A Mental Health Picture of Young Students in Yucatán

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Abstract

Yucatan, Mexico has maintained one of the highest suicide rates compared to other states. This is visible through the local newspapers and verifiable through official sources such as INEGI. The suicide rate has shown an upward trend in recent years. INEGI reports that in 2020 Yucatan was in the third place of suicide rate in the country with 10.4 cases per 100,000 inhabitants. With this in mind, and knowing that the young people is one of the most vulnerable society sectors, this research focuses on get a geolocated picture of their mental health. We applied validated psychologist test through a web app named APPSI to a group of 377 students of a public university in Yucatan. These digital approach allows the rapid assessment of anxiety, depression, stress (dass21), suicidal severity (C-SSRS Columbia) and emotional intelligence (EAYIE). The results shows that dass21 variables are high correlated among each other but less correlated with suicide severity. Furthermore, we found that neither age nor alcohol or tobacco consumption represent a significant difference in the variables measured in the scales but eating habits does. Besides we found that Kanasin is the municipality with the highest scores in the C-SSRS scale and lowest scores in eayie scale and also is the one with more alcohol stores, and it coincides with being one of the municipalities with the highest number of cases of violence and suicides in Yucatan according to local media.

Keywords

Mental Health, Depression, Anxiety, Stress, Emotional Intelligence, Spatial Analysis

1. Introduction

Yucatan is one of the states of the Mexican Republic that, for more than a decade, has maintained a high suicide rate, constantly above the national average, which is in contrast to the quality of life reported in the media.

In Mexico, the young people between 15 and 29 years old is the most affected sector of the population [1], and it is known that suicide is a multi-factorial problem that revolves around mental health and that some of its main identified causes are alcoholism, drug addiction, depression, maltreatment and sexual abuse. Furthermore, depression is a mental health problem that affects around 300 million people around the world (4.4% of the world population) and is considered the main factor associated in cases of deaths by suicide [2]. Depression can affect people of all ages, but the risk of falling into it increases by various factors such as problems associated with alcohol [3] and drugs [4] consumption. Regarding alcohol, studies such as the one presented in [5] show that people who suffer from depression and who also suffer from alcoholism have a high level of suicidal tendencies. Similarly, research such as the one presented in [6] shows that alcoholism is associated with a considerable risk of suicidal behavior, and that people with alcoholism who attempt or commit suicide are characterized by having experienced major depressive episodes. In Mexico, the problem concerning suicide is not minor. Studies such as the one presented by [7] shows the panorama from 1970 to 2007, in which an increase of 275% of

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suicide cases was reported, with people in the range of 15 to 29 years being the most vulnerable and a prevalence of suicidal ideation in people from 18 to 29 years of 9.7%. Similarly, [8] provides information updated to 2016 regarding the relationship between sociodemographic factors and suicidal ideation in the Mexican population. The ENBIARE survey of 2021 concluded that 19.5% of the population had symptoms of depression and one of the factors in the mood balance of people is affected by the expectation of not being able to cover the expenses of the month (indicator of subjective poverty), which affects 43.4% of the adult population [9]. Research such as the one presented in [10] affirm that, between 2013 and 2016, Yucatan was among the states with the highest mortality rate due to suicide. In this study, sociodemographic differences and factors associated with suicide were observed; suicide methods are consistent with those observed in the rest of the country and in countries with poverty and agricultural societies. It should be noted that Yucatan can be taken as a particular case, since the constant increase in the suicide rate contrasts with the high quality of life, which other media tend to attribute, mainly the written press, where sites such as [11], [12] and [13] place Yucatan, specifically the city of Merida, as the best place to live, not only in Mexico, but in the world. Given that there is evidence of the relationship between sociodemographic factors, alcohol and drug use, and depression problems with suicidal ideation, the objective of this research is to determine the association of these factors and geospatial information with suicidal ideation in the Yucatecan population, with the purpose of identifying geographical areas, population sectors or individual cases with higher risk, which will allow better targeting prevention strategies and/or proposing new ones. In addition, it is of vital importance to collect the geographical location since it is an element that greatly facilitates the detection of risk areas and gives rise to geospatial analysis studies in those areas. In addition, together with computer algorithms for early qualification and classification models, it will favor screening in the detection of individual risk cases. The interest lies in that this information contributes to the detection of causes not yet identified associated with the various risk factors, so that this allows to expand the knowledge of the phenomenon, and that this strengthens the decision-making processes, in order to generate more specific prevention strategies and public policies that help mitigate the increase in the suicide rate. Since depression, anxiety and stress are related with suicide risk, and the young people are the must vulnerable section of the population, this research includes the analysis of these factors in university students aiming to find out which one represents the mayor risk in order to generate oriented prevention strategies. In section two we present some other studies that are in the same line, that we have taken as base specially because they were developed with similar population in Latin America. The next section presents the description of the materials and methods, it is, the population and place of study, the sample size and the description of the tool to collect, analyzing and visualizing the data. Then the next section presents the results, and finally its discussion.

