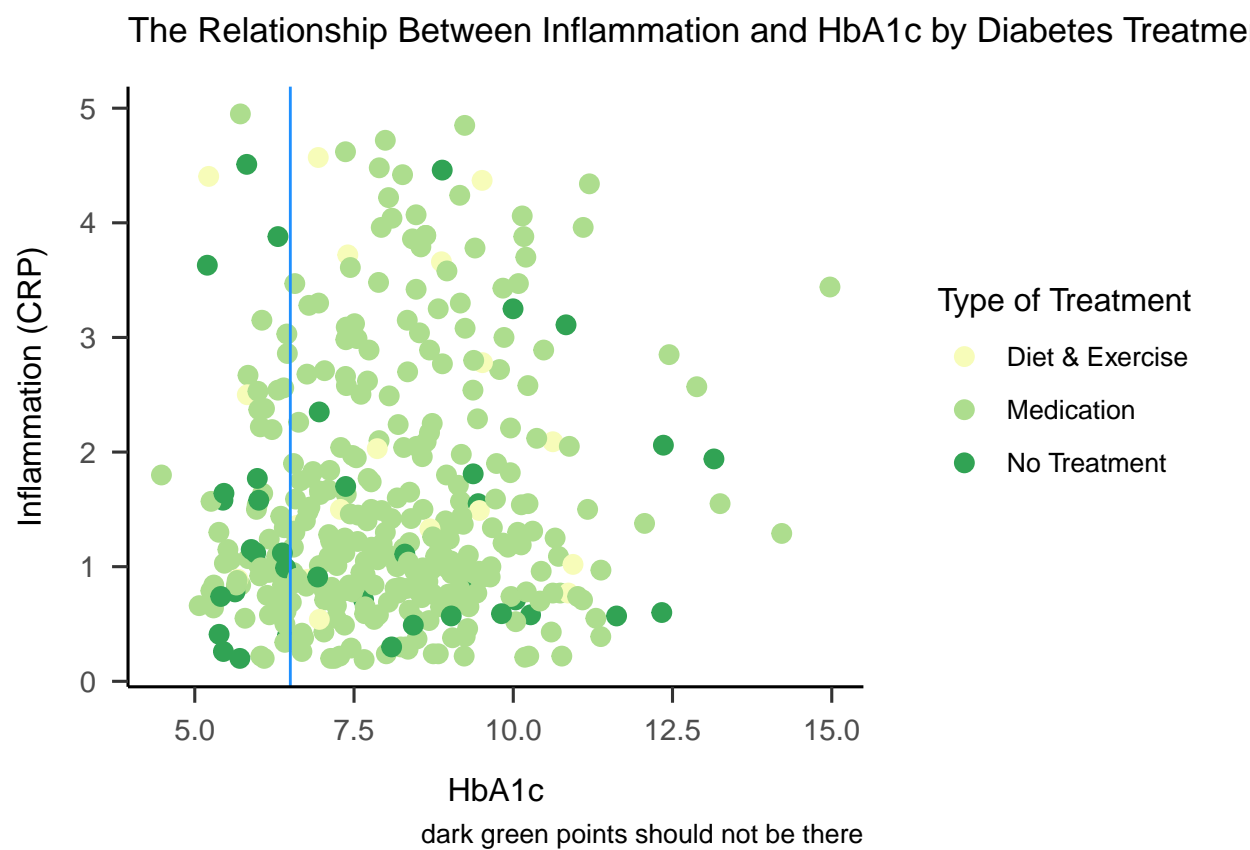
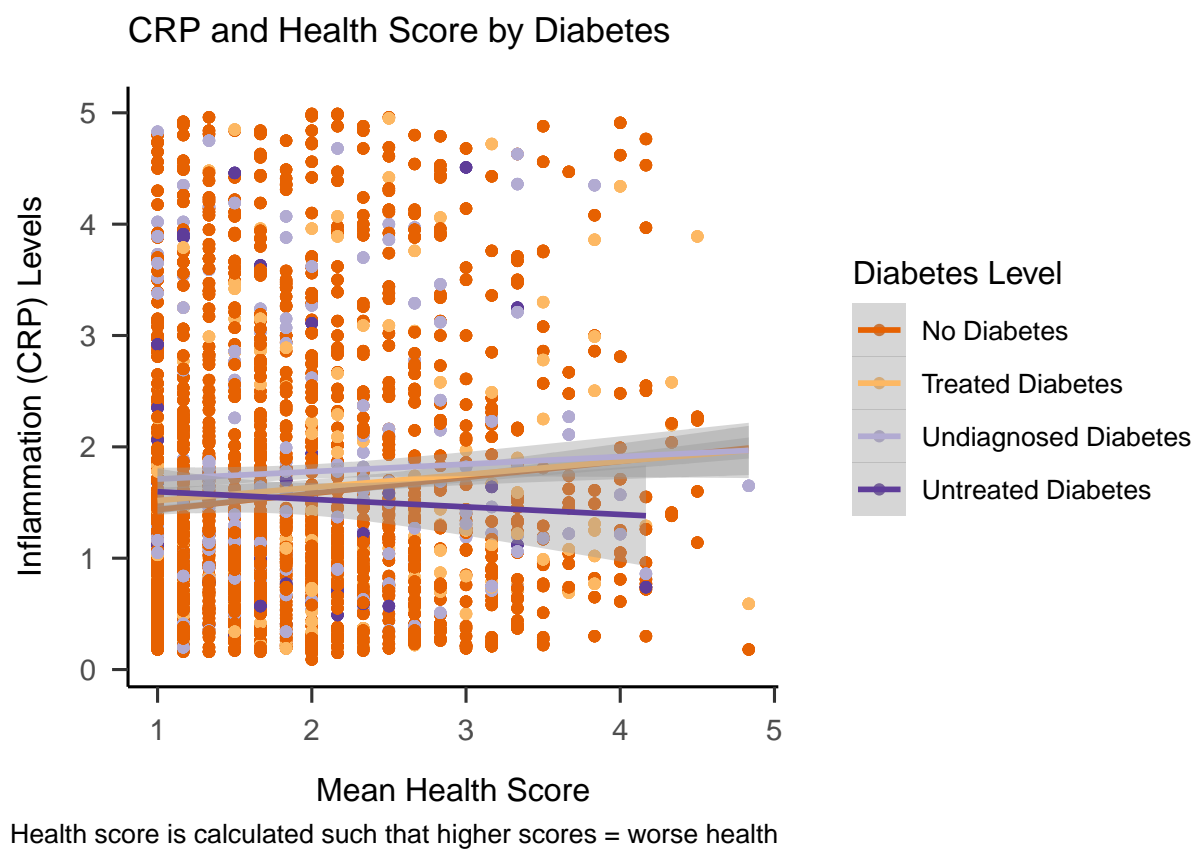*Figure 2*. Figure caption goes here.
