Investigation of the Depression Status of Asian American Adolescents

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Abstract

Depression is one of the most common mental disorders in the United States, and past studies have shown a concerning increase in the rates of depression in youth populations over time. Furthermore, depression is an especially important issue for Asian Americans because of the impact of anti-Asian violence due to the COVID-19 pandemic. While Asian American adolescents are reluctant to seek help for mental health issues, past research has found a prevalence of depressive symptoms in them that have yet to be fully investigated. There have been studies conducted to understand and observe the impacts of multifarious factors influencing the mental well-being of Asian American adolescents; however, they have been generally limited to qualitative investigation, and very few have attempted to quantitatively evaluate the relationship between depression levels and a comprehensive list of factors for those levels at the same time. To better quantify these relationships, this project investigated the prevalence of depression in Asian American teenagers mainly from the Greater Philadelphia Region, aged 12 to 19, and, with an anonymous survey, asked participants 48 multiple-choice questions pertaining to demographic information, daily behaviors, school life, family life, depression levels, school and family support against depression. Each multiple-choice question was assigned as a factor and variable for statistical and dominance analysis to determine the most influential factors on depression levels of Asian American adolescents. The results were validated *via* Bootstrap analysis and *t*-tests. While certain influential factors identified in this survey are consistent with the literature, such as parent-child relationship and peer pressure, several dominant factors were relatively overlooked in the past. These factors include the parents' relationship with each other, the satisfaction with body image, sex identity, support from the family and support from the school. More than 25% of participants desired more support from their families and schools in handling depression issues. This study implied that it is beneficial for Asian American parents and adolescents to take programs on parents' relationship with each other, parent-child communication, mental health, and sex identity. A culturally inclusive school environment and more accessible mental health service would be helpful for Asian American adolescents to combat depression. This survey-based study paves the way for further investigation of effective approaches for helping Asian American adolescents against depression.

Keywords: Asian American Adolescents; Depression; Dominance analysis; *t*-test; Bootstrap analysis

Introduction

Major depression has been one of the most common mental disorders that interfere with or limit people's ability for major life activities. It is characterized by a period of time that lasts at least two weeks, during which a person has experienced a saddened mood or loss of interest or pleasure in daily activities with the majority of specified symptoms for depression [1]. With such varying effects, it is more important than ever to study and analyze depression rates of various groups of people, especially depression rates among adolescents, which make up 13% of the total U.S. population, according to the U.S. Census Bureau estimates. Depression is an ongoing issue among adolescents, and depression rates continue to grow in adolescents year by year. A research study conducted over a course of 12 years found that the rate of individuals whose responses displayed symptoms of major depression increased 52 percent over the course of these 12 years [2]. Another study observed that the total number of teenagers who experienced depression increased 59% between 2007 and 2017, and the rate of growth was faster for teen girls than boys, with 66% and 44% increase, respectively. In 2017, 13% of U.S. teens ages 12 to 17 stated that they had experienced and went through at least one major depressive episode in the past year, an 8% increase from the numbers found a decade earlier [3]. The COVID-19 pandemic has imposed additional stresses to adolescents. In particular, adolescents have to adapt to the online learning format that around 78% of them considered worse or much worse than the in-person learning format [4]. A study from Mental Health America (MHA) indicated that around 15% of U.S. teens experienced a major depressive episode in 2021, a 1.24% increase from 2020 [5]. Around 19% of youth ages 12-17 experienced major depression in 2021, increased from 13% in 2017.

The model minority is an idea that Asian Americans can achieve greater success than other groups because of their values and natural abilities [6,7]. This idea may impose extra stress to Asian American from other racial and ethnic groups to live up to these images of perfection and to meet their parents' expectation [8]. Even though certain Asian Americans are struggling with psychological stressors (such as acculturation stress, discrimination due to racial and cultural background, microaggressions, and parental pressure to succeed) [9-

11], they hesitated to reach out for help or express their psychological problems [11,12]. In the past, Asian Americans were documented having very low hospital admission rates, which has also caused many to believe that Asian Americans had low levels of mental health issues [13]. However, this was not the case, as the true depression rates and suicide rates of Asian Americans have been masked by cultural barriers and biases [14-16]. It was reported in 2003 that 47% Asian American adolescents experienced depression, while 30% of their European American counterparts had depression issue [17]. A report released by the National Alliance on Mental Illness (NAMI) on Jan 1st 2011 indicated that Asian American teenage girls have higher rate of depressive symptoms than any racial, ethnic or gender groups. The death rate from suicides for Asian American women ages 15 to 24 showed a similar trend [18]. These are consistent with a report provided by Commonwealth Fund Survey in 1997 [19]. The trends and changes in these prior studies demonstrate that there is a gradual but significant rise in depression rate for Asian American adolescents. Thus, it is crucial to study what seem to be contributing factors to Asian American adolescents' depression rates and how to decrease these depression rates.

Studies have been done with extensive efforts to identify the influential factors of depression. Researchers have examined parent-child relationships, the effects of insufficient care from families or schools, religious or racial influences, and other factors (refer to [20-27] for a few examples of previous studies). These studies have often been broad, addressing depression on a national level, regardless of ethnicity, race, and socioeconomic status. While it is a good idea to generalize notes on trends that appear in a widespread population, it is equally as important to narrow the focus and examine depression rates in certain groups of people. Compared with other racial or ethnic groups like African American adolescent [28-30], Mexican American adolescent [15,31,32] and European American adolescent [33-35], relatively fewer studies on depression rates of Asian American adolescents have been conducted. While Asian American adolescents are still marked with the model minority stereotype, not all of them meet the expectation from their parents, schools, and community. Even though they have depression issues, they may not seek for help [36]. The COVID-19 pandemic and the recent anti-Asian violence [37-39] may impose extra stresses to Asian American adolescents. All these motivate us to do a comprehensive study on the depression status of Asian American adolescents in this study. One hypothesis to test in this study is that the aforementioned factors, especially model minority stereotype and anti-Asian violence may bring extra risk factors to Asian American adolescents when compared to American adolescents in general.

In the past, there have been various studies conducted to understand and observe the impacts of multifarious factors influencing the depression levels in Asian American adolescents. For instance, Zou P, et al. [16] reviewed broad analyses from 81 studies to find general influencing factors (e.g. acculturative/religious factors, parent-related factors, community violence and discrimination) that connected to depressive symptoms. Another study focused on one specific factor (e.g., parent-adolescent relationships with respect to adolescent's views on expectations and their relationships with their parents [16]). Several other studies aimed to connect risk-taking behaviors, such as sexual behavior, drug use, alcohol & cigarette usage, with depressive symptoms in Asian Americans [40]. It is important to note that many of these studies focused more on establishing connections between various factors and depressive symptoms through a qualitative means. Few of them quantified the depression levels and then established quantitative relationship between those factors and depression

levels to identify which factors have the most or major influences on adolescents with depression. To address these issues, a survey-based approach is used in this work to quantitatively study the factors that influence the depression status of Asian American adolescents.

