Master of Public Health

Master de Santé Publique

Longitudinal Analysis of Mental Health Well-being among Young Adults in France during and after the COVID-19 pandemic

Aditi MANANDHAR

Europubhealth 2023 - 2025, Master II

Location of the practicum:

UMR 1295 CERPOP - Centre for Epidemiology and Research in POPulation Health

INSERM, University of Toulouse

Toulouse, France

Professional advisor:

Pierre-julien COULAUD

Post-doctoral researcher

CERPOP, University of Toulouse

Academic advisor:

Mélanie BERTIN

Associate Professor, EHESP

Acknowledgements

I would like to express my deepest gratitude to my advisors, Dr. Pierre-julien Coulaud and Dr. Mélanie Bertin, for their unwavering guidance, expertise, and encouragement throughout this research journey. Their insightful feedback and patience were invaluable in shaping this work. I also extend my sincere thanks to my thesis co-supervisors, Dr. Michelle Kelly Irving, and Dr. Rod Knight, for their rigorous critiques and thoughtful suggestions, which greatly strengthened the study. This project benefited immensely from collaborations with the FOCUS and EQUITY teams, and I am grateful for their contributions. I acknowledge the generous support provided by the EQUITY team from the Centre for Epidemiology and Research in POPulation Health (CERPOP), without which this research would not have been possible. I would also like to take the opportunity to thank all the participants who took part in the FOCUS survey.

A special appreciation goes to The University of Sheffield (UoS) and École des Hautes Études en Santé Publique (EHESP) for not only providing the academic foundation and resources that made this work possible, but also for fostering an environment of excellence in public health research. The knowledge, mentorship, and opportunities I gained during my time at the UoS and EHESP have been instrumental in my growth as a researcher.

On a personal note, I am deeply thankful to my family and friends for their constant support, understanding, and motivation during this rewarding journey. Finally, I recognize the foundational work of countless researchers in this field, whose pioneering efforts made my own exploration possible.

Table of Contents

List of Tables

List of Figures

List of Supplementary Tables and Figures

List of acronyms

CERPOP	Centre for Epidemiology and Research in POPulation Health
COVID-19	Coronavirus disease 2019
FOCUS	France-Canada Observatory on COVID-19, Youth Health and Social Well-Being
GDPR	General Data Protection Regulation
PHQ-9	Patient Health Questionnaire- 9
SDC	Sociodemographic characteristics
SEC	Socioeconomic characteristics
SEI	Socioeconomic index
SEP	Socioeconomic position
STROBE	STrengthening the Reporting of OBservational studies in Epidemiology

Longitudinal Analysis of Mental Health Well-being among Young Adults in France during and after the COVID-19 pandemic

Abstract

Background: The COVID-19 pandemic has had a profound impact on young adults' mental health, with higher depression prevalence in specific groups (e.g., sexual and gender minority, socioeconomically disadvantaged youth). However, it remains unclear whether these mental health inequities evolve during and after the onset of the COVID-19 pandemic.

Objective: To describe the prevalence of depressive symptoms among young adults during and after the COVID-19 pandemic; to examine the association between social determinants (i.e., gender, sexual orientation, socioeconomic position) and depression, and to explore the effect of the different phase of the pandemic on this association.

Methods: Repeated cross-sectional data from the three online FOCUS surveys among young adults aged 18-29 years in 2020: n= 2,600; 2021: n= 1,796 and 2023/2024: n= 598. Depressive symptoms were measured using the Patient Health Questionnaire-9. A socioeconomic index was created using education, employment status and income. Multivariable logistic regression models were performed separately across the three waves. To test the moderation effect, an interaction term between FOCUS survey wave and equity-deserving groups was used.

Results: Overall, 47% of young adults reported depressive symptoms in 2020, 41% in 2021, and 55% in 2023/2024. Across all waves, women, gender minorities, sexual minorities and youth with a low socioeconomic index were more likely to report depressive symptoms. Depression significantly decreased in 2021 (AOR = 0.84 [0.74–0.96]) and then increased in 2023/2024 (AOR = 1.49 [1.23–1.79]). Interaction models showed that the strength of associations between social determinants and depression remain significant across waves.

Conclusions: Mental health disparities persist among equity-deserving young adults, during and after the pandemic. Findings highlight the need for targeted, equity-focused mental health interventions and policies.

Keywords: COVID-19, Depression, Equity-deserving groups, Young adults.

Analyse longitudinale du bien-être en santé mentale chez les jeunes adultes en France durant et après la pandémie de COVID-19

Résumé

Contexte : La pandémie de COVID-19 a eu un impact profond sur la santé mentale des jeunes adultes, avec une prévalence plus élevée de la dépression dans certains groupes (par exemple, les minorités sexuelles et de genre, les jeunes en situation socioéconomique désavantagés). Cependant, il reste incertain si ces inégalités en santé mentale ont évolué pendant et après la pandémie.

Objectif : Décrire la prévalence des symptômes dépressifs chez les jeunes adultes durant et après la pandémie de COVID-19 ; examiner l'association entre les déterminants sociaux (genre, orientation sexuelle, position socioéconomique) et la dépression ; et explorer l'effet des différentes phases de la pandémie sur cette association.

Méthodes : Données transversales répétées provenant de trois enquêtes en ligne FOCUS menées auprès de jeunes adultes âgés de 18 à 29 ans en 2020 (n = 2 600), 2021 (n = 1 796) et 2023/2024 (n = 598). Les symptômes dépressifs ont été mesurés à l'aide du questionnaire PHQ-9. Un indice socioéconomique a été créé à partir du niveau d'études, du statut d'emploi et du revenu. Des modèles de régression logistique multivariée ont été réalisés séparément pour chaque vague. Pour tester l'effet modérateur, une interaction entre la vague de l'enquête FOCUS et les groupes en quête d'équité a été analysée.

Résultats : Globalement, 47 % des jeunes adultes ont rapporté des symptômes dépressifs en 2020, 41 % en 2021 et 55 % en 2023/2024. Dans toutes les vagues, les femmes, les minorités de genre, les minorités sexuelles et les jeunes ayant un faible indice socioéconomique étaient plus susceptibles de présenter des symptômes dépressifs. La dépression a significativement diminué en 2021 (OR_a = 0,84 [0,74–0,96]) puis a augmenté en 2023/2024 (OR_a = 1,49 [1,23–1,79]). Les modèles avec interaction montrent que la force des associations entre les déterminants sociaux et la dépression reste significative à travers les vagues.

Conclusions : Les inégalités en santé mentale persistent chez les jeunes adultes appartenant à des groupes désireux d'équité, pendant et après la pandémie. Ces résultats mettent en évidence la nécessité de mettre en œuvre des interventions et des politiques en santé mentale ciblées, fondées sur l'équité et adaptées aux besoins spécifiques de ces populations.

Mots-clés : COVID-19, Dépression, Groupes en quête d'équité, Jeunes adultes.