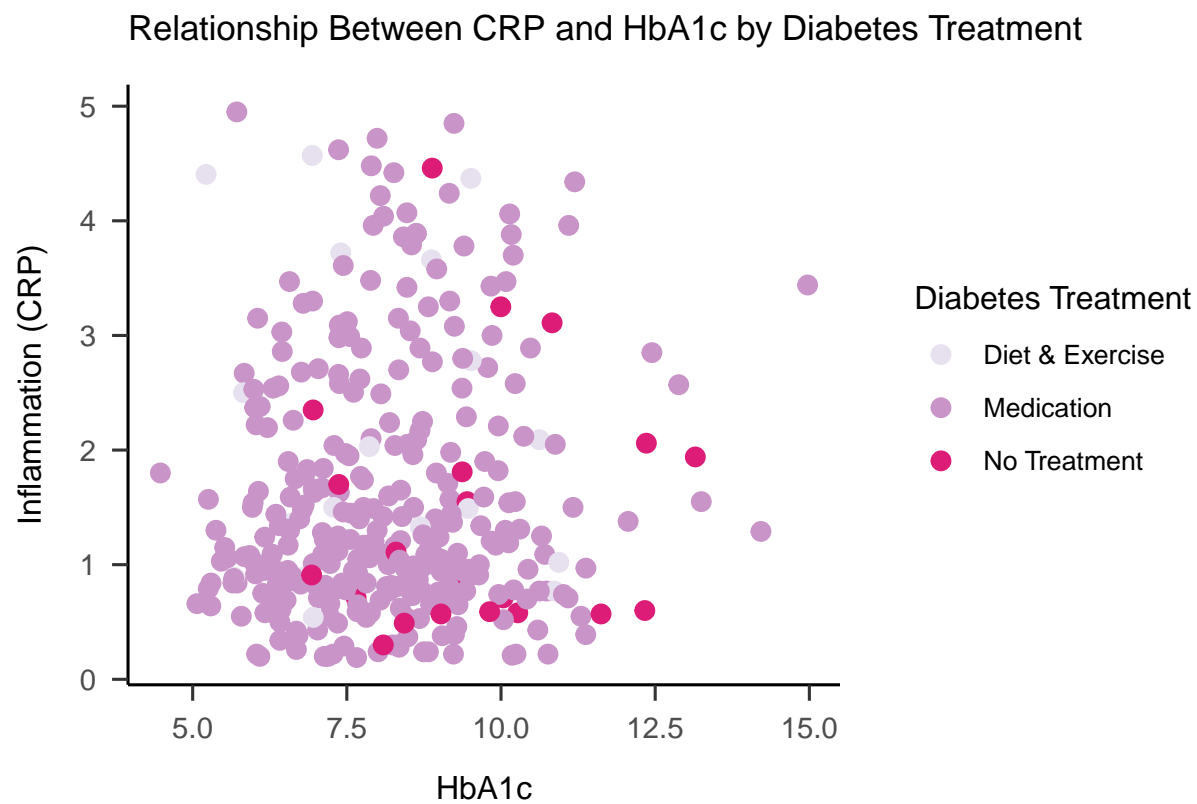
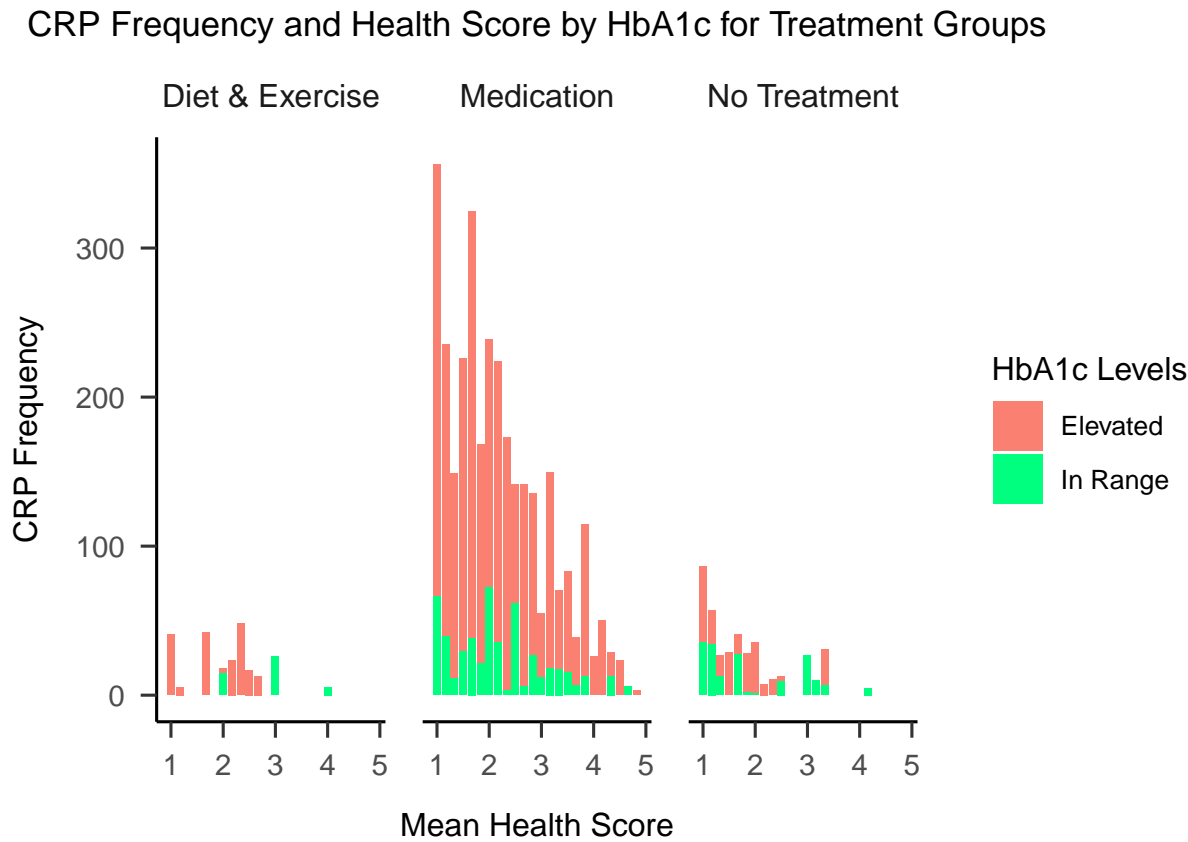*Figure 3*. Here goes the caption.