2. Related Work

The Columbia scales (C-SSRS) and DASS-21 have been widely used in studies with different populations belonging to different cultures to measure depression, anxiety and stress, especially in university students during the COVID-19 pandemic. This section presents some of them, which have served as a reference in this research in for the methodology, tools and results. In [14] the author applied the Columbia-Suicide Severity Rating Scales (C-SSRS) test to a population sample of 1,645 individuals in Chile, achieving an accurate classification of suicidal risk, thereby demonstrating that the items differentiate symptoms that address suicidal thoughts according to severity. In this study it was observed that women have significantly more suicidal ideation and suicidal risk than men; however, data for the Mexican population indicate that the suicide rate is 4 times higher in men than in women [15]. Also, works such as the one presented in [16] and [17] allow us to observe a significant positive correlation between the variables of suicidal ideation with depression, anxiety and stress. In [18] the authors state that depression, anxiety, well-being, and suicidal tendencies are highly associated during adolescence and are predictors of mental health in adulthood. In their research, the authors applied various instruments, including the C-SSRS to measure the relationship between these variables in a

population of students in Mexico City. The results indicate that women have higher levels of depression, anxiety, stress and suicidal ideation than men and lower levels of self-perception of well-being. In [19] a study with students from a University in Chile is presented. It determines the prevalence of depression, anxiety, stress, insomnia and suicide risk. For this, they used the Columbia scale and DASS-21 as instruments, among other variables. A high prevalence of mental health diseases was found (depression 37.1%, anxiety 37.9%, stress 54.6%, insomnia 32.5% and suicide risk 20.4%). The study presented in [20] mentions that suicide is a problem that has resisted prevention efforts and that it continues to be one of the main causes of mortality worldwide, so it is necessary to improve the methods to prevent it. Likewise, they mention that the C-SSRS has helped to mitigate some of the weaknesses of clinical research and has improved the accuracy of detection and the predictive validity of risk estimates compared to other measures that combine ideation and behavior. In [21], the authors used the C-SSRS, included in the WMH-ICS (World Mental Health-International College Student) survey, to assess its accuracy with a sample of first-year Spanish students. The experiment included the participation of clinical psychologists who were unaware of the initial survey responses and applied the International Neuropsychiatric Mini-Interview (MINI). The comparison of the results showed a reasonable agreement between the interviews and the surveys, therefore it was concluded that these surveys can be useful for the detection of mental health problems. In the same way, in the research presented in [22] the authors present a study to measure the reliability and validity of the C-SSRS with a group of adolescent girls with severe delinquency. The results of the test coincided with the evaluations carried out by social workers and caregivers. In [23] a research is presented in which the electronic Columbia Suicide Severity Rating Scale (eC-SSRS) was used to monitor suicidal ideation and behavior in patients with major depressive disorder, insomnia, post-traumatic stress disorder, epilepsy and fibromyalgia among 2009 and 2011. Patients who reported suicidal ideation with intent to act or suicidal behavior at baseline were found to be 4 to 9 times more likely to report suicidal behavior prospectively during study participation. Studies such as the one presented in [24] used the online C-SSRS scale to assess perceptions of risk, fear, mental health status, and coping strategies regarding the COVID-19 pandemic in Saudi nursing students. The results showed that religion is the most common coping strategy, and that 43.3%, 37.2% and 30.9% of the respondents have some degree of depression, anxiety or stress respectively. In [25] the authors measured suicidal behavior in university students in China. The study included psychological variables such as depression, anxiety, stress, hopelessness, happiness orientation, meaning of life, and coping styles. It was found that the greatest risk factors are depression, anxiety, stress and hopelessness. On the other hand, the authors in [26] applied the DASS-21 scale to estimate the prevalence of symptoms of depression, anxiety, stress, and associated factors in university students. The results revealed a moderate prevalence of depression (18.4%), anxiety (23.6%) and stress (34.5%). In [27] a study is presented in which the DASS-21 scale was used to determine the mental health status of a group of university students in Saltillo, Mexico during the COVID-19 pandemic. The results showed that the students suffer from high levels of stress, anxiety and depression, which is higher in women and people who suffer from a chronic illness. In addition, it was found that students who believe that others comply with the safety measures of COVID-19 have significantly less anxiety and depression. In [28] the authors applied the online DASS-21 scale to Ethiopian university students during the COVID-19 pandemic to measure their levels of depression, anxiety, stress, and other associated factors. The study found prevalence of depression (46.3%), anxiety (52%) and stress (28.6%). A similar study is presented in [29] where the DASS-21 scale is applied to undergraduate students who were taking classes online during the COVID-19 pandemic. The results revealed that most of the students present moderate symptoms of depression (16.98%), anxiety (16.98%) and stress (14.46%) due to online classes. Similarly, [30] presents a study in which DASS-21 was applied to a group of high school students in Guadalajara, Mexico. It was found that women have higher levels in the three factors included in the scale and that students who had family members infected with COVID-19 presented significantly higher levels of anxiety compared to the others. Similarly, the authors in [31] applied the DASS-21 scale and other psychological scales during the pandemic to analyze the symptoms of depression, anxiety, and stress in Brazilian university students. The results showed symptoms of depression, anxiety and stress in 60.5%, 52.5% and 57.5% of the population respectively. In [32] the authors present a research with the objective of