The survey-based approach has been approved as an efficient way for studying the factors that may influence depression levels in populations [41-44]. The following factors were mainly included in published survey studies: drug/alcohol/cigarette usage [45,46], performance in schools [16,47], parent-child relationship [16], race and ethnic identity [48], the usage of mental health service [49-51], sex and sexual identity [40]. While each of these factors may play a role in determining a participant's depression level, it is essential to analyze these factors at the same time. Therefore, all these factors are included in the survey designed in this study. In addition, the COVID-19 and the recent anti-Asian violence may induce additional stress to Asian American Adolescents. Questions on COVID-19 and anti-Asian violence are thus included in the survey. Nine questions from the Patient Health Questionnaires-9 (PHQ-9) approach [52] are included to quantify the depression levels of survey participants. Based upon the survey results, quantitative analysis, especially dominance analysis [53,54], is then conducted to summarize participants' response to the 48 survey questions and further identify the dominant factors from all the influential factors for depression formation of Asian American adolescents. Finally, suggestions are offered from this study on how to help parents, schools and community can help adolescents against depression.

Materials and Methods

Survey design

Most previous studies quantified depression levels through the Patient Health Questionnaires-9 approach by Dr. Kroenke K, et al.[52]. PHQ-9 is a method of quantifying the severity of one's mental illness (es). It is one of the most validated and universally used tools in diagnosing and monitoring depression. The questionnaire consists of 9 questions about participants: interest in things, feelings of depression, sleep problems, lack of energy, poor appetite or overeating, feelings of letting down family, troubles with concentration, and changes in speaking patterns, and thoughts of suicide. The following four options are available for each question in the time span of the last two weeks: "not at all", "several days", "more than half the days", and "nearly every day". Each option is assigned a corresponding 0-3 point value, with 0 for "not at all" and 3 for "nearly every day". The points from each of the nine questions are added up and are categorized. A sum between 1-4 represents minimal depression, 5-9 represents mild depression, 10-14 represents moderate depression, 15-19 represents moderately severe depression, and 20-27 represents severe depression. The nine questions from the PHQ-9 approach were incorporated in this survey to quantify the depression levels of participants so that a quantitative relationship between depression levels and influential factors was able to be built.

The survey contains 48 multiple-choice questions. The 48 multiple-choice questions were designed to collect participants' response on: 1) demographic questions (Question 1-6), daily behaviors (Question 7-15), school life (Question 16-24), family life (Question 25-32), depression levels (Question 33-41 from the PHQ-9), awareness and response to depression issue (Question 42-43), school and family support against depression (Question 44-46), impact of COVID-19 and anti-Asian violence on depression (Question 47-48). Most of the questions were designed based upon literature review, while certain questions were not commonly mentioned in existing survey

questionnaires. These questions include: 1) the number of Advanced Placement (AP) courses the participant has taken, 2) participant's sickness, 3) sickness of participant's family members, 4) time spent in video games, 5) satisfaction on personal body image, 6) care from the participant's teacher, 7) parents' relation related to each other, 8) relationship with siblings, 9) impact from COVID-19, 10) impact from anti-Asian violence. These questions were incorporated to obtain a more comprehensive list of factors that may influence participants' depression levels. The surveys from many Asian-Americans were collected either a Google form or in person in the Greater Philadelphia area. Totally 403 surveys were collected, with 219 of them obtained from the Google online form while the rest from in-person collection from June 2nd to July 4th in 2021. These 403 participants consist of 190 male students, 208 female students and 5 students who considered them in other gender categories (not specified).The average age of all participants is 16.07 ± 2.40, with the minimum and maximum ages 12 and 19, respectively. Around 64% of students were from public schools, while the rest attended private schools.

Analysis of survey result distribution

The survey data was saved in a Comma-Separated-Value (CSV) file, with samples in rows and questions in columns. In order to process the data in the R language, each column was assigned a factor (i.e., variable) that reflected the corresponding question. For example, a variable named Gender was assigned to the column for the question on gender. The depression levels of survey participants were quantified according to the PHQ-9 approach. To build the quantitative model between the questions (i.e., factors) and the depression levels, the multiple-choice options were digitized in the scale of 1 to 5 for options "Strongly disagree", "disagree", "neutral", "agree", "strongly agree". It should be notice that the quantitative data obtained from the survey only reflect the adolescents' opinion/perception of the topic described in the question statement. They do not completely represent the objective measurement of the variables/factors implied by the survey questions. A similar approach was implemented to other options. For each question, the distribution of participants' responses was obtained

in R and interpreted. For example, the distribution of participants' responses to the question on their daily sleeping time is shown in Figure 1.

Dominance analysis to identify influential factors for depression

Dominance analysis presented in [53,54] was implemented in this work to evaluate the influence on participants' depression levels for each factor that was associated with one question in the survey. It was challenging to conduct dominance analysis for all 48 multiple-choice questions at the same time, due to the large combination options for all 48 factors. Therefore, the factors were generally separated into five groups so that influential factors were identified for each group. The five groups were designed for demographic information (Question 1-6), daily behaviors (Question 7-17), school life (Question 18-24), family life (Question 25-32), and response to depression issues (Question 42-48). The influential factors from each group were combined as a final pool of factors for further dominance analysis to identify the most important factors for the depression levels. Participants' responses to Questions 33-41 were used to quantify their depression levels. The dominance analysis deals with developing linear regress models with increasing number of factors and evaluating the contribution of the addition of each factor to the fitting of the model. The enhancement of the R^2 value, which is a common measure for the goodness of fitting, is used by dominance analysis as an indicator of the contribution of the added factor in the model. A larger enhancement of R^2 value indicates a larger contribution of the added factor for improving the fitting of the model to the data. This work does not aim to develop a prediction model that fit the depression data perfectly. Instead, the R^2 values were used to evaluate the impact of the added factors to the fitting to the depression data.

The data for the group of factors related to daily behaviors is used an example here to illustrate the general procedure of dominance analysis. The "dominance analysis" package in R was implemented for the corresponding calculation.