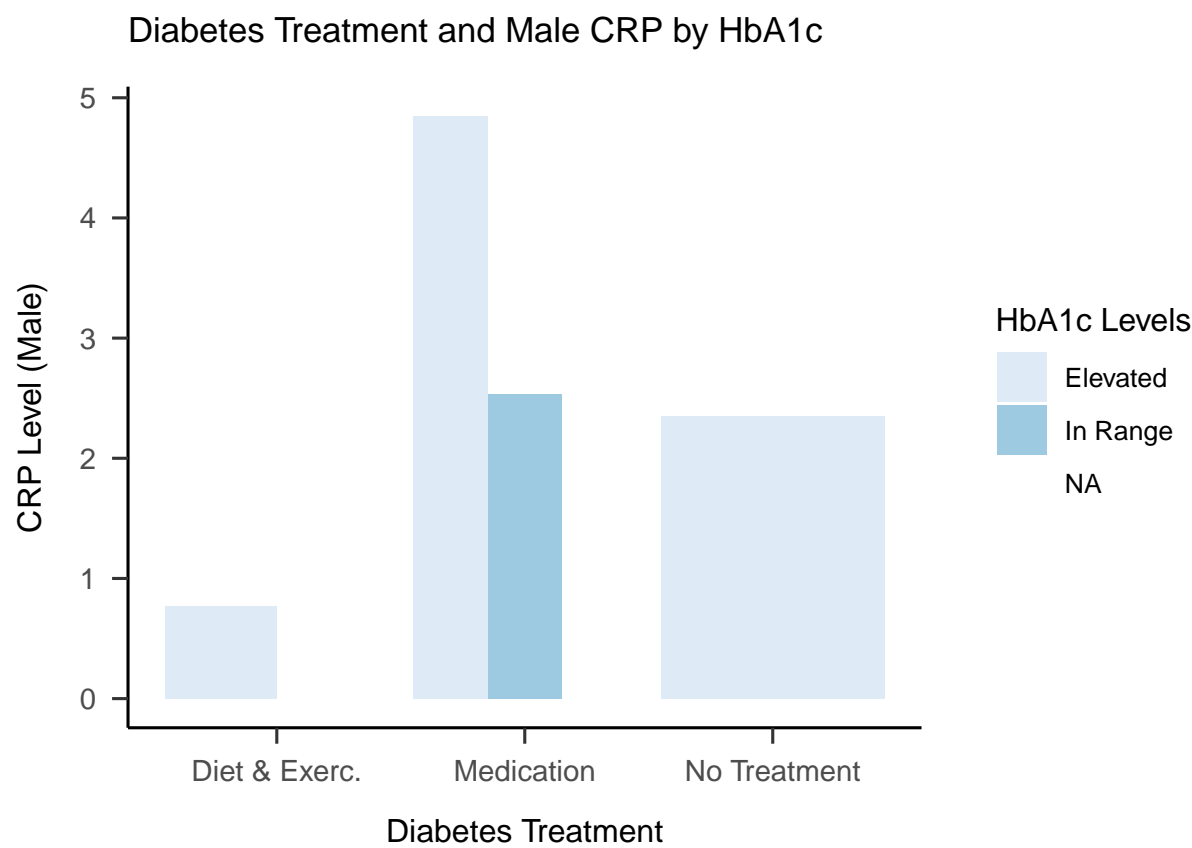
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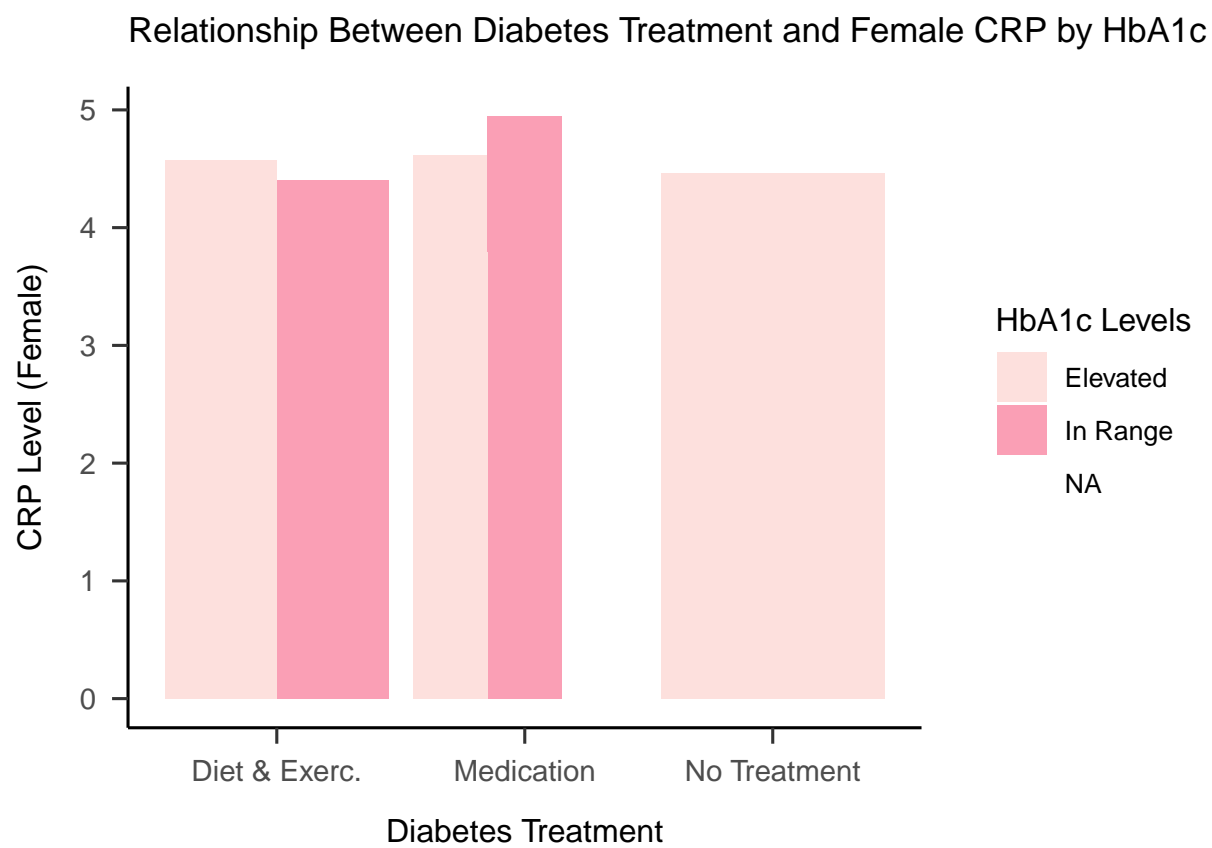