1. Introduction

1.1 Background/ Literature review

Mental health is a critical component of overall well-being, influencing how individuals think, feel, and behave in daily life. It affects cognitive functioning, emotional stability, and social interactions, playing a key role in personal and professional life (1). Although mental health is a key indicator for assessing overall well-being across the life course, extensive research has established that the onset of mental health problems (e.g., stress, anxiety, depression) occurs during young adulthood (2). For instance, data from the 2019 National Health Interview Survey in the United States showed that the percentage of adults who experienced any symptoms of depression was highest among those aged 18- 29 with 21%, compared to older age groups (ranging from 17% among 30- 44 to 18% among those aged 65 and over) (3). Young adulthood is a crucial developmental stage between 18 to 29 years old, marked by major life transitions, including academic and career development, financial independence, and evolving social dynamics (4–6). At this life stage, young adults may face multiple barriers to access mental health support services, including individual (e.g., low mental health literacy, negative beliefs about help-seeking, mental health stigma) and structural barriers (e.g., lack of tailored mental health resources and services, and financial barriers), further exacerbating their mental health needs and concerns (7–9). Understanding mental health in young adults is essential because early identification and intervention can prevent long-term psychological distress and improve overall well-being (10,11).

From 2020 to 2023, the COVID-19 pandemic has affected young adults' mental health (12). Successive periods of lockdown, social isolation, financial instability, disruptions to education and career plans generated unprecedented levels of uncertainty, contributing to a significant increase in loneliness, anxiety and depression within this population (13–15). However, most research studies on youth mental health during the COVID-19 pandemic have focused on short-term assessments (mostly using cross-sectional data and pre- and during- pandemic comparison) at an early phase of the pandemic (mainly in 2020- 2021), leaving a critical gap in understanding how mental health problems in young adults evolve after the pandemic. First longitudinal studies in this area have documented a significant increase in mental health problems among young adults during the COVID-19 pandemic. For example, longitudinal studies in Norway and the Netherlands reported a significant increase in mental health problems from 2020 to 2021 such as anxiety, depression and loneliness among adolescents (16,17). A critical appraisal of the evidence from longitudinal COVID-19 studies, also highlighted significant increases in depressive symptoms among youth in the United Kingdom during early phase of the pandemic (18). Similarly, a nationwide study of French university

students (18-21 years) found high rates of perceived stress, anxiety, depression symptoms, and suicidal thoughts, 15 months after the pandemic began, with depression rates initially decreasing after the first lockdown before rising again by 22% (19). Therefore, future research is needed to examine the long-term effects of the COVID-19 pandemic on young adults' mental health to inform the development of tailored interventions that can best address their mental health needs in the post-pandemic era.

While previous COVID-19 research studies have provided overall trends in mental health among young adults, research before and during the pandemic has highlighted that specific subgroups of young adults' experience mental health inequities. Previous meta analyses and systematic reviews indicate that young women have experienced a more significant rise in emotional and mental health problems, such as depression and anxiety, compared to young men before and throughout the pandemic (16,20–23). Furthermore, research examining gender inequities in mental health in Canada found that sexual and gender minority youth reported higher levels of mental health problems (e.g., depression, suicide and self-harm), during the pandemic compared to their heterosexual and cis-gender counterparts (24,25). These differences are explained by the higher levels of discrimination, social isolation, and lack of support experienced by sexual and gender minority youth (26–28). It is also well documented that young adults with a disadvantaged socioeconomic position are more likely to experience mental health problems, as reported in a study conducted in Japan in 2020, which found higher levels of psychological distress among low-income groups and younger generations (29). A meta-analysis conducted in the United States during the pandemic also found that women, young adults, individuals from more disadvantaged socioeconomic positions (education, income, unemployment), were highly associated with psychological distress (30). These findings highlight the heightened mental health burden faced by specific subgroups of young adults (e.g., sexual and gender minority, lower-income youth), emphasizing the need for targeted support and interventions to address these mental health inequities. It remains unclear whether the mental health of these subgroups of youth has evolved over time and to what extent these social determinants have influenced their mental health trajectories.

To address these knowledge gaps, it is important to examine social inequities in mental health among young adults during and after the onset of the COVID-19 pandemic to better understand how social determinants, such as gender, sexual orientation and socioeconomic position, have contributed to inequalities in mental health outcomes as well as to inform more equitable public health responses and support services.

1.2 Research Aims and Objectives

Specifically, my thesis report will aim to address the three following research questions: 1) How has young adults' mental health evolved during and after the COVID-19 pandemic? and 2) To what extent did social determinants, such as gender, sexual orientation, and socioeconomic position affect depressive symptoms among young adults? and 3) Did these associations vary across different phases of the pandemic?

To respond to these questions, the present report will use the data collected in France in the *France-Canada Observatory on COVID-19, Youth Health and Social Well-Being* (FOCUS) study – a repeated cross-sectional survey with a nested cohort carried-out during (two successive online surveys in 2020 and 2021) and after (one online survey in 2023/2024) the onset of the COVID-19 related public health measures among a large and diverse sample of young adults living in France and Canada.

During my internship, my first objective was to conduct a brief literature review to identify relevant statistical approaches to analyze repeated cross-sectional study with nested cohort data. My second objective was to describe the prevalence of depressive symptoms across the three online survey waves of the FOCUS study. Then, my third objective was to explore the association of social determinants and depression among young adults at each wave of the FOCUS study, and to assess the effects of FOCUS survey wave on this association.

Based on the existing literature on young adult's mental health, I hypothesized that the prevalence of depressive symptoms among participants in the FOCUS study would decrease as the pandemic progresses, in relation to my first research question. Specifically, those who completed the third survey 2023/2024 will report fewer depressive symptoms compared to those who took part in the 2020 or 2021 FOCUS online surveys. Indeed, previous studies have shown that this may be because early stressors, such as isolation, financial instability, and fear of the unknown, gradually lessen with vaccine availability, and economic recovery (31). Regarding my second research question, I hypothesized that specific subgroups of young adults (i.e., gender, sexual orientation and socioeconomic position) would experience inequities in mental health across different waves of the FOCUS study. Specifically, women may report higher depressive symptoms due to increased caregiving roles, job instability, and emotional sensitivity to stress (32). Non-binary, bisexual, and youth who self-identify as a sexual minority face additional challenges, such as discrimination, healthcare barriers, and social isolation (28). Similarly, young adults from disadvantaged socioeconomic backgrounds would report significantly higher levels of psychological distress. Job loss, housing insecurity, and lack of work options may increase anxiety and depression (33). Education provides foundational skills and is a predictor of future employment and income; lower educational

attainment has been consistently linked to higher rates of depression (34). Unemployment is associated with a significantly increased risk of mental health outcomes (35). Meanwhile, income affects access to basic needs, healthcare, and social life, with low income contributing to chronic stress and increased vulnerability to mental disorders (36).