exploring the sociodemographic and educational factors associated with depression, anxiety and stress in students of health-related professions from the application of the DASS-21 scale and questions about sociodemographic and educational characteristics. It was found that sleep duration, communication with teachers, feelings of inferiority, and family problems are independent predictors of depression, but strong predictors of anxiety, and that feelings of inferiority and family problems are important risk factors for stress. Finally, works such as [33], [34], [35] and [36] carried out similar methodologies to measure levels of depression, anxiety and stress together with other variables such as sleep habits and physical activity in young university students from of the application of the DASS-21 scale and other scales with similar results. The works presented above are evidence of the use of the C-SSRS and DASS-21 scales to measure depression, anxiety, stress and suicide risk in various population but specially in young people.

3. Materials and Methods

This section describes the study population, the psychological tests applied, and the data collection tool. Although some of the works mentioned in the related work section refer to the period of the pandemic, this work does not aim to take into account that period as a risk factor, but rather the living conditions and habits of the students. On the other hand, the sample was randomly selected among a group of students recently enrolled in the University, so that no selection criteria in terms of sex were established. Despite the fact that young people are the sector of the population most vulnerable to suicide, this sample represents young university students and not the general population.

3.1. Population and place of the study

For this research we select 378 students from a public University in Merida Yucatan. The population was distributed as follows: 72.5% males, 27.2% females and 0.3% preferred not to answer; the range of age was between 17 an 29 where the three biggest groups was 46.8% students with 18 years old, 27.8% students with 19 years old, and 13% students with 20 years old; the 70.6% of the students live in Merida city and the rest live in the peripheral municipalities. Other interesting data is that the 32.2% of the students said that they have live in Merida about one year or less. This information is interesting because it reflects the population grow of the city, but also shows a migration dynamic, that could be interesting of studying for the life conditions of the students, such as isolation, incomes, or else.

3.2. psycological tests

For this research we decided to use the C-SSRS test for measure the suicide risk, the DASS-21 test for measure depression, anxiety and stress levels, and the EAYIE-AD to measure the self-reported emotional intelligence in adults. The last one has three factors which are interpersonal emotional awareness (CE Inter), intrapersonal emotional awareness (CE Intra) and emotional regulation (RE). In relation to suicide risk, from the performance of an ordinal logistic regression and finally, through a ROC curve model, we determined the suitability of this model to predict the risk of suicide. In relation to the DASS-21 test Cronbach's α was used to measure reliability and to find out the correlations, the Pearson correlation coefficient test.

3.3. Data collection tool

This tool is divided in four phases described as follows. For the data collection phase, a web application that can be accessed from the project website (https://siemai.mx/appsi/), was created. Through the App, the students answered the questionnaires from their school. We asked them to write their address as accurate as possible, and then, we used google map API to get the corresponding coordinates. For the data storage phase, the responses were automatically stored digitally in a database. It is important to point out that the geolocation values obtained will allow future geospatial analysis to be carried