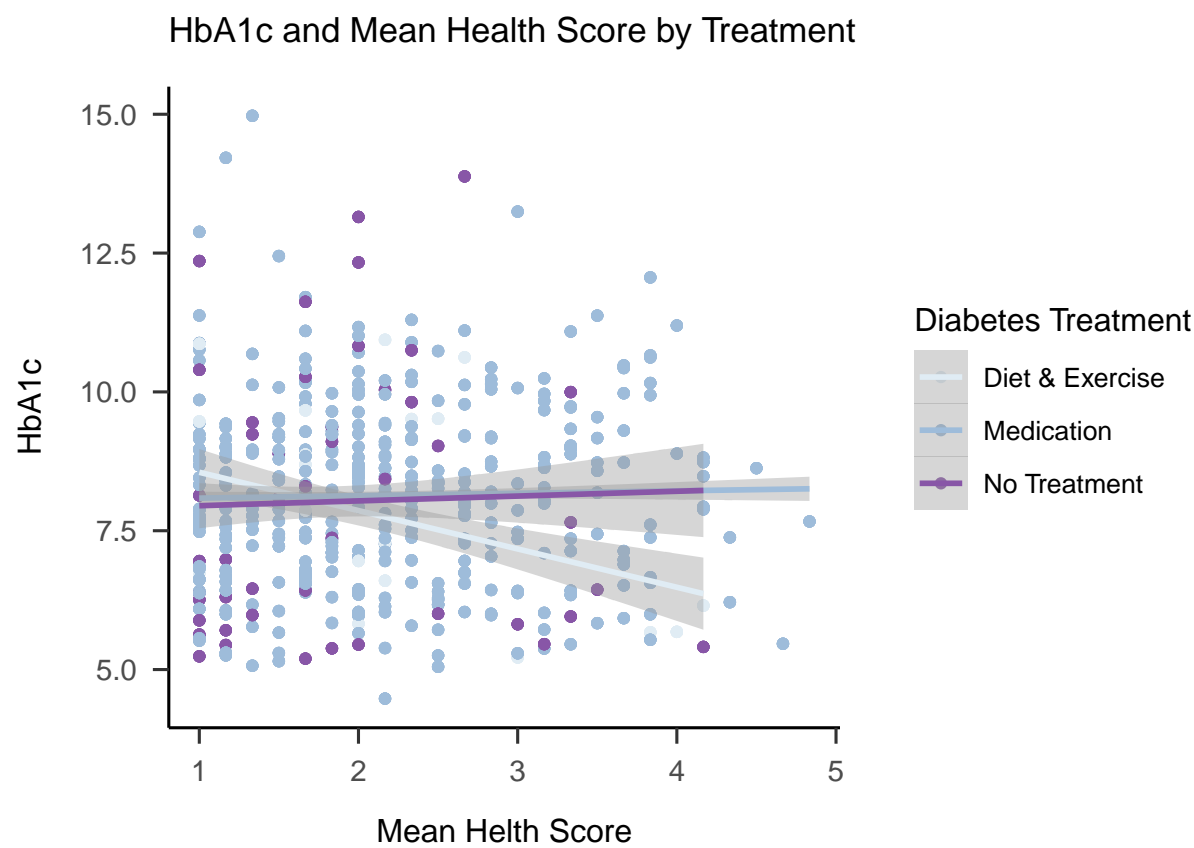*Figure 5*. Here goes the caption.
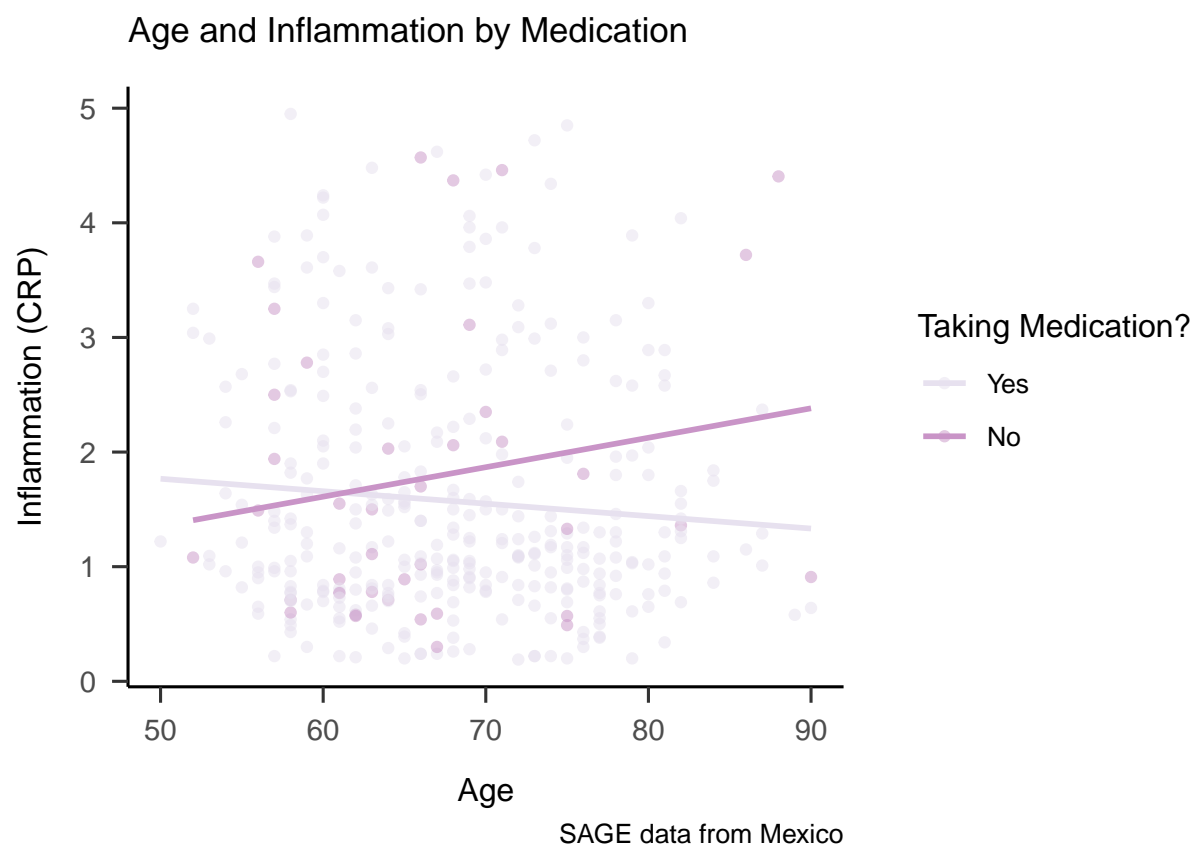