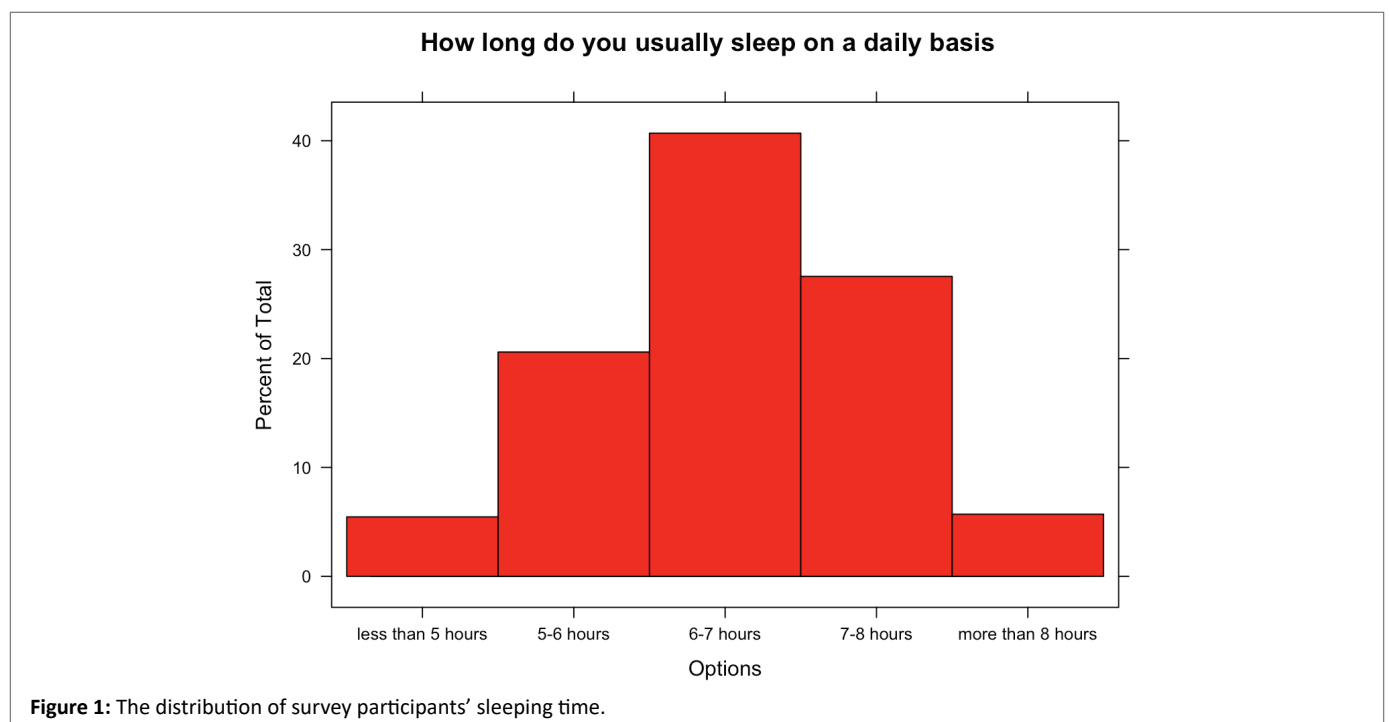**Figure 1:** The distribution of survey participants' sleeping time.

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Step 1: The enhancement of the R^2 value was calculated for the linear regression model that only one factor is considered. According to reference [53,54], 70% of the samples were used to build linear regression models while the rest of samples were saved to test the developed models. The results for the daily-behavior factors were shown in the row "Level 0" in Figure 2A and supplemental Table S1. Level 0 means only one factor was included in each regression model. It can be seen from Figure 2A that the R^2 value was enhanced 0.144 when Sickness was used as the only factor in the linear regression model. Similarly, the enhancement of the R^2 value for other behavior-related factors can also be found in Figure 2A. A small R^2 value means little improvement of the model if the corresponding factor is added into the model (e.g., Smoke).

Step 2: One additional factor was added at a time into the linear regression model, and the enhancement of the R^2 value was recorded. For example, when the factor Drugs was added into the model with Alcohol as the only factor, the R^2 value was enhanced by 0.003 (referred to supplemental Table S1). On the other hand, adding Sickness enhanced the R^2 value by 0.142. The enhancement of the R^2 value was thus quantified when two-factor linear regression models were built. These models are called Level-1 models in dominance analysis [53,54]. Step 2 was iteratively implemented so that the enhancement of the R^2 value of models with adding all possible combinations of factors was evaluated.

Step 3: To evaluate the contribution of each factor in enhancing the R^2 value, the mean value of the R^2 enhancements was calculated for the model with different numbers of factors (i.e., different levels, with Level 0 for one factor, Level 1 for two factors and so on). As seen in Figure 2A, the enhancement of the R^2 value generally decreases as the number of factors increases in the model. This is due to the fact that the models have more factors typically fit

the data better (with a larger R^2 value). There is smaller room for further enhancement of R^2.

Step 4: The mean enhancement of the R^2 value across all levels of models (i.e., with all possible combination of factors) was finally calculated and used as the indicator of the influence of each factor on the depression level. Figure 2B shows the mean enhancement of the R^2 value for each factor included in the model. It seems that the Body image, Sleep, Sickness, and Food are among the dominant factors in the daily behavior group on the depression levels.

Step 5: The dominant factors in each of the five categories of factors, which were defined as the factors with a mean R^2 enhancement value larger than 0.05 to reduce the number of factors, constructed a new pool of factors for another dominance analysis (i.e., Step 1-4) to find the global dominant factors on the depression levels of survey participants. As seen in Figure 2A, the contribution to R^2 for those dominant factors is typically the largest when only that dominant factor is contained in the model (e.g., body image and sleep). The R^2 enhancement values of all factors at Level 0 (i.e., with only one factor) were further used to confirm the significance of global dominant factors. The result of the global dominance analysis will be shown in the results section.

Bootstrap analysis and two-sample t-test to validate the results from dominance analysis

Bootstrap analysis and two-sample t-test were the two approaches used in this work to validate the results from the dominance analysis. In Bootstrap analysis, a random sample set composed of the original data was used to generate a new data set to test the accuracy of the dominance analysis previously made. For each new data set, the dominance analysis was conducted by following the steps shown in Section 2.3. Typically, 100 new data sets are recommended for dominance analysis [53,54]. The mean enhancements of the R^2
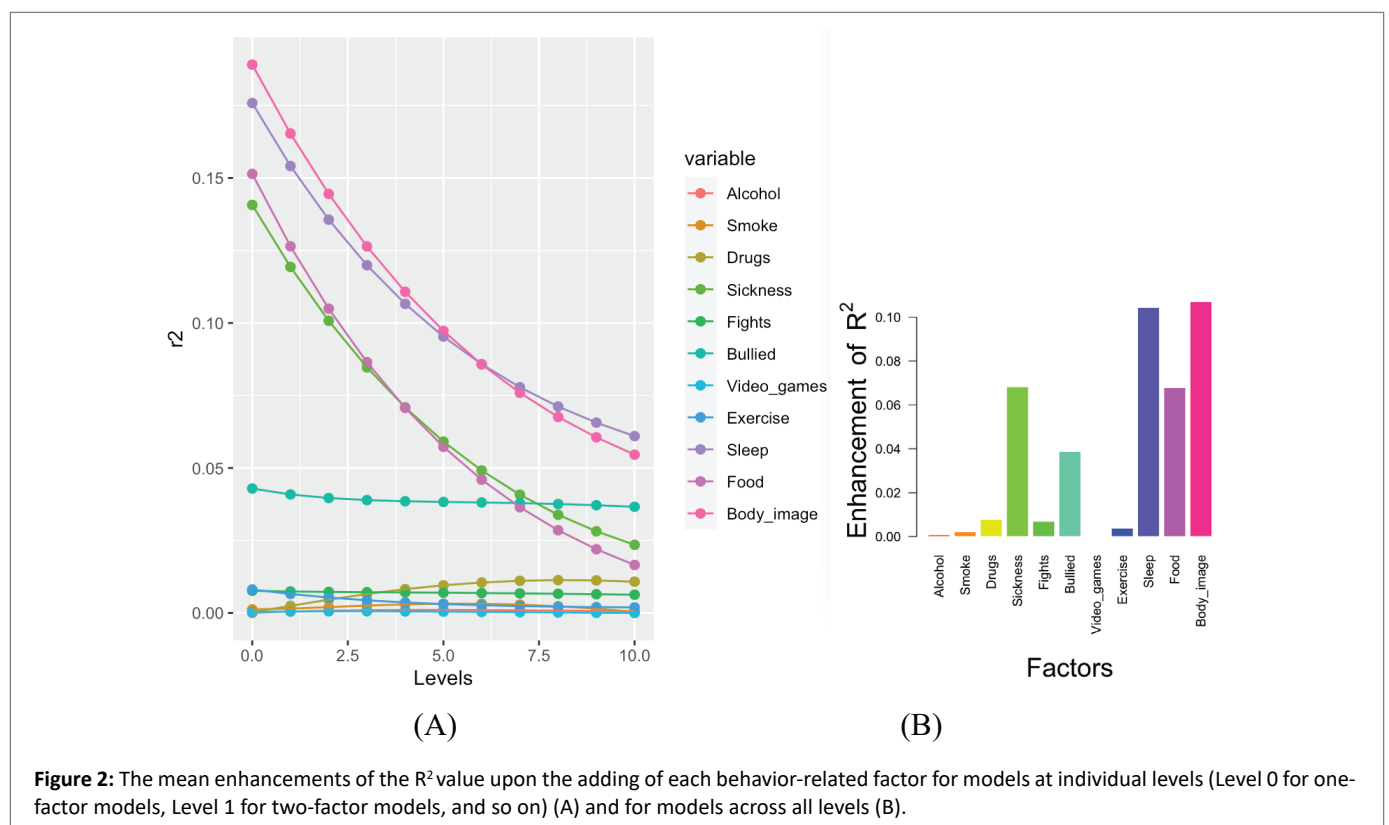
Figure 2: The mean enhancements of the R^2 value upon the adding of each behavior-related factor for models at individual levels (Level 0 for one-factor models, Level 1 for two-factor models, and so on) (A) and for models across all levels (B).