Lastly, I hypothesized that the FOCUS survey wave would act as a moderator in the relationship between social determinants and depressive symptoms. Specifically, I expected that the association between social determinants and depression would be strongest during the earlier phases of the pandemic (2020/2021), when uncertainty, lockdown measures, and economic instability were most intense (37,38), and that this association would weaken over time (2023/2024), as restrictions and lockdowns eased, vaccines became widely available, and societal conditions began to stabilize (39,40).

2. Methods

2.1 Study design and settings

The FOCUS study was an observational study that aimed to describe the social and health experiences of young adults living in France and Canada during the COVID-19 pandemic. The FOCUS study includes data from three online surveys launched between October 2020 to December 2020 (Wave 1), July 2021 to December 2021 (Wave 2), and June 2023 to April 2024 (Wave 3) among young adults aged 18–29 in France. FOCUS survey in 2020 took place during a rapid surge in COVID-19 infections and coincided with France's second national lockdown, which was slightly less strict than the first. While bars, restaurants, gyms, and other non-essential venues were closed, schools and a broader range of job sectors remained open. Additionally, individual movement was restricted to within a one-kilometer radius from home (37). FOCUS survey in 2021 occurred during a period of easing restrictions, though it overlapped with a Delta-driven surge in cases. In response, the French government introduced a ‘sanitary pass’ in July 2021 to boost vaccination rates, which later became a stricter ‘vaccine pass’ by December, effectively requiring full vaccination for access to most public spaces (38). FOCUS survey in 2023/2024 was conducted after 5 May, 2023, when the World Health Organization had announced that COVID-19 was no longer a public health emergency of international concern and thus, lockdowns were lifted, cases had decreased and societal conditions had largely returned to normal (39,40).

2.2 Participant recruitment and data collection

Participants were recruited through a convenience sampling approach using multiple recruitment strategies. The first FOCUS survey in 2020 was promoted through online

advertisements on social media (e.g., Facebook, Instagram), online posts on the websites of university partners and youth community organizations, as well as press articles and word of mouth. Similar promotional strategies were used to recruit young adults in the 2021 FOCUS survey, with most of the participants recruited through online advertisements on social media. In order to set up a nested cohort, participants who completed the first survey and provided their consent to be contacted were invited by email to participate in the second survey. For the third FOCUS survey, the research team developed partnerships with French organizations providing online mental health support to youth in France (i.e., Fil Santé Jeunes and Nightline) in order to improve the recruitment process and reach diverse profiles of youth. Participants from the first and second survey were also invited to take part in the third survey. To participate in the FOCUS study in France, young adults had to have reached the age of majority in their jurisdiction of residence, which is 18 years old in France and not exceed 29 years of age. The other inclusion criteria were that participants should be a resident in France and be able to fill out the online questionnaire in French. The questionnaire was available on *Qualtrics* and collected data on sociodemographic, COVID-19 experiences, healthcare access and mental health. The questionnaire was first developed in English and then converted to French by two bilingual researchers, one of whom was an English- French translator. Before the launch of each online survey, a pre-test questionnaire involving five voluntary young adults was conducted to ensure that the language and wording used in the questionnaire was appropriate for a young adult sample. Details about the study objectives and potential risks and benefits were outlined on the first page of the questionnaire. Participants were able to withdraw from the survey at any time. To ensure the integrity of online survey and prevent fraudulent submissions, advanced security features were utilized including a Captcha verification question before accessing the survey and detection capabilities to identify false IP addresses, survey duplicates and potential bots (41).

2.3 Study population

For the present report, our study population included young adults who participated in the FOCUS study in France. Our analysis sample included those who had completed the sociodemographic characteristics (including questions about age, gender, sexual identity, birthplace, education, area of residence), as well as the socioeconomic characteristics (including questions about employment, income and living arrangement) and the depression scale. The study population comprised 4,098 participants in 2020, 3,429 in 2021 and 1,753 in 2023/2024, including participants from the nested cohort. To ensure an independent cross-sectional sample, only each participant's first response was retained. This approach was taken to maintain the assumption of independence required for logistic regression analysis and remove within-subject correlation (i.e., repeated responses from the same participants). By

retaining the first response per participant, the dataset was treated as cross-sectional, allowing for more accurate and valid inference from the regression model (42). Participants who selected 'Other' in education (2020: n= 4), employment (2020: n= 2; 2021: n= 1) and living arrangement (2021: n= 6; 2023/2024: n= 5) without providing a specification, as well as those who chose 'Prefer not to say' in all the sociodemographic and socioeconomic variables were excluded (Figure 3). This list wise deletion approach was implemented to ensure that only respondents who completed all relevant items in the sequential order of the FOCUS questionnaire were included in the analysis, thereby maintaining consistency across variables and avoiding complications from partial data. While this approach reduced the sample size, it is commonly used when the missing data is assumed to be random (43,44). It also maintains comparability across analyses and simplifies interpretation in large survey-based studies (45). After this process, the resulting independent cross-sectional sample consisted of 2,600 participants from 2020, 1,796 from 2021 and 598 from 2023/2024. To test whether the FOCUS survey wave had an effect on the association between social determinants and depressive symptoms, data from the three survey waves were pooled in a sample including a total of 4,994 participants.

2.4 Measures

2.4.1 Outcome

Depressive symptoms were collected using the 9-item Patient Health Questionnaire (PHQ-9) (46), a validated scale that contains nine questions to assess the frequency of depressive symptoms over the past two weeks. The PHQ-9 has been translated in multiple languages, including French (47). A study conducted previously has demonstrated that the English and French PHQ-9 versions did not have substantial differences in scoring metrics (48). Each item is rated on a four-point Likert scale from “not at all” (=0) to “nearly every day” (=3) with a total score ranging from 0 to 27. The scores are classified as 0–4 (minimal depression), 5–9 (mild depression), 10–14 (moderate depression), 15–19 (moderately severe depression), and 20–27 (severe depression) (46). Cronbach's alpha coefficient was 0.89 (2020), 0.88 (2021), and 0.89 (2023/2024), indicating very good internal consistency in the FOCUS survey sample. As used in previous studies (49), the cut-off score of ≥10 was used to identify young adults with moderate-to-severe depressive symptoms. The PHQ-9 has demonstrated 88% sensitivity and 88% specificity for detecting depression when using a cutoff score of 10 or higher (46).

2.4.2 Exposure

The main exposure variables of interest were gender, sexual orientation, and socioeconomic index (SEI).

- Gender

Gender identity was collected using a single-answer multiple-choice question, as follows: "*What term best describes your gender identity*?" Participant's responses included a pre-defined list of 8 options (Man, Woman, Non-binary, Agender, Gender-fluid, Gender-queer), an open-ended question to list other gender, and an option for those who did not prefer to say. After preliminary analysis of the distribution, it was deemed best to categorize these options as Man, Woman, and Gender minorities (including Non-binary, Agender, Gender-fluid, Gender-queer, other).