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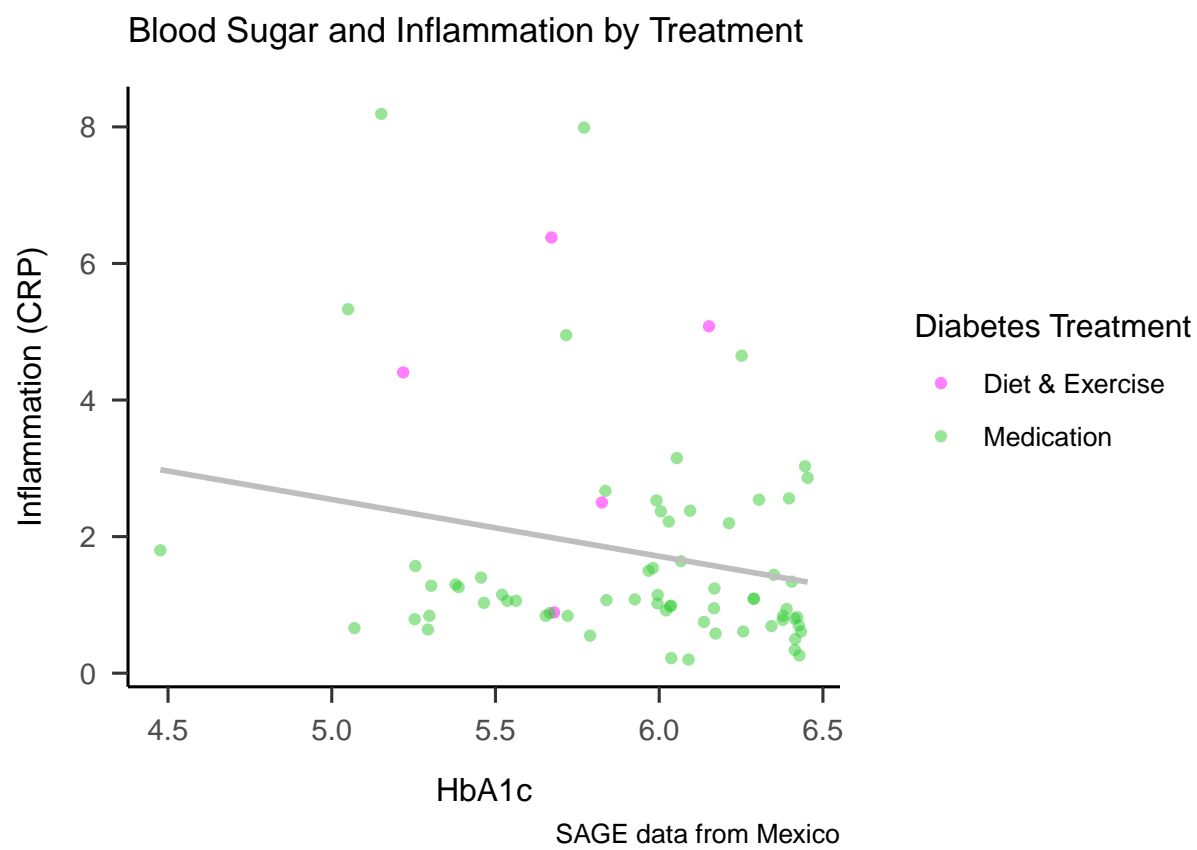