values (as shown in Figure 2B), along with the ranking of the selected factors, were calculated and compared with their original values in the dominance analysis. The Bootstrap analysis package "boot Average Dominance Analysis" in R was used for conducting the analysis.

Another approach of validation on the dominance analysis result was conducting two-sample t-test for those dominant factors. For example, Body image was found as the top factor in the behavior-related factors (Figure 2). The depression levels of participants who were happy with their body image were hypothesized as the same as those of participants who were not happy with their body image (i.e., the null hypothesis) in the t-test. The alternative hypothesis was participants happy with their body image had lower depression levels than those not happy with their body image. The command t-test in R was used to conduct the two-sample t-test. It turned out that the alternative hypothesis is true, with the p-value of 8.651e-14. A similar approach was implemented to validate the influence of the dominant factors identified from the dominance analysis.

Results

There is a lack of conclusive studies on depression regarding mental health in Asian American adolescents, and more specifically, the quantitative relationship between the influential factors and the depression levels in Asian American adolescents has not been systematically studied. To address this, this section first summarizes the response of participants' response to individual survey questions and then presents the dominance analysis on the factors associated with individual questions.

Investigate participants' responses to individual survey questions

The histograms of participants' responses to individual were plotted and interpreted. Participants' responses are summarized below for each category of questions.

Responses on demographic information (Question 1-6): The number of males and females taking this survey was roughly equal. A small percentage of participants identified themselves as other genders. The age of survey takers ranged from 12 years old to 19 years old. The most common age of participants was 17, followed by 16 years old and 15 years old. There are an equal number of participants residing in an urban or suburban environment with a small percentage of participants living in a country environment. Most participants taking this survey had a weighted Grade-Point-Average (GPA) of 3.5 to 4.5. Most participants have taken at least one Advanced-Placement (AP) course. However, nearly one third of participants haven't taken an AP course.

Responses on daily behaviors (Question 7-17): Question 7-15 surveyed participants their behaviors in the two weeks prior to taking the survey. It turned out that: roughly 85% of participants did not take more than a sip of alcohol; approximately 99% of participants did not smoke; over 95% of participants did not use marijuana, cannabis, or other drugs; over 90% of participants have not been in a physical fight; and an overwhelming 95% of participants were not bullied. Roughly 50% of the participants were not sick. Nearly 33% of participants felt sick for several days. A small percentage of participants either felt sick for more than half of the two weeks or nearly every day. Approximately 45% of participants played video games for more than 20 minutes nearly every day. Around 80% of participants played video games for more than 20 minutes a day, with 42% playing video games nearly every day. As for the time for daily exercise, around 85% of participants exercised for 20 minutes to 2 hours. Approximately 40%

of participants slept for 6-7 hours on a daily base. Roughly 25% of participants slept for 7-8 hours, and around 20% of participants slept for 5-6 hours. Roughly 50% of the participants agreed to be happy with the food they ate, with an additional 10% being very happy. Approximately 10% of participants were unhappy with the food they ate. Roughly 40% of participants were happy with their body image, while 25% of participants were not happy with their body image.

Responses on school life (Question 18-24): Around 34% of participants agreed or strongly agreed with that they felt peer-pressure at school. Approximately 70% of participants agreed or strongly agreed that they had a close friend to count on if they had any problems. Only a small minority, around 9%, felt they did not have a close friend to rely on. Approximately 75% of participants agreed that their friends did not use drugs. However, roughly 11% of participants agreed or strongly agreed that their friends used drugs. Roughly 61% of participants agreed or strongly agreed that their friends and classmates did not exclude them from parties or events. Around 14% of participants felt that their friends and classmates excluded them from parties or events. Approximately 60% of participants did not have questioned their sexual identity. However, roughly 22% of participants agreed or strongly agreed that they had questioned their sexual identity. Roughly 57% of participants agreed or strongly agreed that their teachers cared for them. Nearly 12% of participants did not think their teachers cared for them. A vast majority of participants, approximately 75%, agreed or strongly agreed that they had finished their school assignments on time. Only around 13% of participants claimed they did not finish most of their school assignments on time.

Responses on family life (Question 25-32): Most participants, roughly 75% of participants, lived with their parents. Roughly 55% of participants claimed they did not fight with their parents often, while approximately 24% of participants agreed that they had fights with their parents often. Most participants, roughly 64%, stated that their parents liked their close friends. Only around 12% of participants claimed their parents disliked their close friends. Approximately 56% of participants believed their parents had a good relationship with each other, but about 18% of participants felt their parents had a poor relationship with each other. Roughly 50% of participants get along with their siblings, while around 15% of participants claimed they did not get along with their siblings. Approximately 42% of participants did not know whether their parents treated their siblings better than them or not. Around 32% of participants claimed their siblings were not treated better, while roughly 26% of participants felt their siblings were treated better. Approximately 62% of participants did not have any family members with serious health issues. Roughly 18% of participants did have family members with serious health issues.

Responses on depression level quantification (Questions 33-41): These questions were designed in the PHQ-9 method to quantify participants' depression levels in the two weeks prior to taking the survey. In the two-week time frame, a certain percentage of participants have felt little interest or pleasure while doing things for several days (42%), more than half days (12%), nearly every day (8%). The percentages of participants felt down or hopeless for several days, more than half days, and near every day during the two-week period were 40%, 9% and 7%, respectively. Around 42%, 10%, 12% of participants had trouble in sleeping for several days, more than half days, and near every day. Around 27% of participants stated they had problems with their appetite for several days, and an additional 18% had issues with their appetite for more than half or nearly every day. Around 41% of participants had feelings of failure for several days, and roughly 20% felt like a failure for more than half or nearly every

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day of the two weeks. A little less than 40% of participants stated they had trouble concentrating for several days, and roughly 17% experienced issues for more than half or nearly every day of the two weeks. The majority of participants, roughly 52%, noted that they felt tired for several days during the two weeks prior to taking the survey. Approximately 21% of participants felt tired or had little energy for more than half or nearly every day. Around 15% of participants felt sluggish or restless for several days, while roughly 10% of participants had this issue for more than half or nearly every day. Roughly 20% of participants had thoughts of suicide for several days, while an additional 10% experienced these thoughts for more than half or nearly every day.