- Sexual Orientation

Participants identified their sexual orientation through a single-answer multiple-choice question: "*What is your sexual orientation?*" The response options included seven predefined identities (Straight/heterosexual, Gay/homosexual, Lesbian, Asexual, Bisexual, Pansexual, Queer), along with an open-ended field for self-description and a "Prefer not to say" option. For analysis purposes, responses were grouped into three categories: Straight/heterosexual, Bisexual, and Sexual minorities (encompassing Gay/homosexual, Lesbian, Asexual, Pansexual, Queer, and other self-identified orientations).

- Socioeconomic index (SEI):

To capture the broader socioeconomic position (SEP) of young adult participants at the time of the FOCUS survey, I developed a socioeconomic index (SEI) using the following three variables: education level, employment status, and individual income. While employment, education and income have been identified as key predictors of mental health problems among young adults separately (34,35,50), previous studies have shown that the use of a composite measure combining these three factors allow to better capture the cumulative effect of social disadvantage than any single indicator alone (51). The SEI was tailored to reflect the transitional socioeconomic conditions of young adults, many of whom are still in education or early in their careers. Traditional indicators like income alone may not adequately capture SEP in this age group. Combining multiple indicators, such as education and income, provides a more accurate measure of SEP (52). Additionally, both objective and subjective socioeconomic measures are important for understanding mental health outcomes, especially in younger populations where single indicators may be unstable or still developing (53).

I purposefully recoded the education, employment and income variables into three categories to better capture the socioeconomic realities of young adults and to improve the clarity of the analysis. By consolidating the original response options into broader, more meaningful groups, I aimed to reflect key distinctions in education, employment, and income that are relevant during this transitional stage of the life course. This recoding also helped increase statistical

power by ensuring adequate sample sizes within each category and made it easier to interpret how different levels of SEI relate to depression. This approach is particularly relevant for young adults aged 18- 29, a period marked by key life transitions and heightened vulnerability to depression, and aligns with previous research emphasizing the need to tailor SEP measures to this age group in order to more accurately assess social disadvantage (54,55).

In the FOCUS questionnaire, participants were asked to report the highest educational attainment they had achieved including response options ranging from “none, elementary or primary school” to “university degree”. These responses were then grouped into three categories: 1) primary (none, elementary or primary school, primary school certificate), 2) secondary (professional or general lycée, BEP/CAP, college, professional or general baccalaureate) and 3) higher education (any program or diploma after baccalaureate).

Second, participants were asked to report their employment status at the time of the survey using pre-defined categories. Using R, response options were recoded into three categories: 1) unemployed (including student or apprentice, unable to work and unemployed), 2) student-workers (including students who were employed, trainee and paid interns), and 3) employed (including employees and self-employed individuals).

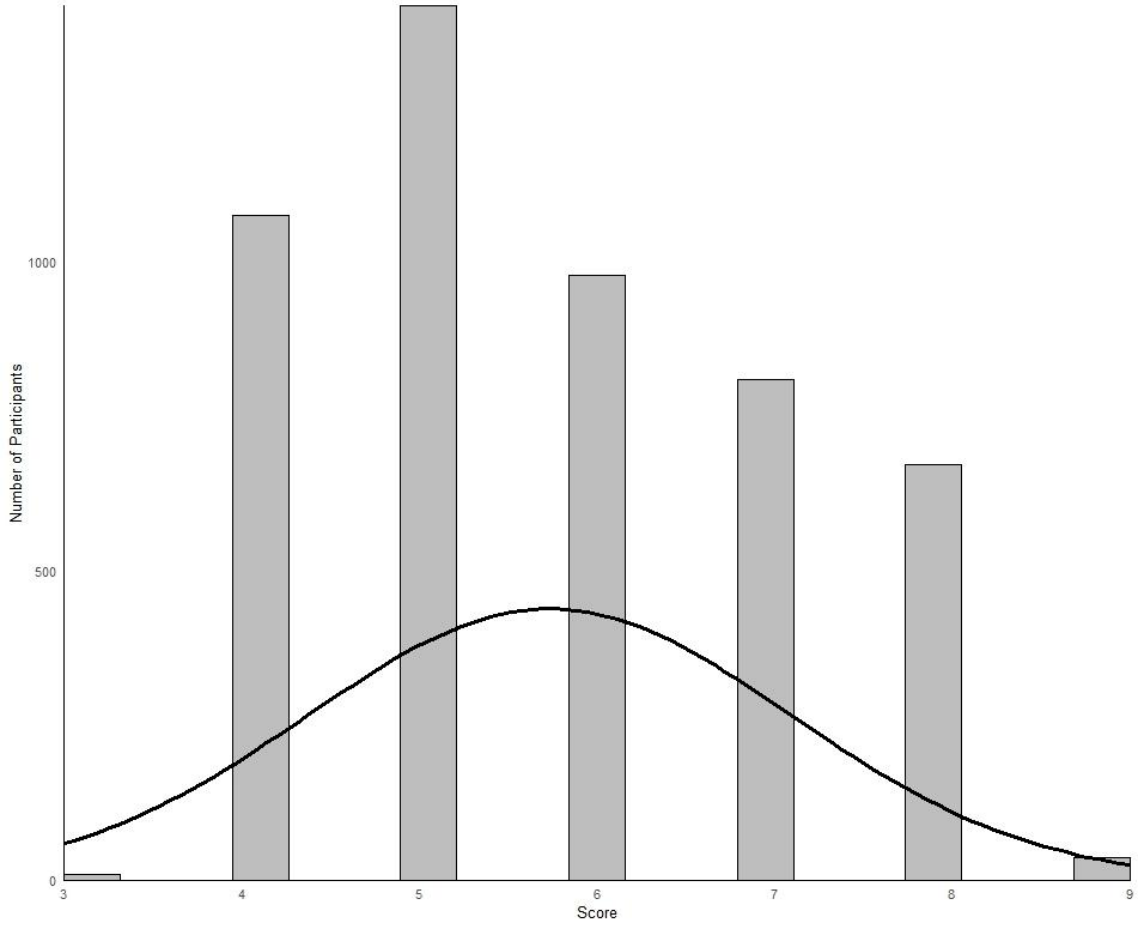
Third, participants were asked about their pre-tax annual income from all sources last year (including benefits and financial support). To classify individual income levels, we used poverty thresholds (i.e., 1,216 € per month) (56) and average (i.e., 1,679 € per month) (57) and high income (3,358 € per month, twice the average income) estimated by National Institute of Statistics and Economic Studies (INSEE) in the French adult population in 2022. Based on the thresholds our income variable was categorized as follows: 1) low (no income, between 230 € to 1500 € per month), 2) medium (between 1,500 € to less than 3,000 € per month) and 3) high income level (more than 3,000 € per month).

To construct the index, each recoded variable category was assigned a score from 1 to 3, with 1 corresponding to the lowest level of education (i.e., primary education), employment status (i.e., unemployed) and individual income (i.e., low income). These scores were then summed to obtain a total score ranging from 3 to 9 for each participant. I used the median and interquartile range to identify three groups with low (score of 5 or less), medium (score between 5 and 7) and high (scores greater than 7) socioeconomic indices.