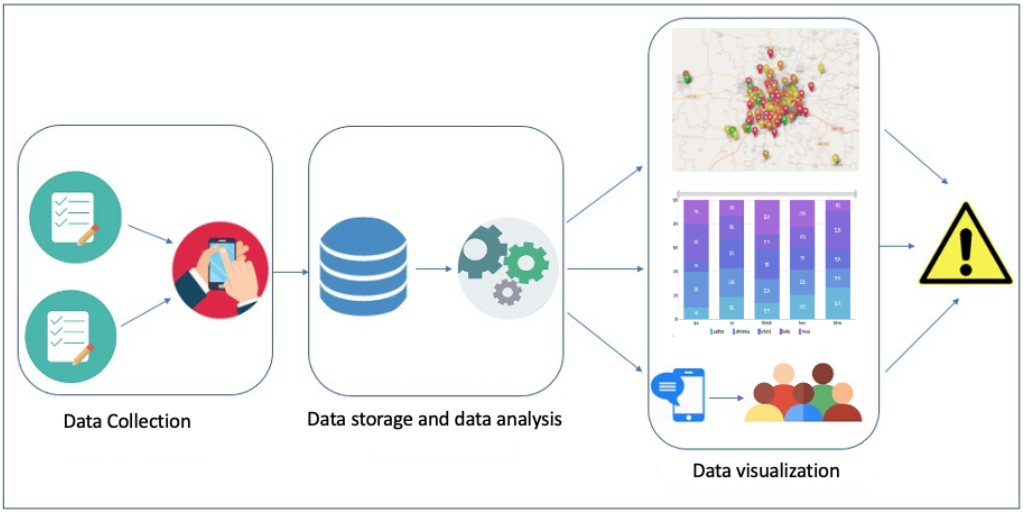

Figure 1: Dataflow diagramm of the collection, storage, analysis and visualization phases.

Table 1
Mental health mean values divided by age and sex.

	Criteria	Age		Sex	
		<=18(47.1%)	>18(52.9%)	Male(72.5%)	Female(27.2%)
C-SSRS	Suicidal Severity	0.3820	0.5376	0.3722	0.7156
DASS21	depression	0.7415	0.8743	0.6824	1.1372
	anxiety	0.9719	1.0804	0.8394	1.5490
	stress	0.5617	0.5427	0.4489	0.8333

out looking for risk factors associated with sociodemographic variables. Once the students send their responses, the application sends them a thank you message through WhatsApp, which seeks to have more interaction with the students. The data analysis phase consisted of three parts. For the first one we developed an algorithm that scores the tests immediately (as soon as the respondent completes the questionnaires) and classify them by levels of impact (null, low, moderate, severe and extreme) for each variable of the used scales. The second part consisted of identifying the variables with the greatest impact and the third one consisted of establishing correlations with other data. The data visualization phase consisted of the creation of a web platform that allows the next: i) to see on a map the data classified by variable and level, and ii) to see the general statistics obtained through the data, including the distribution of the population on each level of depression, anxiety, stress and suicide severity, sex, age, food habits, time living in Yucatan, etc. It is an interactive platform that shows the updated status of the database. The 2 shows the complete dataflow diagram in its four phases. The results are shown in the next section.

4. Results

4.1. Results by age and sex

The table 1 shows the mean values of mental health variables divided by age and sex

It can be seen that people under 18 years old have similar levels of depression, anxiety, stress, and suicidal severity as people with 18 years old or older. That is, it is not possible to affirm that age is a factor that indicates a difference in this population. However, when dividing the population by sex, it can be seen that women reach higher levels (practically double that of men) in all variables. Although this coincides with the literature and the findings in other researches, it is also necessary to highlight

Table 2
Mental health mean values divided by substances consumption. (C-SSRS: Suicide Severity estimated by Columbia test, DASS21: Depression Anxiety and Stress Scale 21) C=Consumption, NC=No consumption

		Alcohol		Tobacco		Other substances	
		C	NC	C	NC	C	NC
	Criteria	(40.6%)	(59.4%)	(15.9%)	(84.1%)	(6.6%)	(93.4%)
C-SSRS	Suicidal Severity	0.5555	0.4017	0.9	0.3817	0.8	0.4403
DASS21	depression	0.9150	0.7410	1.0666	0.7634	0.92	0.8039
	anxiety	1.1372	0.9553	1.3833	0.9621	1.08	1.0255
	stress	0.7581	0.4107	0.7666	0.5110	0.44	0.5596

that the number of men with manifestations of violence, such as suicide, is greater.

4.2. Results by substance consumption

The table 2 shows the mean values obtained in the scales related with the consumption and not consumption of alcohol, tobacco and other substances.

It is possible to see that, with respect to the population that consumes alcohol, there is no great difference in the values of the C-SSRS and DASS21 tests compared to those who do not consume alcohol. However, those who reported consuming alcohol have higher averages in the four variables.

With reference to tobacco consumption, something similar is observed, unlike the average of values on the C-SSRS scale (suicidal severity) where the risk of those who consume tobacco is more than double that of those who do not consume tobacco.

Finally, the table shows that those who reported consuming some other substance have practically the double of the risk (suicidal severity) than those who do not consume, but similar values in the depression, anxiety and stress variables.

Although there is no significant difference in the averages of the C-SSRS and DASS21 scales between alcohol consumers and non-consumers, almost double the value was identified in the average stress, which is why this variable has deserved special attention.

4.3. Results by municipality

In this section it can be seen in the figure 2 that the two municipalities with the highest index in each of the scales (C-SSRS and DASS21) are Merida and Kanasin. It can even be noted that the second has higher values regarding the suicidal severity scale (C-SSRS). Furthermore, with respect to the anxiety and stress variables, the population in the municipality of Uman achieves comparable values.