While the above paragraph shows the percentages for individual response options on the PHQ-9, the following lists the mean score for each question, with 0 for "not at all", 1 for "several days", 2 for "more than half the days", and 3 for "nearly every day" in the last two weeks: 1.04 for feeling little interest or pleasure, 0.84 for feeling or hopeless, 1.05 for trouble in sleeping, 1.20 for feeling tired, 0.70 for appetite problems, 0.92 for feelings of failure, 0.84 for trouble concentrating, 0.35 for feeling sluggish or restless, and 0.44 for thoughts of suicide. The mean of the sum score of all individual response options on PHQ-9 is 7.37. The sum score of the PHQ-9 standard is typically used to indicate whether the participant has minimal depression (score 1-4), mild depression (score 5-9), moderate de- pression (score 10-14), moderately severe depression (score 15-19), and severe depression (score 20-27). While the aforementioned score 7.37 indicates a mild depression level was found in most survey participants, certain participants obtained scores for moderate de- pression (17.12% of participants), moderately severe depression (4.96%), and severe depression (5.46%).

Participants' responses to depression issues (Questions 42-48): Roughly 47% of participants noted they first experienced symptoms of depression during middle school (Grades 6-8). Approximately 36% of participants stated they experienced these symptoms during high

Figure 3: Dominance analysis for the six factors in the Demographic Information group.

school (Grades 9-12). Roughly 27% of participants note they would seek mental health services. However, a staggering 40% of participants state that they would not seek mental health services if they felt troubled. Many participants (around 48%) held a neutral stance as to whether they received strong support from their school, and approximately 25% felt they did not receive strong support. Approximately The largest portion of participants (42%) stated that they received strong support from their family. However, roughly 30% noted that they did not receive strong support. Roughly 43% of participants believed that the COVID-19 pandemic did contribute towards their stress levels. However, approximately 34% of participants claimed the COVID-19 pandemic did not impact their stress levels. Nearly 50% of participants held a neutral stance on whether the anti-Asian hate violence has contributed to their stress. Roughly 32% of participants noted that the violence had impacted their stress levels, while 18% of participants claimed it had not.

Dominance analysis

Due to the large number of factors considered in the survey, factors were separated into five groups for the dominance analysis. The dominant factors from each group were combined for another dominance analysis so that the most influential factors on participants' depression levels were identified.

Dominance analysis of demographic factors: The six factors in the demographic information group (Questions 1-6) were analyzed. Figure 3 suggests that the gender is the most significant demographic factor, followed by GPA, the number of AP courses taken, the location of the participant's home, the age, the type of participant's school (i.e., private *versus* public).
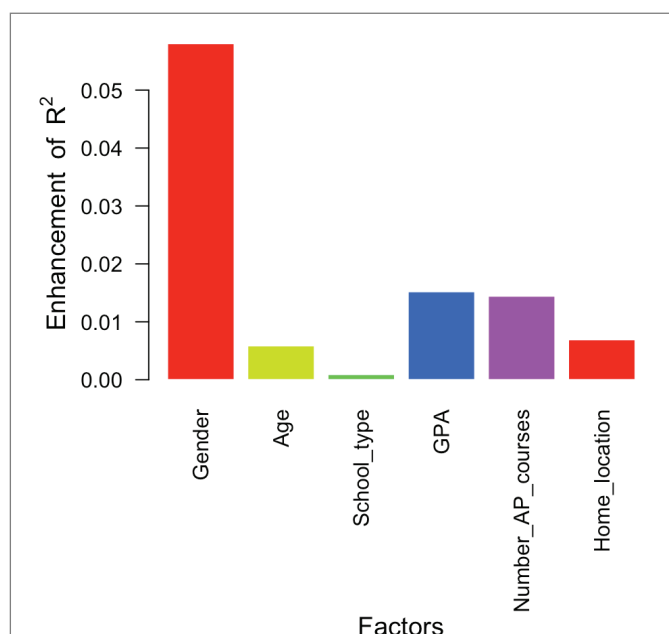
Dominance analysis of behavior factors: The eleven factors (Questions 7-17) in the Daily Behavior group were ranked *via* the dominance analysis in this section. Participants' feeling on their body image was the most dominant factors in this group, followed by the sleeping time, participant's sickness, the food they ate, being bullied, drug usage, physical fights with others, exercise time, smoking, alcohol usage and video game time (Figure 4).

Dominance analysis of factors related to school life: The seven factors (Question 18-24) related to school life was ranked according to the dominance analysis. Figure 5 suggests that peer pressure and sexual identity are the most significant factor, followed by completion of assignments, care from the teacher, being excluded in school, having reliable friends, and whether their friends used drugs.

Dominance analysis of factors related to family life: Among the six factors related to family life (Questions 25-32), Figure 6 suggests that the participants' parents' relationship with each other and fighting with their parents were the most significant factor in the family life group. They were followed by other factors like sickness of family members, whether their siblings were treated better than them, whether their parents liked their close friends and their relationship with their siblings.