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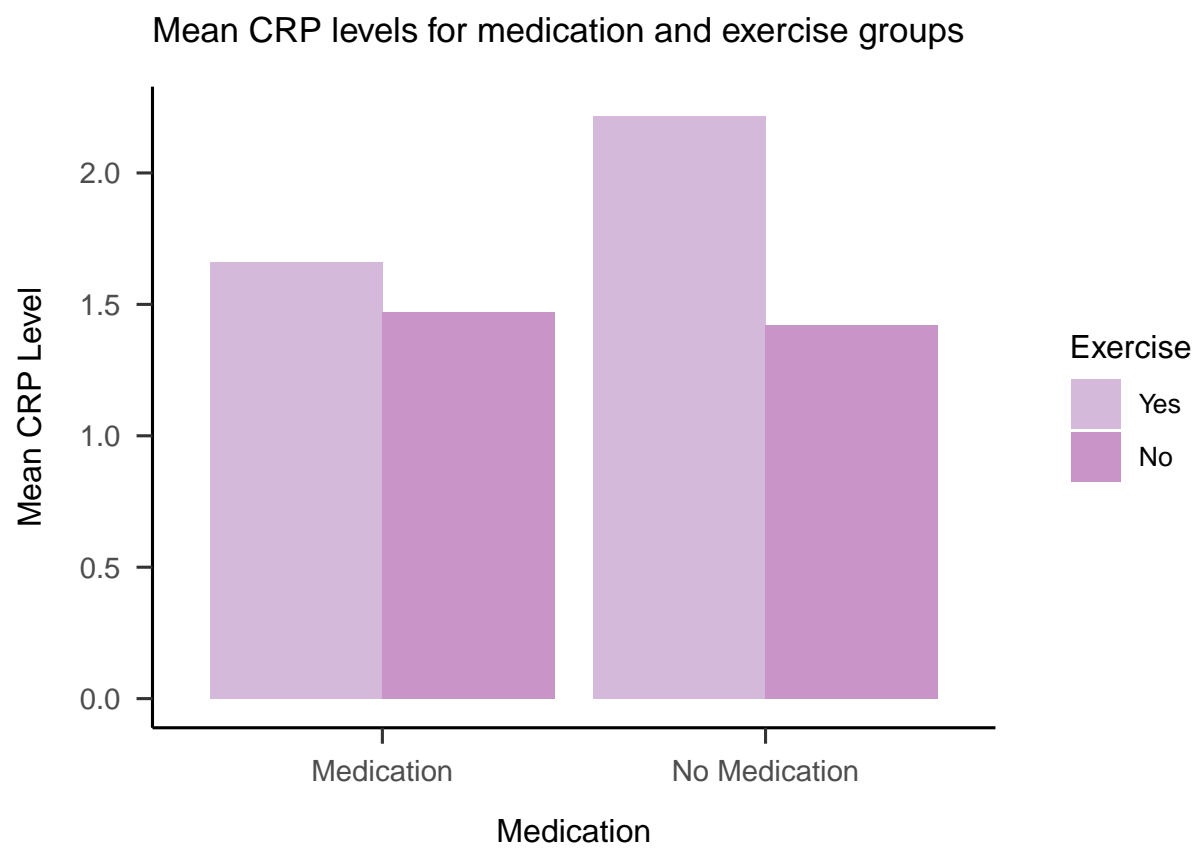
Figure 8. Here goes the caption.