Likewise, in the same figure it is notable that the municipality of Merida, compared to the other municipalities, has the highest values with respect to the variables of the eayie scale, which measures protective factors, and that the population of kanasin shows the lowest values in two of the three factors of eayie scale. This can be interpreted as Kanasin representing a municipality of attention by showing high values on the mental health scales, low values on the protective factors scale.

To determine the existence of a significant difference between Kanasin and the other municipalities with respect to each of the mental health scales, we applied the Mann-Whithney test, the results of which are shown in table 3. It can be seen that there is no significant difference between the municipalities with the highest number of individuals surveyed.

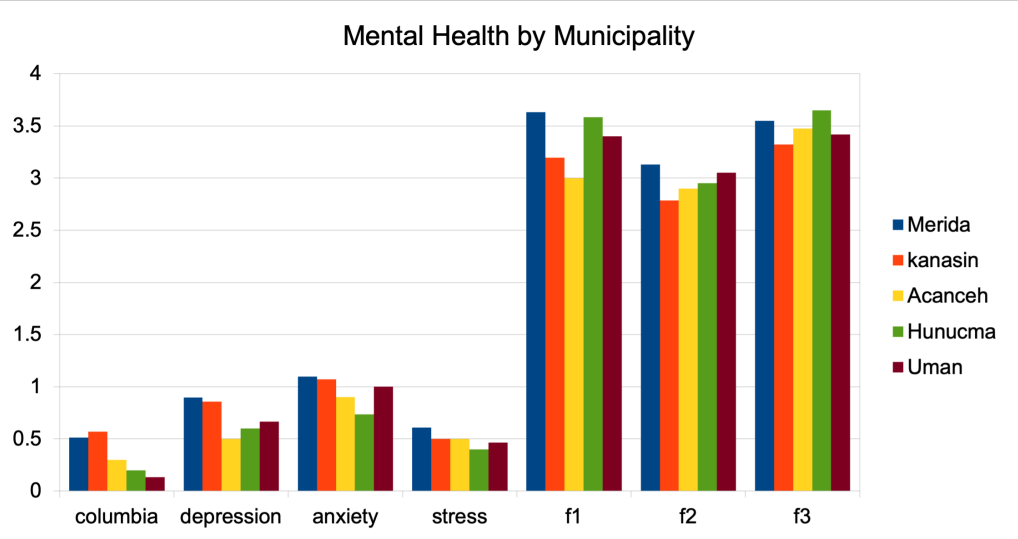

Figure 2: Mental Health by Municipality.

Table 3
Significant difference between municipalities.

Municipalities	C-SSRS	DASS21		
		depression	anxiety	stress
Kanasín-Mérida	0.945	0.917	0.858	0.604
Kanasín-Hunucmá	0.164	0.616	0.403	0.902
Kanasín-Acancéh	0.514	0.483	0.777	1.000
Kanasín-Umán	0.135	0.651	0.659	0.715

4.4. Results by Feeding Habits

Regarding feeding habits five questions were asked: i) do you think you consume a variety of foods?, ii) have you skipped breakfast in recent months? , iii) do you consider that you consume enough food?, iv) have you eaten only once a day in the last few months? and v) have you left with out eating in the last few months ? For each of the questions the possible answers were yes (in blue) and no (in red). Figure 3 shows that those who consider that not having a varied diet have higher values in the four mental health variables. Figure 4 shows that those who tend to skip breakfast have higher values on all four mental health variables. Figure 5 shows that those who consider not eating enough food have higher values in the four mental health variables. Figure 6 shows that those who have eaten only once a day in recent months also have higher values on the mental health variables. figure 7 shows that those who left without eating in the last few months have higher values of suicide severity, depression, anxiety and stress.

Also, it can be observed that, in terms of protector facts (f1,f2,f3), there is no to much difference between the ones how have good and bad eating habits.

What can be inferred from figure 3 to 7 is that eating habits play an important role in the mood and mental health of young university students, especially because a large part of them come from other states and their living conditions are unknown, regarding whether they live alone, with friends or family or if they have enough money to maintain healthy eating habits.

Table 4 presents the significant difference among feeding habits related with mental health variables. It can be seen that eating various foods has a significant difference between the ones who use to and the ones who don't in the four variables. Beside, do not have breakfast shows a significant difference between the ones who use to and the ones who don´t in three of the four variables correspondent to