Dominance analysis of factors related to participants' response to depression issues: The six factors related to participants' response to depression issues (Questions 42-48) were ranked. Figure 7 indicates that the support from family and the support from the school are the most significant factors in this section. They were followed by the COVID-19 pandemic, the time for them to have depression issues, the anti-Asian violence, and the usage of the mental service.
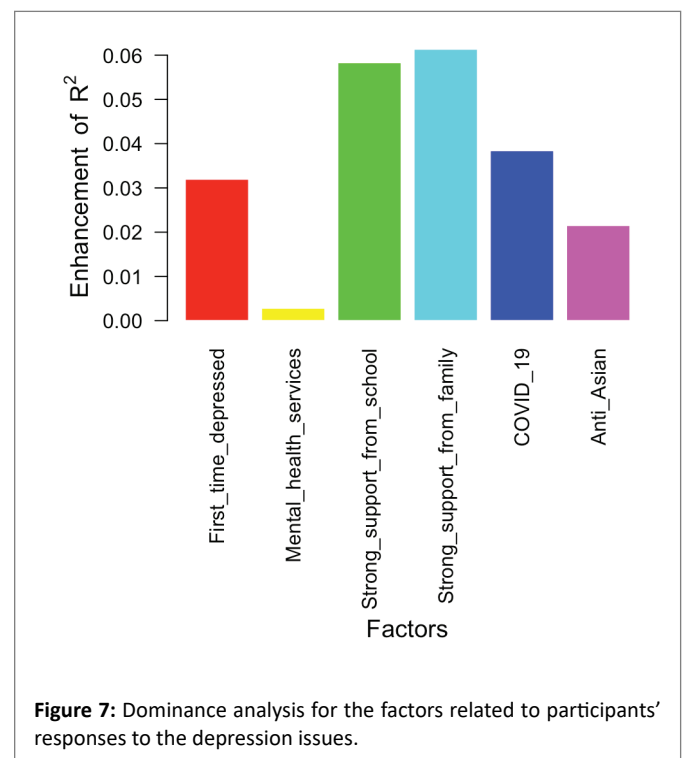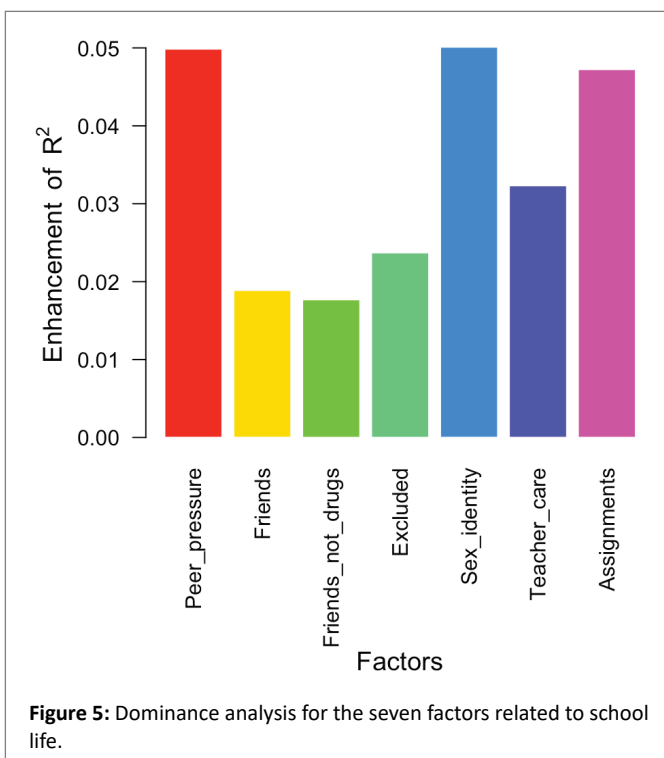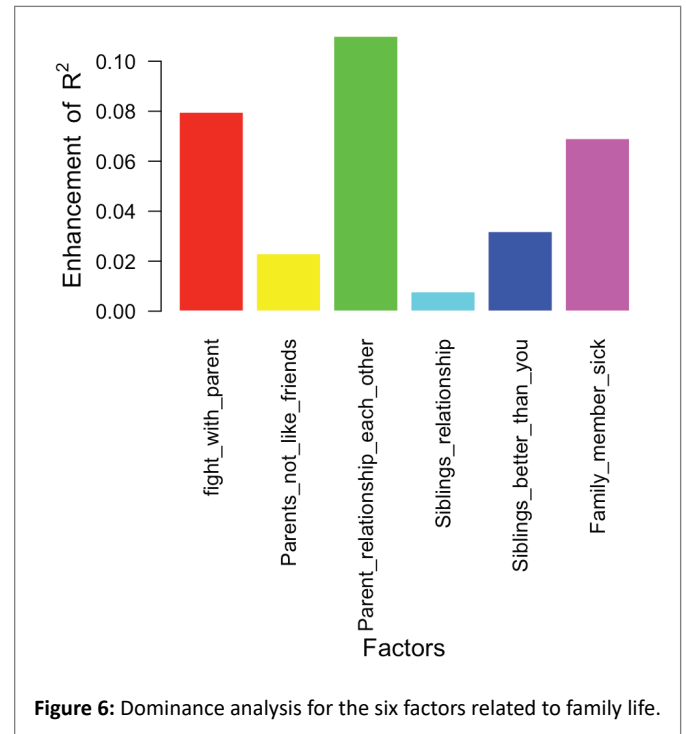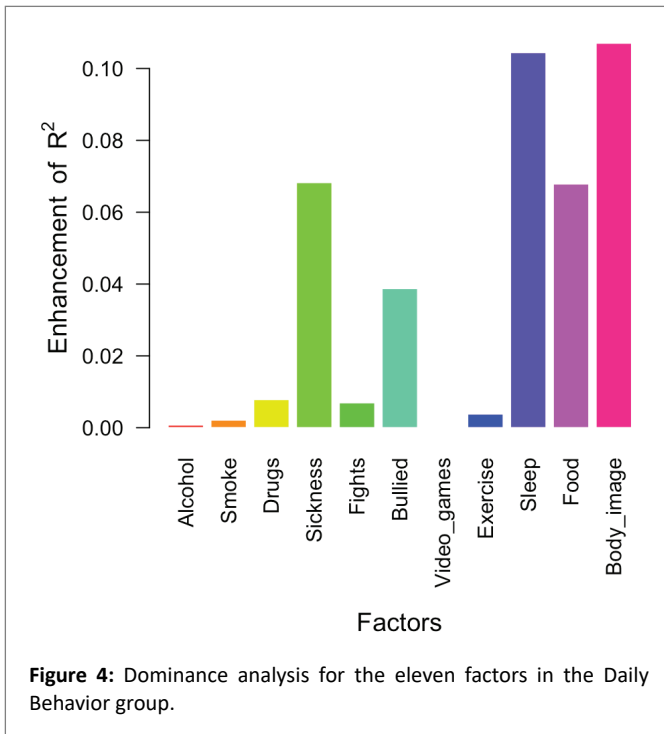
Dominance analysis of the important factors identified in each of the groups of factors: While the important factors are identified

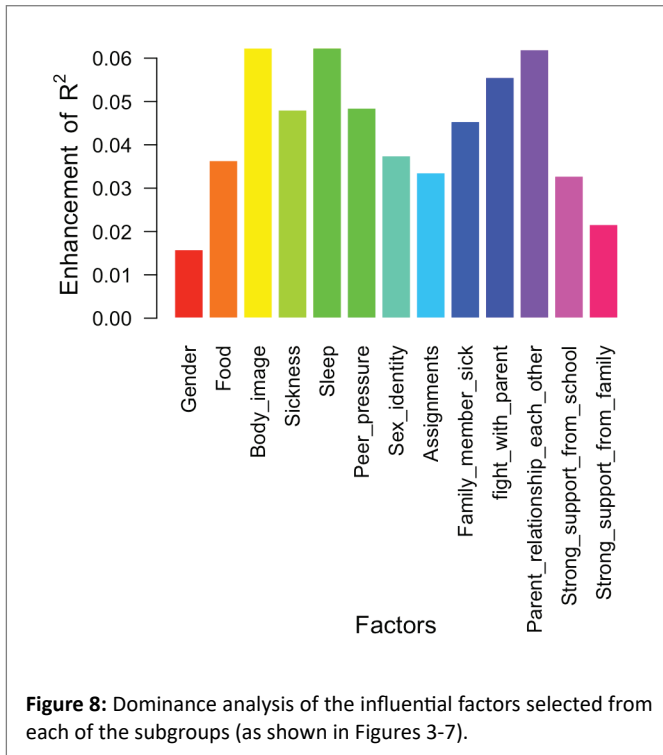**Citation:** Lin S, Fan JM, Zhang V, Chen C, Lam D, et al. (2022) Investigation of the Depression Status of Asian American Adolescents. J Psychiatry Ment Health 7(1): dx.doi.org/10.16966/2474-7769.147

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for the subgroups of factors in the subsections above, it is necessary to conduct another dominance analysis at a global level so that all important factors are evaluated together to find the most dominant factors. Thirteen factors that contributed to an average R^2 enhancement of 0.05 were selected from the dominance analysis of the subgroup factors (i.e., local dominance analysis). While more factors were added in this global dominance analysis, the result on the ranking of the top dominant factors was not changed (results

not shown due to space limitation). The ranking of the selected 13 variables is: participants' parents' relationship with each other, satisfaction with their body image, sleeping time, fighting with parents, peer pressure, participants' sickness, sickness of family members, participants' choice of sex identities, food, finishing school assignments in time, support from school on depression issues, support from family on depression issues, and participants' gender (Figure 8).