The number of participants across a range of SEI scores is displayed in Figure 1 below, overlaid with a smoothed density curve in black to highlight the distribution pattern. The distribution is approximately unimodal and slightly skewed to the right. The most frequent SEI

score is 5, with over 1,300 participants in this category. The number of participants decreases progressively with higher SEI scores, with fewer than 700 participants in scores of 8 or above.

Figure 1: Distribution of Socioeconomic Index (SEI) scores in the pooled sample (n= 4,994)



2.4.3 Covariates

The covariates included the following sociodemographic variables: age, born in France (yes or no), area of residence (large urban center 100,000+ people versus medium or small city), and living arrangements (alone, with a partner, with parents, with roommates/friends). We used the median age to dichotomize our sample into three categories (i.e., 18- 20 years, 21-24 years, and 25- 29 years) corresponding to meaningful developmental distinctions within the broader stage of emerging adulthood, as described by Arnett's theory. This framework recognizes that young adults experience significant transitions in identity, relationships, and roles during this period, with each sub-phase reflecting unique psychosocial challenges and milestones relevant to mental health (54). Living arrangements and area of residence are important indicators of socioeconomic position, with individuals in lower socioeconomic positions more likely to experience housing instability and reside in disadvantaged neighborhoods (58). All of these covariates were considered as potential confounders in the

analysis because: a) they are empirically demonstrated explanatory factors (social determinants) associated with depression (59,60), and b) are empirically or conceptually related to our exposure variable of socioeconomic index (61).

2.4.4 Moderator

In order to test variations in the association between our exposure variables and depression across the different phases of the pandemic, a variable called “Wave” was created in the pooled sample, to identify participants from Wave 1 (2020), Wave 2 (2021) and Wave 3 (2023/2024).

2.5 Statistical analyses

I conducted a brief literature review on PubMed and Web of Science to identify previous research studies (i.e., published in the last 10 years) that used a similar study design of the FOCUS study, including repeated cross-sectional studies and nested cohort. To identify these studies, my search strategy included a combination of the following key terms: “repeated cross-sectional”, “young adults”, “mental health”, “nested cohort”. Based on this literature search, a set of relevant articles were selected from which key information regarding the methods and statistical approaches were extracted. For example, I collected details on study design, key variables analyzed, statistical models used, handling of missing data, and main findings related to mental health that were then summarized into a table (Table 1). This brief literature review allowed me to handle missing data properly and identify the best modeling approach in order to inform the next steps of my data analysis.

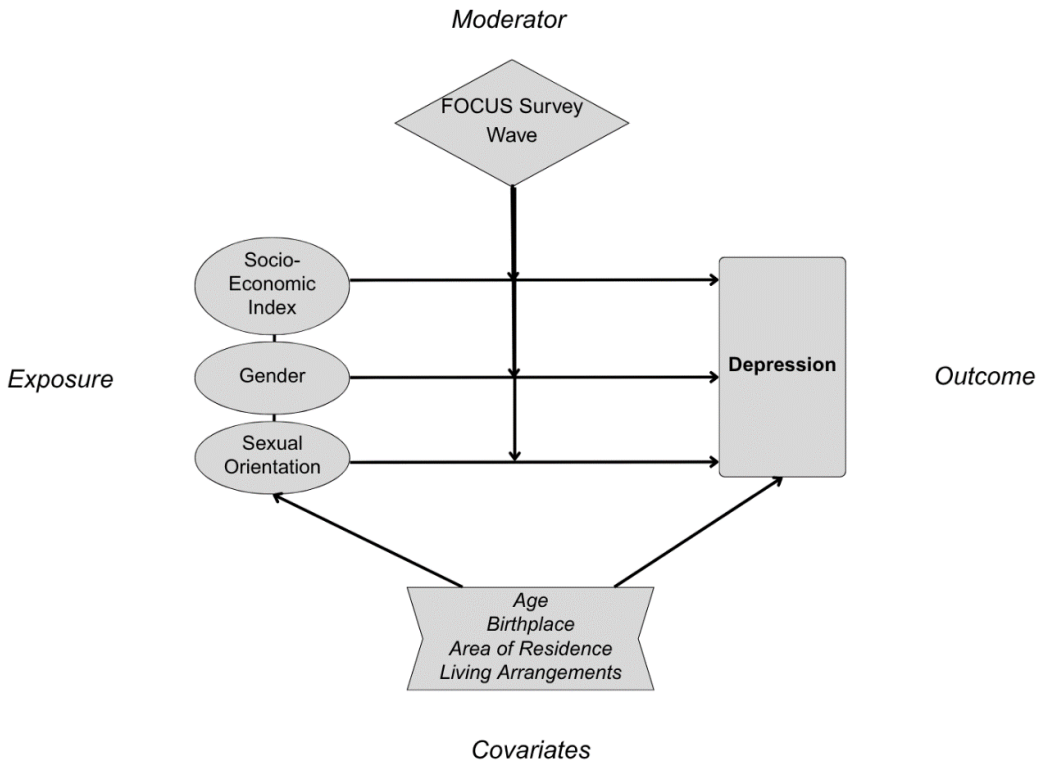
I first started with a series of descriptive analyses to identify my analysis sample and determine the proportion of missing data at each survey wave (Figure 3). The selection process was based on the sequential order of the questions as presented in the FOCUS questionnaire. Therefore, I first included participants who completed all sociodemographic characteristics, and then those who completed questions about socioeconomic position before examining the completion of the depression scale. In order to identify any potential selection biases that might have been created by this selection process, I conducted a comparative analysis of the sociodemographic and socioeconomic characteristics of participants who did not complete the depression scale and those who did. To assess significant differences between these sub-samples, I performed a Wilcoxon rank sum test for continuous variables and Pearson’s Chi-squared test or Fisher’s exact test for categorical variables (Supplementary Table A2).

I performed a descriptive analysis to provide an overview of the socioeconomic index components, including education, employment and income. The distribution of this was visualized with the outcome- depressed or not depressed, for all three waves to explore

potential differences between the groups (Supplementary Table A3). I then produced a descriptive table characterizing all covariates and exposure variables, stratified by depression levels across the three waves. Categorical data were summarized using frequency with percentages.

With the findings from the brief literature review and preliminary descriptive analyses, I consulted junior and senior statisticians from the EQUITY team to identify a modelling approach that would be appropriate to respond to my research objectives. Based on these discussions, two approaches were identified. First, I performed a multivariable logistic regression to examine trends in depressive symptoms across each wave, as well as to assess mental health disparities across subgroups defined by gender, sexual orientation, and socioeconomic index. This approach also allowed me to evaluate the association between socioeconomic disadvantage and depressive symptoms in different phases of the pandemic and after. Using the repeated cross-sectional independent samples, this model allowed to examine this association adjusted by the pre-identified covariates (i.e., age, area of residence, birthplace and living arrangements). This is also explained by the Directed Acyclic Graph that I have prepared for this study (Figure 2).