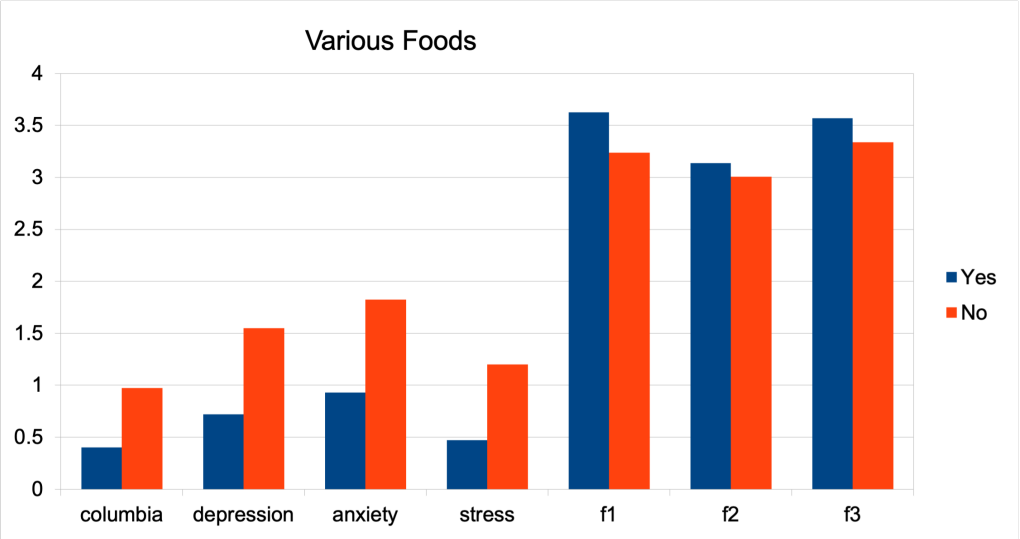

Figure 3: Various foods.

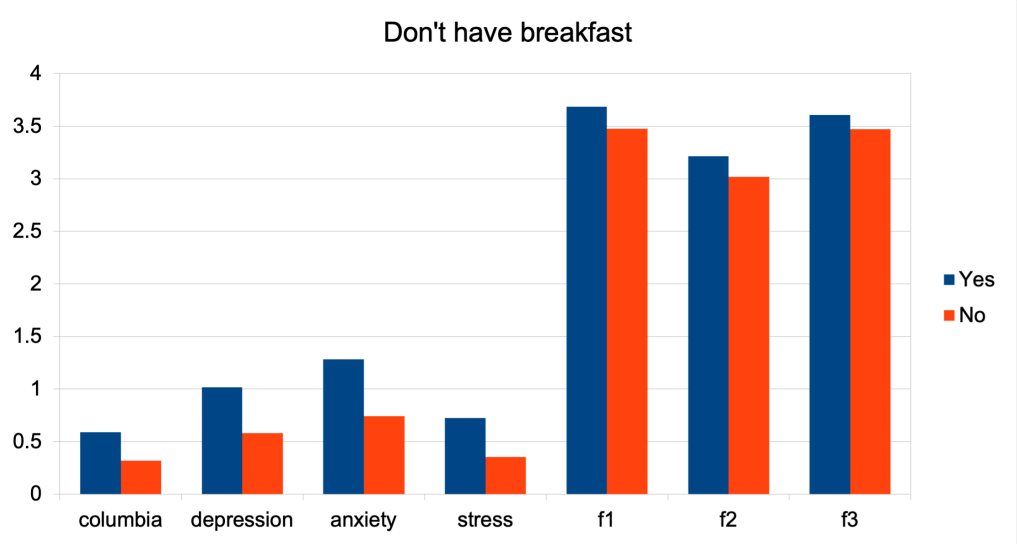

Figure 4: Don't have breakfast.

the DASS21 scale. Finally, eating enough food, have eaten only once in the last few months and left without eating in the last few months have significant difference in only one of the four mental health variables. On the other side, the depression is the variable than has significant difference in four of the five feeding habits.

Based on the above mentioned, we can say that bad eating habits could affect the mental health of young students, specially with depression problems.

5. Classification Models Development

Based on the previous results showing that substance use and eating habits play an important role with respect to mental health in terms of the variables analyzed, three classification models were developed to classify the suicide risk (columbia scale). For this, the following twelve variables were taken into account: 1) sex, 2) various foods, iii) don´t have breakfast, iv) enough food, v) have eaten only once vi) been left without eating vii) alcohol consumption, viii) tobacco consumption, ix) other substances consumption, x) depression, xi) anxiety and xii) stress.