Figure 4: Dominance analysis for the eleven factors in the Daily Behavior group.

Figure 6: Dominance analysis for the six factors related to family life.

Figure 5: Dominance analysis for the seven factors related to school life.

Figure 7: Dominance analysis for the factors related to participants' responses to the depression issues.

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Figure 8: Dominance analysis of the influential factors selected from each of the subgroups (as shown in Figures 3-7).

Validation of the importance of the top-ranked factors from dominance analysis

Bootstrap analysis was conducted for each dominance analysis, and the top factors in each dominance analysis remained on the top list. In addition to the validation from the Bootstrap analysis, the two-sample *t*-test was conducted for each factor selected for the global dominance analysis as shown in the previous section. The p-values of the *t*-test for the selected 13 factors in Figure 8 are all below 0.05: p-value as 1.679e-10 for participants' parents' relationship with each other, p-value as 8.651e-14 for satisfaction with their body image, p-value as 8.833e-10 for sleeping time, p-value as 5.728e-14 for fighting with parents, p-value as 1.551e-09 for peer pressure, p-value as 3.391e-08 for participants' sickness, p-value as 1.003e-06 for sickness of family members, p-value as 1.59e-06 for participants' choice of sex identities, p-value as 1.821e-07 for food, p-value as 5.957e-07 for finishing assignments in time, p-value as 4.75e-10 for support from school on depression issues, p-value as 8.673e-10 for support from family on depression issues, and p-value as 3.482e-05 for participants' gender. It is interesting to see that the top four factors (i.e., participants' parents' relationship with each other, satisfaction with their body image, sleeping time, and fighting with parents) generally have smaller p-values than other factors. These small p-values validated the significance of the impact of these top factors on participants' depression levels.

Discussion

Important factors that influence the depression in Asian American adolescents

The quantitative relationship between the influential factors and the depression levels in Asian American adolescents has not been systematically studied. This study designed a survey with 48 questions to systematically investigate the influence of all possible factors on the depression levels of Asian American adolescents. The top 13 dominant factors identified from this study are participants' parents' relationship with each other, satisfaction with their body image, sleeping time, fighting with parents, peer pressure, participants' sickness, sickness of family members, participants' choice of sex identities, food, finishing school assignments in time, support from school on depression issues, support from family on depression issues, and participants' gender. Some of these factors have been found as influential factors causing the depression issues in Asian American adolescents, such as fighting with parents [16], peer pressure [55], finishing school assignments in time [56], sleeping time [57]. It was found in this study that female participants generally had higher depression levels than male participants (p-value 3.482e-05). This is also consistent with the literature [58].

This study contributes to the literature by identifying some factors have not been well recognized for their influence on the depression of Asian American adolescents. Some of these factors are of value for us to take actions for helping Asian American adolescents. For example, improving parents' relationship with each other and providing more support from the family and school are among these factors. Certain of these factors may be related to the acculturative stress of Asian American immigrants. For example, the difference in values between the adolescents from a newer generation and the often immigrant parents may cause conflict in the choice on food, and clothes or other things important for adolescents' body image. In addition, participants' choice of sex identities is another factor that is typically ignored by Asian American parents. The choice of nontraditional sex identities is generally stigmatized in the older generations of Asian Americans. However, this is a factor that should not be ignored. When comparing the rate of suicidal attempt and injury by suicidal attempt between the two groups in a study focusing on disparities in suicidal behaviors by sex and sexual identity among Asian American adolescents, there is a clear disparity towards LGBTQ+: with 41% of those that identified as LGBTQ+ attempting suicide compared to 5.5% of the others, and 17.6% of LGBTQ+ participants being injured by suicidal attempts compared to 1.7% of the others [15]. The aforementioned factors should be considered in helping Asian American adolescents against depression.

It was hypothesized in this study that the dominant risk factors for Asian American adolescents might be different from American adolescents in general, due to the model minority stereotype and the anti-Asian violence. A closer examination of the dominant factors identified for Asian American adolescents indicate that this is not the case. The risk factors associated with model minority stereotype (e.g., GPA, number of AP courses taken) and anti-Asian violence were not as significant. The COVID-19 pandemic, which was related to anti-Asian violence, was not a dominant risk factor either. On the other hand, the top 13 risk factors identified in this study have also been recognized for their influence on the depression symptoms in American adolescents, in general. For example, improving parents' relationship with each other and with participants correlates with lesser depression symptoms in participants and lower PHQ-9 scores. As found in past research, family cohesion proves to be among the important factors to fewer depression symptoms for American adolescents [59] and seems to be the same for Asian American adolescents as well [60]. Certain of these factors may be related to the acculturative stress of Asian American immigrants. For example, the difference in values between the adolescents from a newer generation and the often immigrant parents may cause conflict in the choice of food, clothes, physical traits, or other aspects important for adolescents' body image [61].

Approaches for supporting Asian American Adolescents in combating depression

The ultimate goal of this study is to find effective approaches for helping Asian American adolescents in combating depression. This study indicated that roughly 47% of participants noted they first experienced symptoms of depression during middle school (Grades 6-8), however, roughly 27% of participants noted they would seek mental health services. In addition, more than 25% of participants felt they did not receive strong support from their schools, while roughly 30% of them noted that they did not receive strong support from their families. This is consistent with the dominance analysis results, which indicated that support from the school and support from the family were among the influential factors for the depression levels of Asian American adolescents. Since adolescents spend most of their time either at home or in schools, effective support from families and schools is essential for helping them with the depression issues.

As for the support from families in helping adolescents with depression issues, here are some approaches implied from this study:

1)   Both parents and the child should take parent-child programs that can discuss certain subjects about effective communication between parents with each other, effective parent-child communication, and deep conversation on mental health, sex identity, and academic expectation. These programs offer adolescents the support many have stated that they may not get from their parents. For example, parents should offer the child reasonable authority on the choice of food and body image (two influential factors identified from this study).

2)   Parents should pay attention to the child's symptom of early depression and seek help from professional mental-health service. This study indicated that adolescents may show depression issues when they start middle school study. The environment Asian American adolescents are raised in may also have an impact on the stigma towards mental health. This lack of usage is likely caused by a stigma, as literature suggests that those who hold onto the values of Asian culture are more likely to view seeking professional help for mental health as a weakness. Asian American parents should attend introductory programs on adolescent mental health and not avoid facing the child's mental issues.

3)   Parents should build a community effectively connecting parents, siblings/relatives (if applicable), the child's close friends, and mental-health consultants. Someone in this community should really listen to the child for talking about problems and provide supportive suggestions. Talking with friends about depression problems was shown as the major approach used by Asian American adolescents in this study. Since participants' friends may not find the best solutions for the problems, connecting them with parents and mental-health consultants is important for a quick effective response to the child's mental health issue.