Figure 2: Directed Acyclic Graph (DAG) illustrating the hypothesized relationships between outcome, exposure, covariates and moderator



Second, I created a pooled sample (as described above) to test whether there is a moderating effect by FOCUS survey wave in the association between equity-deserving groups and depressive symptoms. To do this, I produced marginal predictions plot using the marginaleffects package (62), to visually illustrate the interaction effect. To facilitate the interpretation, the emmeans package (63) was used to provide odds ratios for depression across subgroups and waves. I first ran a multivariable logistic regression model without interaction terms (Model 1: PhQ-9 ~ Wave + Sexual Orientation + Gender + Socio Economic Index + Age + Area of Residence + Birthplace + Living Arrangement). Then, the following models were performed to test each interaction term separately:

- Model 2: PhQ-9 ~ **Wave * Gender** + Sexual Orientation + Socio Economic Index + Age + Area of Residence + Birthplace + Living Arrangement
- Model 3: PhQ-9 ~ **Wave * Sexual Orientation** + Gender + Socio Economic Index + Age + Area of Residence + Birthplace + Living Arrangement
- Model 4: PhQ-9 ~ **Wave * Socio Economic Index** + Sexual Orientation + Gender + Age + Area of Residence + Birthplace + Living Arrangement

R statistical software (version 4.4.1) available on the CERPOP server was used. STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) checklist (in appendices) for cross-sectional studies was utilized to ensure comprehensive and transparent reporting of study design, methods, and findings (64).

2.6 Sensitivity analysis

To assess the robustness of the main findings, a sensitivity analysis was performed using a higher threshold for PHQ-9 (score ≥ 15). This threshold is used to identify participants with major depressive symptoms (46). Logistic regression models were re-estimated to evaluate the consistency of the results across different model specifications. Similar results were found with this threshold (see appendices).

2.7 Ethics statement

The FOCUS study protocol received ethical approval from the University of British Columbia Behavioral Research Ethics Board (H20-02053). In France, the Data Protection Officer at the University of Paris was consulted to ensure that our data privacy and security procedures were compliant with the European Union's General Data Protection Regulation (GDPR). In France, a copy of the anonymized FOCUS survey databases was saved and stored in the secure server of the CERPOP. An amendment was made to include me as an intern of the FOCUS

research team. Additionally, I prepared and submitted an ethics online application to the University of Sheffield (Application Reference Number: 066918) to conduct this research. An information sheet was attached to the questionnaire, and consent was obtained from all participants, who were assured of confidentiality and anonymity.

3. Results

3.1 Summary of Relevant Study Designs

From the literature review, I identified four studies which were utilizing repeated cross-sectional with nested cohort data. These studies employed various modeling approaches. Wright et al. utilized multivariable logistic regression to examine the association between different factors (e.g., lockdown measures, demographics, pre-existing health conditions) and mental health outcomes, revealing that younger adults experienced higher psychological distress compared to older adults, and female gender was significantly associated with increased stress and depressive symptoms (65). However, the study's limitation is its use of a non-representative, opt-in online sample, which likely excludes certain groups (e.g., those without digital or English literacy) and may bias prevalence estimates. Lo Moro et al. applied repeated-measure multilevel mixed-effects linear regression to assess mental health changes over time, adjusting for variables such as age, gender, and other relevant factors available at two time points (pre-pandemic and pandemic) (66). The models accounted for the nested structure of the data, which highlighted rise in depressive symptoms and stress from pre-pandemic period to pandemic, particularly among females. The strength of this analysis is that it accounts for within-subject correlations by considering repeated measures from the same individuals. The multivariable logistic regression, however, helps us to understand how specific variables might correlate with mental health outcomes at different time-points. The study was limited by the regression model not capturing individual changes over time (66).

De Oliveira et al. combined adjusted binary logistic regression and multilevel models to explore bullying and mental health trends among adolescents in Brazil. Their findings showed a decrease in depressive and anxiety symptoms following policy changes, but the study was constrained by a high dropout rate in the longitudinal sample (67). Wang et al. utilized multivariate logistic regression to investigate the effect of the implementation of the “Double Reduction” policy among Chinese adolescents and observed a decrease in depressive and anxiety symptoms (68). Collectively, the findings underscore the pandemic's negative psychological impact, particularly on subgroups like younger adults and females, while also highlighting methodological considerations when analyzing data from repeated cross-sectional and nested cohort survey. Across these studies, common limitations included sensitivity to multi-collinearity, which made it difficult to isolate the effects of individual predictors due to high inter-correlations. Many analyses also relied on assumptions of linearity, potentially oversimplifying complex, real-world relationships. Additionally, challenges in capturing individual-level changes over time limited the ability to track within-person variability, reducing the precision of longitudinal insights.