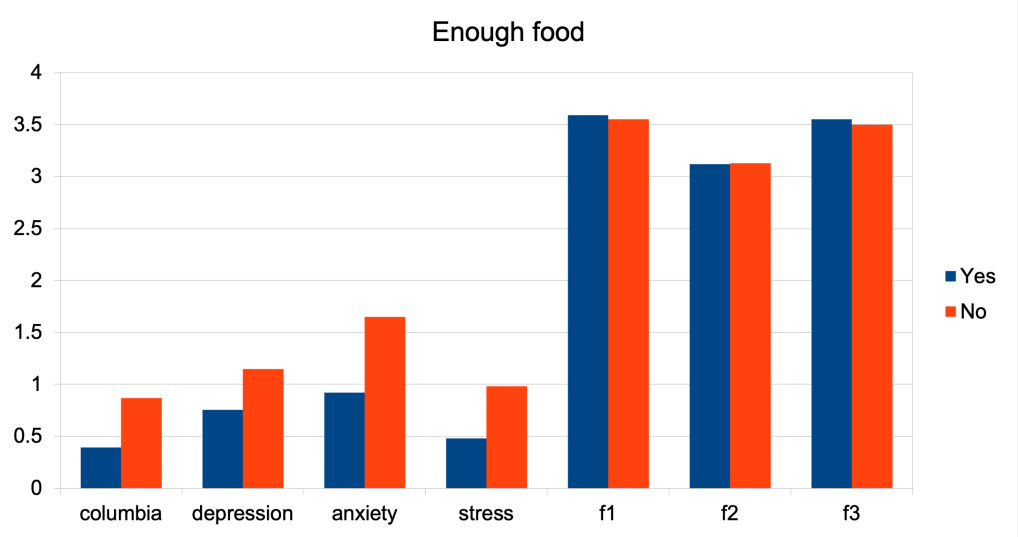

Figure 5: Enough food.

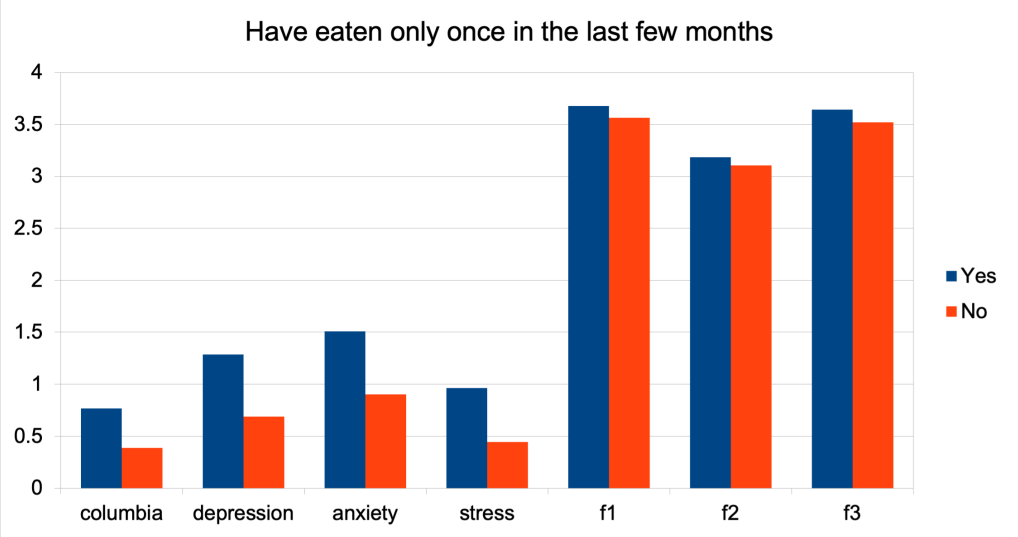

Figure 6: Have eaten only once in the last few months.

All possible combinations of these variables were calculated and decision tree, knn and Multilayer perceptron (MLP) models were tested.

Table 5 to table 7 shows the results of each one. It can me seen that the MLP model has the higher accuracy using nine of the twelve variables, so it looks like it is possible to predict or detect the suicide risk using sociodemographic variables such as eaten habits and alcohol and other substances consumption in addition with anxiety and stress.

6. Discussion

Bolton, D., and Bhugra, D. [37] note that many psychiatric disorders are strongly influenced by cultural and social factors, where the apparent increase may reflect cultural and social changes in representations of mental health. As well as that in recent decades there have been increasingly evident fractures in social solidarity, which interact with specific sociopolitical, economic and environmental stressors that affect and exacerbate the younger generations. The study area (southeast of Mexico) is characterized by less economic development (with lower salaries compared to the north or center of the country) [38].