CRP and Health Score by Diabetes

Figure 9. Here goes the caption.

Figure 10. Here goes the caption.

Figure 11. Here goes the caption.
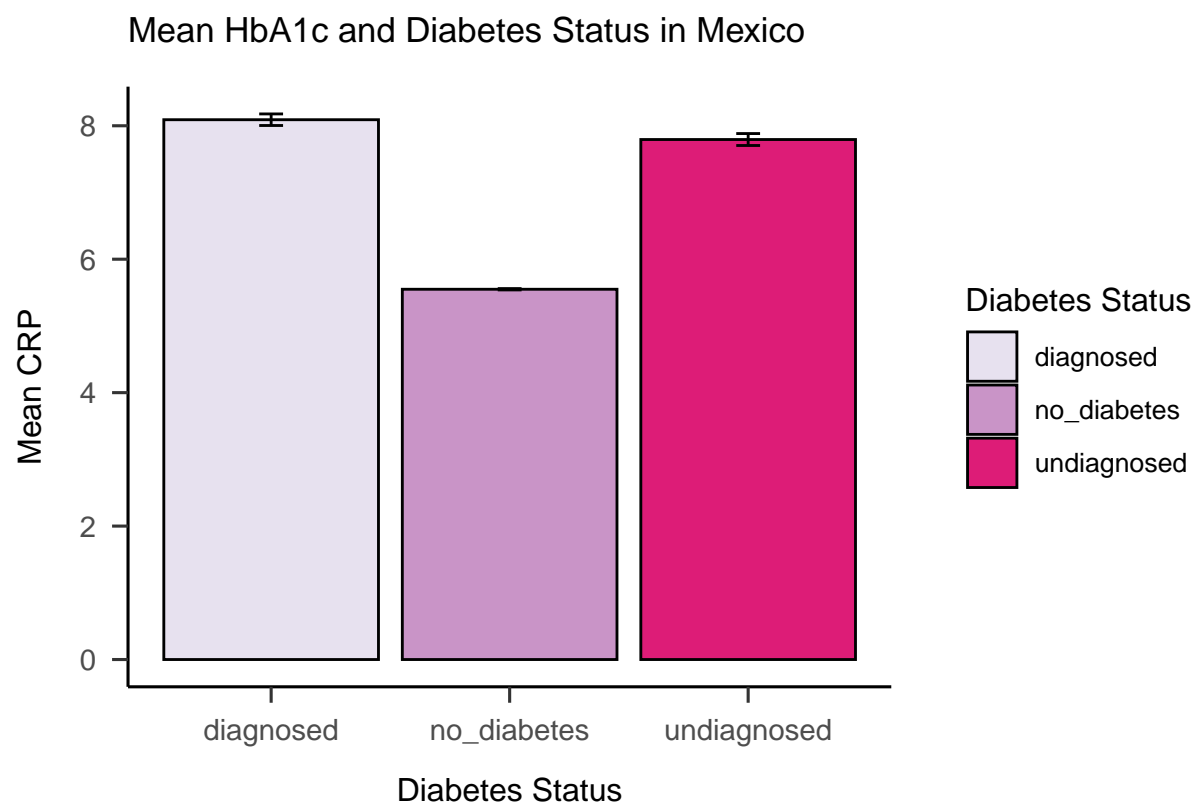