Table 1: Modeling approaches from literature review

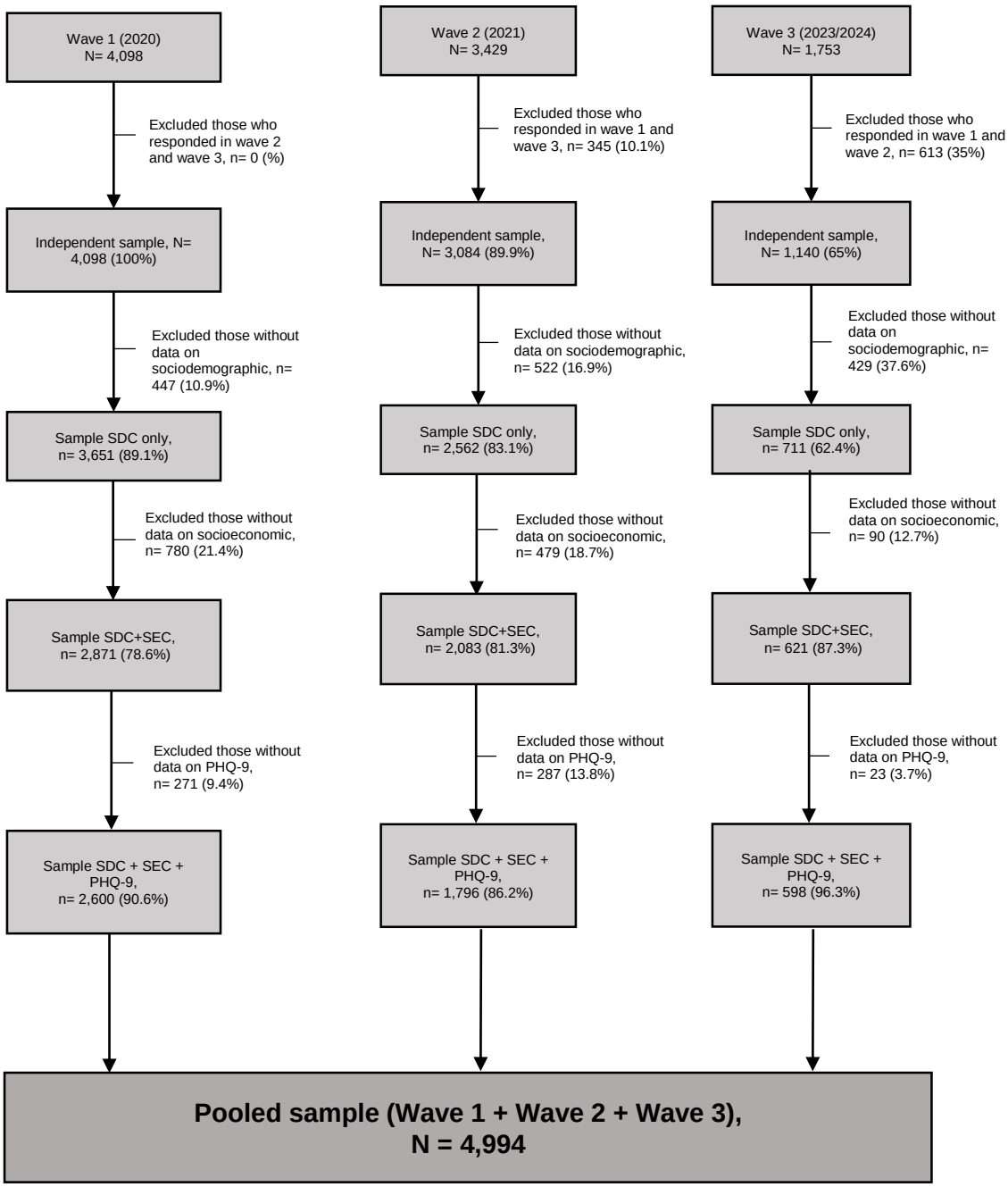
Study	Purpose	Modelling approaches	Interpretation of findings	Limitations of approach	Limitation of the study
Wright, A. *et al.* (2022) (65)	To examine the association between different factors (e.g., lockdown measures, demographics, pre-existing health conditions) and mental health outcomes	Multivariable Logistic regression modelling	Increased Psychological Distress: Younger adults experienced higher psychological distress compared to older adults.; Decreased Life Satisfaction: Participants reported lower life satisfaction during the second lockdown compared to the first.; Lower social connectedness was associated with higher psychological distress and lower life satisfaction.	Does not account for changes within individuals over time	Samples were taken from an opt-in online panel with complex recruitment strategies, which is unlikely to be representative.
Lo Moro, G. et al. (2022) (66)	Assessed changes over time; The models accounted for the nested structure of the data	For longitudinal subsample: repeated-measures multilevel mixed-effects linear regression model (levels: participant, time point)	Depressive symptoms and stress significantly increased over time, indicating a negative psychological impact of the pandemic.; Female gender was significantly associated with higher stress and depressive symptoms, consistent with broader literature on gender disparities in mental health.	Requires sufficient sample size for reliable estimation; complex and can be computationally intensive	Opportunistic sampling and that no data about students who refused to participate were collected. Moreover, the study was performed in a single center, limiting its representativeness and generalizability.
	To adjust for potential confounders, the researchers employed multivariable linear regression, including variables that were associated with the outcomes in at least one of the time points	For repeated cross-sectional survey: multivariable linear regression model	Depressive symptoms and stress were significantly higher in the pandemic group compared to the pre-pandemic group, confirming an overall deterioration in mental health.	Assumes linear relationships between variables, which may not always hold; Cannot capture individual-level changes over time	
de Oliveira, B.N. et al. (2025) (67)	To investigate the change in victimization and perpetration of bullying, both outcomes were regressed against survey waves (2019 versus 2022)	Adjusted binary logistic regression	No significant differences in the prevalence of bullying victimization (44% in 2019 vs. 40% in 2022) or perpetration (9.8% in 2019 vs. 8.6% in 2022) between the two cohorts.	Does not account for clustering	The longitudinal sample had a high dropout rate, which might affect the generalizability of the results; Bullying experiences were self-reported, which may introduce recall and social desirability biases
	Utilized to account for the hierarchical structure of the data, recognizing that students (level 1) were nested within schools (level 2).	Multilevel models for longitudinal subsample	Significant decrease in bullying victimization was observed, dropping from 46% in 2019 to 30% in 2022 (OR = 0.46; 95% CI: 0.30–0.69). However, bullying perpetration rates remained relatively unchanged (9.1% in 2019 vs. 6.7% in 2022)	While multilevel models are appropriate for nested data, the study's design (repeated cross-sectional with a nested cohort) may have complexities that could influence the interpretation of results.	
Wang, D. et al. (2024) (68)	To analyze the odds of experiencing depressive or anxiety symptoms, taking into account various covariates such as demographics, academic pressure, and life events.	Multivariate logistic regression (nested cohort)	The study observed a decrease in the prevalence of depressive symptoms from 12.1% to 9.2% and anxiety symptoms from 8.9% to 6.2% following the implementation of the "Double Reduction" policy.	Assumes a linear relationship between independent variables and the log odds of the outcome, which might not always hold; Sensitive to multi-collinearity (when independent variables are highly correlated)	The duration between the two survey waves was short, which may not be sufficient to capture long-term effects of the policy on mental health outcomes

3.2 Description of Study Population

Figure 3 presents the stepwise sample selection for FOCUS Survey Wave 1 (2020), Wave 2 (2021) and Wave 3 (2023/2024), based on data completeness criteria. In total, 4,098, 3,429, and 1,753 young adults in France participated in the first, second and third FOCUS surveys respectively. To ensure independence of observations between survey samples, only each participant's first response was retained. Consequently, 345 survey questionnaires (10.1%) from the 2021 FOCUS survey, and 613 participants (35%) from the 2023/2024 were not included. Of the independent samples, surveys with incomplete sociodemographic data, 10.9% (2020), 16.9% (2021) and 37.6% (2023/2024) were excluded. 21.4% (2020), 18.7% (2021), and 12.7% (2023/2024) were not included as they had not completed socioeconomic characteristics. Finally, 9.4% (2020), 13.8% (2021) and 3.7% (2023/2024) were excluded from the present analysis because they did not complete the PHQ-9. The final pooled sample included 4,994 participants, comprising 2,600 from the first survey (90.6%), 1,796 from the second survey (86.2%) and 598 from the third survey (96.3%).

Results of the comparative analysis of the sociodemographic and socioeconomic characteristics of participants who did not complete the depression scale and those who did (Supplementary Table A2) indicates no statistically significant differences between the two subgroups (all p-value > 0.05). This suggests that the risk of selection bias due to missing outcome data appears minimal, and therefore participants who were included in our analysis sample had similar sociodemographic and socioeconomic than those who did not complete the PHQ-9 scale.