4)   Parents and the child should try to find effective approaches for releasing stress. The importance of grades was emphasized throughout survey responses. Instead of imposing more pressure or working load, the parents should communicate with the child and the child's teachers to set a reasonable expectation on the child's grades. In addition, parents should let the child have enough sleep and inspire the child to find extracurricular interest to release stress. The mostly mentioned approaches in the survey include sports, reading, music, writing and drawing. A reasonable amount of online interactions (in social media) and video games may be helpful for adolescents to release stress.

The following support from schools was implied/mentioned in this study by the participants to help them with the depression issues:

1)   The school should make the mental health resources/counselors more accessible. Since mental health issues are stigmatized in the Asian culture, Asian parents pay more attention to the physical symptoms. If adolescents cannot get parents' awareness of their depression issues, accessible mental health resources at schools can offer them another chance to realize the depression issues. As shown in this study, only a small portion of Asian American adolescents would seek help for mental health service. It is beneficial to adolescents if the mental health service team/counselors can set up checkup meetings with them from time to time (e.g., quarterly checkup). In addition, schools should provide basic seminars/lectures on mental health and how to realize and handle depression issues.

2)   The school should provide inclusive environment for various race and ethnic groups. Since Asian Americans are minority groups in populations, they may feel how they look different from the majority of their classmates. The satisfaction of their body image was turned out as one of the top influential factors on their depression levels in the dominance analysis. It is essential for schools to develop a supportive, and equitable environment that makes Asian American adolescents feel both welcomed and included in classrooms, especially against the anti-Asian violence in this still ongoing COVID-19 pandemic.

3)   The school should develop some friendship building activities for various race and ethnic groups. As shown in this study, talking with friends is the most favorite approach used by participants to release stress. As a minority group in schools, some Asian American adolescent may not find friends. Designing activities that inspire the collaborations between various race and ethnic groups will be beneficial to help students to make new friends.

4)   An effective communication channel between the school and the family should be developed to help adolescents identify and combat the depression issues. This channel can help parents and teachers work together and respond to the child's depression issues in a timely manner. This channel can be set up *via* the mental health service of the school so that parents and teachers can obtain help from mental health experts in time.

Limitations

While this study aims to conduct a comprehensive and quantitative analysis of factors that may contribute to the depression of Asian American adolescents, the results and conclusions were based on the survey results of 403 participants, mainly from the Philadelphia Metropolitan Area. The data collected from the survey only reflect the perception of the participants on the factors/variables implied by the survey questions. They are not actually objective measurements of those variables. Therefore, the results might change if a different population of Asian American adolescents were surveyed. More samples would be helpful to reduce the subjective effect on the analysis result, but they could only be collected if the COVID-19 pandemic was gone. More samples are needed from various locations to get the results that are reflective of Asian-American adolescents as a whole in the US. This can only be done by a federal agent after COVID-19 pandemic. The conclusions of this study are mainly applied to Asian American adolescents, although some findings may be of value to other race and ethnic groups. The survey questions and dominance analysis approach can be also used to study the influential factors for the depression issues of other race and ethnic groups.

The 48 questions (i.e., factors) in the survey were based upon a thorough literature review. The large number of questions makes it challenging to categorize them. Some questions could be put into multiple categories. For example, COVID-19 and anti-Asian violence could be considered for the daily-behavior category, while family member sickness could have significant impact on daily life. However, the way for categorizing these variables/factors does not affect the dominance analysis, as the important factors stand out with a relatively large R^2 contribution, no matter what categories they are input into. The number of questions was not designed too large to make the survey too long, which might result in a low return rate in collecting surveys. Some factors of potential impact to adolescents' depression levels were not included though. For example, the socioeconomic status of participants was not included in the survey at the beginning. It was added into the survey at the end so that 44 samples returned the related information. The result indicated 88.6% of these 44 participants did not have financial issues in their families. Since the data for this item was not complete, it was not included in the dominance analysis. A question should have been designed to evaluate the impact of social media, as adolescents might use social media to seek for help or suggestions. Another limitation in the survey design is that certain questions did not give participants' options to opt out. For example, participants who did not have siblings picked a neutral opinion on sibling-related questions. These limitations should be considered in the future survey design for studying the depression issues.

Conclusions

Recognizing the most influential factors that influence depression is crucial to reducing the rate of depression. It gives insight on the subjects that need to be addressed to combat depression. This study conducted a comprehensive and quantitative investigation of the factors influencing Asian American depression. Dominance analysis revealed that participants' parents' relationship with each other, satisfaction with their body image, sleeping time, fighting with parents, peer pressure, were the most significant out of all the factors. The dominant risk factors were found similar between Asian American adolescents and general American adolescents, and the risk factors related to model minority stereotype and anti-Asian violence was not as significant as hypothesized. Certain participants would like for parents and school to support them more to reduce their pressure. Talking to friends was found as the major approach used by survey participants to release stress, rather than seeking mental health services. This study implied that it would be beneficial for Asian American parents and children to attend parent-child program effective communication between parents with each other, effective parent-child communication, and deep conversation on mental health, sex identity, and academic expectation. A more inclusive environment at schools, along with more accessible mental health recourses, would also be helpful. A future study would need a larger sample size, more diverse socioeconomic statuses, and more questions relating to new technologies such as social media.

Conflicts of Interest

The authors declare no conflict of interest.

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Supplemental Materials

Supplemental Table S1 (the enhancement of R for linear regression models of single and multiple factors related to survey participants' daily behaviors).

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Supplementary Table S1: The enhancement of R for linear regression models of single and multiple factors related to survey participants' daily behaviors.

	Alcohol	Smoke	Drugs	Sickness	Fights	Bullied	Videogames	Exercise	Sleep	Food	Body image
Level 0	0.002	0.000	0.001	0.144	0.009	0.033	0.001	0.006	0.126	0.123	0.191
Alcohol		0.000	**0.003**	0.142	0.009	0.032	0.001	0.006	0.123	0.122	0.196
Smoke	0.002		0.002	0.144	0.009	0.034	0.001	0.006	0.126	0.122	0.191
Drugs	0.004	0.001		0.143	0.010	0.038	0.001	0.006	0.130	0.127	0.192
Sickness	0.000	0.000	0.000		0.007	0.020	0.000	0.002	0.073	0.063	0.133
Fights	0.002	0.000	0.002	0.142		0.028	0.001	0.006	0.128	0.124	0.194
Bullied	0.002	0.001	0.006	0.132	0.005		0.001	0.005	0.132	0.113	0.178
Videogames	0.002	0.000	0.001	0.143	0.009	0.033		0.005	0.125	0.124	0.193
Exercise	0.003	0.000	0.001	0.140	0.009	0.032	0.000		0.123	0.117	0.187
Sleep	0.000	0.000	0.006	0.091	0.012	0.039	0.001	0.004		0.072	0.135
Food	0.002	0.000	0.006	0.085	0.011	0.023	0.003	0.001	0.075		0.102
Body image	0.007	0.000	0.002	0.086	0.012	0.020	0.003	0.002	0.070	0.034	
Alcohol+Smoke			0.003	0.142	0.009	0.034	0.001	0.006	0.124	0.122	0.196