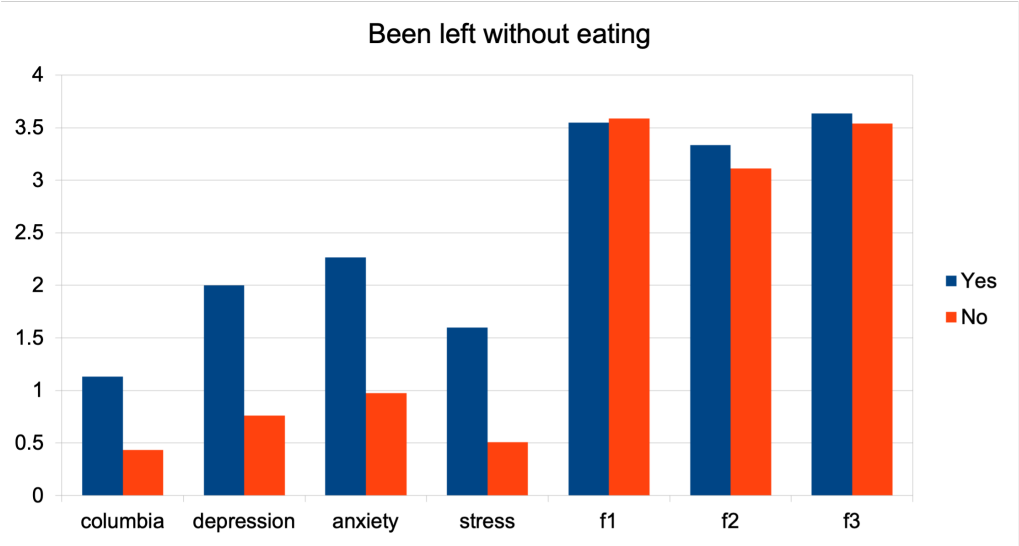

Figure 7: Left without eating.

Table 4
Significant difference among feeding habits.

Feeding habits	C-SSRS	DASS21		
		depression	anxiety	stress
Various foods	<.001	<.001	<.001	<.001
Don't have breakfast	0.002	<.001	<.001	<.001
Eat enough food	<.001	0.013	0.001	0.004
Have eaten only once	0.001	<.001	0.001	0.001
Left without eating	0.001	<.001	0.001	0.001

Table 5
Decision Trees Classification Model variables and accuracy.

v1	v2	v3	v4	v5	accuracy
Have eaten only once	alcohol consumption	tobacco consumption	other substances consumption	stress	0.75652174

In other works [26] it has been described that being a woman, living with the family, having a stable partner and alcohol consumption in young people can be factors associated with high levels of stress, however in the results found in university students, It stands out that stress levels are lower, possibly due to the greater frequency of visits to parks among young people [39], safety and good quality of life that is reported to be maintained in the study area [40]. Something similar happens with depression and anxiety, since they are less frequent in the population studied compared to other parts of Mexico, Latin America and other countries [41], [42], [43]. On the other hand, a clear correlation between anxiety and stress, as well as anxiety and depression, was identified in the population of young people studied, which coincides with other works that describe these findings [44] and describe that reducing maladaptive coping behaviors can have the most positive impact in reducing depression, anxiety, and stress in this population.

On the other hand, the results of the tests to measure the levels of depression, anxiety and stress

Table 6
KNN Classification Model variables and accuracy.

v1	v2	v3	v4	v5	v6	accuracy
sex	enough food	alcohol consumption	tobacco consumption	other substances consumption	stress	0.77391304

Table 7
MLP Classification Model variables and accuracy.

v1	v2	v3	v4	v5	v6	v7	v8	v9	accuracy
sex	Don't have breakfast	enough food	left without eating	Have eaten only once	alcohol consumption	other substances consumption	anxiety	stress	0.91428571

were higher in young people who consumed tobacco, alcohol or other substances, in agreement with what was described by [45], [46]; however, the high consumption of substances are not the only causes, but when they are linked to other elements such as the social fabric, regularity in social activities and high economic situation, they may not represent a negative effect [49]. Specifically, the consumption of cannabis has been associated in various studies with the subsequent development of depression and suicidal tendencies in young people, so this is an important situation to consider regarding public health, for which health care policies must be considered for their adequate approach [46].

Author Contributions

Conceptualization, Gandhi Hernández, Sally Vanega, Matilde Coello, Manuel Sosa; methodology, Gandhi Hernández, Sally Vanega, Matilde Coello, Manuel Sosa; software, Gandhi Hernández; Validation, Sally Vanega, Matilde Coello, Manuel Sosa; formal analysis, Sally Vanega, Matilde Coello, Manuel Sosa; investigation, Gandhi Hernández, Sally Vanega, Matilde Coello, Manuel Sosa; resources, Gandhi Hernández, Sally Vanega, Matilde Coello, Manuel Sosa; data curation, Gandhi Hernández; writing—original draft preparation, Gandhi Hernández, Sally Vanega, Matilde Coello, Manuel Sosa; writing—review and editing, Gandhi Hernández, Sally Vanega, Matilde Coello, Manuel Sosa; visualization, Gandhi Hernández ; All authors have read and agreed to the published version of the manuscript.

Informed Consent

"Informed consent was obtained from all subjects involved in the study.". It can be consulted in http://siemai.mx/CentroGeo/consentimiento_itm.php

Data Availability

The data generated during this research are available at http://siemai.mx/CentroGeo/mapa.php.

Conflicts of Interest

"The authors declare no conflict of interest.".

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