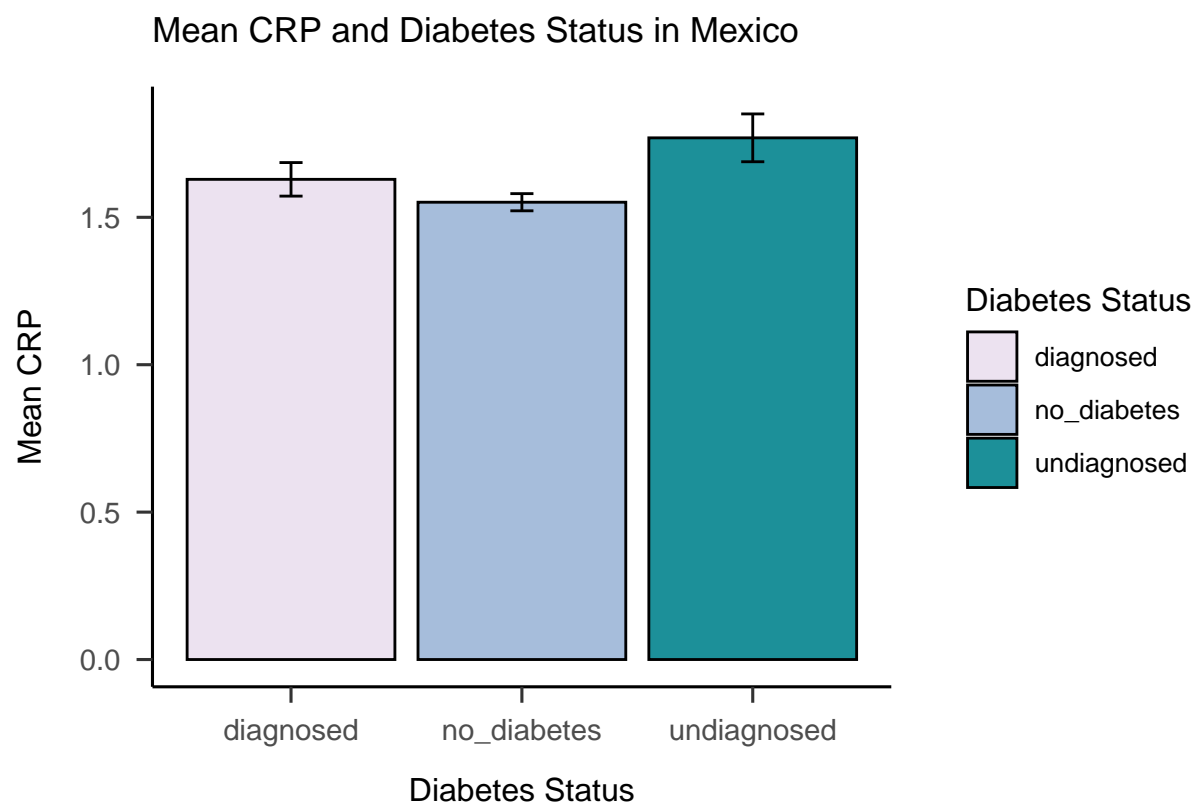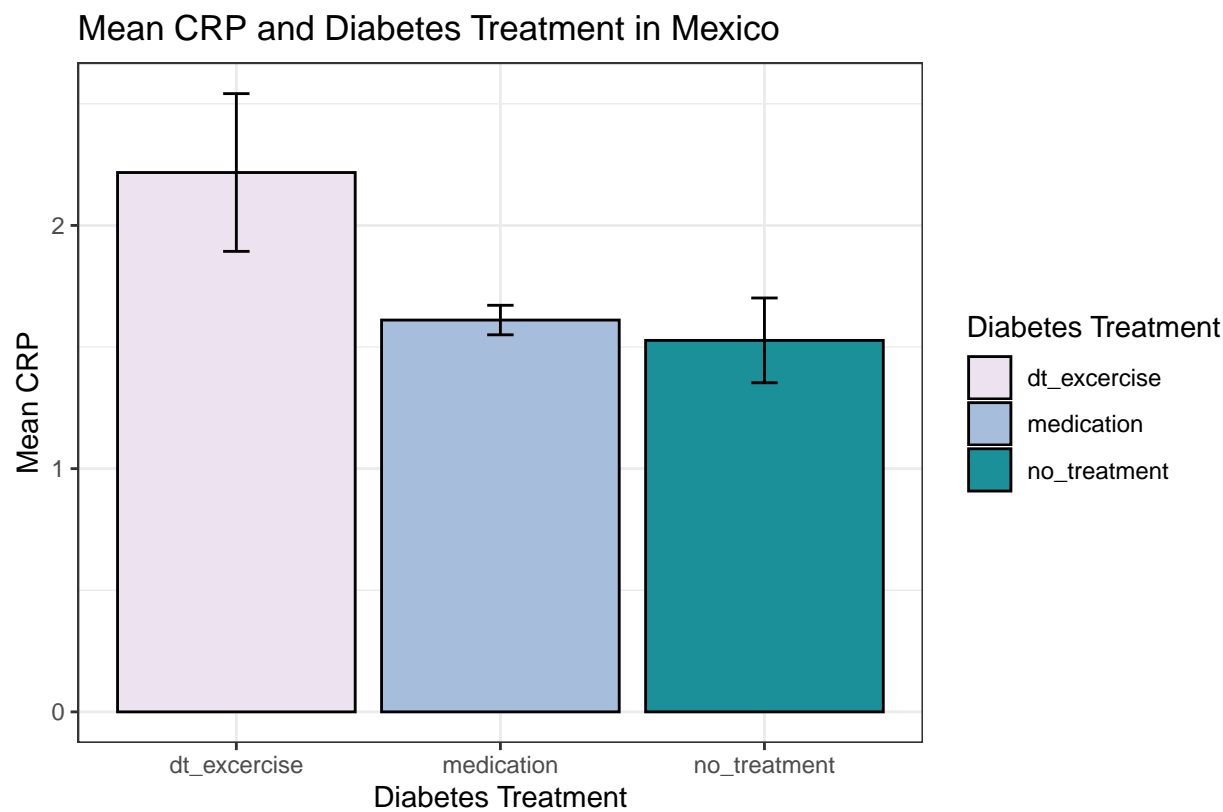Figure 5

Figure 12. Here goes the caption.

Figure 4

Figure 13. Here goes the caption.

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