Figure 3: Flow chart of the sample selection (selected participants from the FOCUS France Survey 2020, 2021, 2023/2024)



Note: *Sociodemographic characteristics (SDC) (includes age, gender, sexual identity, birthplace, education, area of residence), Socioeconomic characteristics (SEC) (employment, income and living arrangement) and PHQ-9 (Patient Health Questionnaire-9)*

3.3 Distribution of Participant Characteristics by Depression Status

Participant characteristics across depression levels in all three FOCUS survey waves are presented in Table 2.

The distribution of participants across the three survey waves varied in key demographic characteristics. In 2020, 47% of young adults reported experiencing depressive symptoms, followed by 41% in 2021 and 55% in 2023/2024. According to the age-group, the highest proportion of young adults were aged 21- 24 in 2020: 38.5%, in 2023/2024: 36.3% and 25- 29 in 2021: 43.0%. Women constituted the majority of participants, accounting for 59.1%, 63.5%, and 56% of respondents in Waves 1 through 3 respectively. The sample comprised predominantly of heterosexual participants across survey waves (2020: 67.5%, 2021: 71%, 2023/2024: 62%). Across all survey waves, urban residents consistently represented over two-thirds of participants (more than 65%), and those born in France accounted for more than 95% of respondents. 30.8% in 2020 and 33.3% in 2023/2024 were living with family members; 30.6% in 2020 and 33.6% in 2023/2024 were living alone; and 30.6% in 2021 were living with partner, which were the most prevalent living arrangements. The socioeconomic index distribution shifted significantly across waves with low socioeconomic participants representing 57% in 2020 but declining to 45.3% in 2021 and 33.8% by 2023/2024.

In the FOCUS survey waves, the highest proportions of youth with moderate-to-severe depressive symptoms were observed among those aged 18- 20 with 55.6% in 2020 and 65.2% in 2023/2024 (p-value < 0.001). Differences in area of residence and birthplace were less pronounced with no significant variation in depression rates ($p = 0.2$ to 0.8). Living arrangements played a notable role. Young adults living alone in 2020: 50.8%, 2023/2024: 57.7%, or with family members in 2020: 49.6%, 2021: 47.4%, 2023/2024: 63.3% reported higher depressive symptoms compared to those living with a partner or roommates ($p < 0.001$).

Significant differences were noted across exposure variables, with p-values < 0.001 for gender, sexual orientation, and socioeconomic index, indicating strong statistical associations. A higher proportion of young adults with depressive symptoms were found among women (2020: 50.2%, 2023/2024: 59.4%) and individuals identifying as a gender minority (2020: 66.7%, 2021: 57.3%, 2023/2024: 72.5%). Individuals identifying as bisexuals or as a sexual minority reported higher depressive symptoms (Bisexuals- 2020: 57.4%, 2021: 53.2%, 2023/2024: 54.8%; Sexual minorities- 2020: 56.6%, 2023/2024: 69.9%). Additionally, young adults in low socioeconomic index consistently reported higher rates of depressive symptoms (2020: 53.6%, 2021: 47.9%, 2023/2024: 67.3%) compared to those with medium or high socioeconomic index.

Table 2: Participant Characteristics by Depression Status Across FOCUS Survey Waves

Variable	Wave 1 (2020) Sample SDC + SEC + PHQ-9				Wave 2 (2021) Sample SDC + SEC + PHQ-9				Wave 3 (2023/2024) Sample SDC + SEC + PHQ-9			
	Total, N = 2,600	Depressed, n= 1,220 (47%)	Not Depressed, n= 1,380 (53%)	p-value[1]	Total, N = 1,796	Depressed, n= 733 (41%)	Not Depressed, n= 1,063 (59%)	p-value[1]	Total, N = 598	Depressed, n= 330 (55%)	Not Depressed, n= 268 (45%)	p-value[1]
	n (col%)	n (row%)	n (row%)		n (col%)	n (row%)	n (row%)		n (col%)	n (row%)	n (row%)	
Age				**<0.001**				**<0.001**				**<0.001**
18-20	833 (32.0)	463 (55.6)	370 (44.4)		405 (22.6)	207 (51.1)	198 (48.9)		198 (33.1)	129 (65.2)	69 (34.8)	
21-24	1,001 (38.5)	455 (45.5)	546 (54.5)		619 (34.5)	259 (41.8)	360 (58.2)		217 (36.3)	116 (53.5)	101 (46.5)	
25-29	766 (29.5)	302 (39.4)	464 (60.6)		772 (43.0)	267 (34.6)	505 (65.4)		183 (30.6)	85 (46.4)	98 (53.6)	
Gender				**<0.001**				**<0.001**				**<0.001**
Man	943 (36.3)	368 (39.0)	575 (61.0)		566 (31.5)	198 (35.0)	368 (65.0)		223 (37.3)	102 (45.7)	121 (54.3)	
Woman	1,537 (59.1)	772 (50.2)	765 (49.8)		1,141 (63.5)	484 (42.4)	657 (57.6)		335 (56.0)	199 (59.4)	136 (40.6)	
Gender minorities	120 (4.6)	80 (66.7)	40 (33.3)		89 (5.0)	51 (57.3)	38 (42.7)		40 (6.7)	29 (72.5)	11 (27.5)	
Sexual Orientation				**<0.001**				**<0.001**				**<0.001**
Heterosexual	1,756 (67.5)	739 (42.1)	1 017 (57.9)		1,276 (71.0)	468 (36.7)	808 (63.3)		371 (62.0)	184 (49.6)	187 (50.4)	
Bisexual	397 (15.3)	228 (57.4)	169 (42.6)		235 (13.1)	125 (53.2)	110 (46.8)		84 (14.0)	46 (54.8)	38 (45.2)	
Sexual minorities	447 (17.2)	253 (56.6)	194 (43.4)		285 (15.9)	140 (49.1)	145 (50.9)		143 (23.9)	100 (69.9)	43 (30.1)	
Area of Residence				0.8				0.7				0.7
Urban	1,894 (72.8)	891 (47.0)	1 003 (53.0)		1,243 (69.2)	511 (41.1)	732 (58.9)		419 (70.1)	229 (54.7)	190 (45.3)	
Rural	706 (27.2)	329 (46.6)	377 (53.4)		553 (30.8)	222 (40.1)	331 (59.9)		179 (29.9)	101 (56.4)	78 (43.6)	
Born in France				0.2				0.7				0.2
Yes	2,500 (96.2)	1 167 (46.7)	1 333 (53.3)		1,719 (95.7)	700 (40.7)	1 019 (59.3)		574 (96.0)	314 (54.7)	260 (45.3)	
No	100 (3.8)	53 (53.0)	47 (47.0)		77 (4.3)	33 (42.9)	44 (57.1)		24 (4.0)	16 (66.7)	8 (33.3)	
Living Arrangement				**<0.001**				**<0.001**				**<0.001**
Alone	796 (30.6)	404 (50.8)	392 (49.2)		531 (29.6)	224 (42.2)	307 (57.8)		201 (33.6)	116 (57.7)	85 (42.3)	
With family members	802 (30.8)	398 (49.6)	404 (50.4)		519 (28.9)	246 (47.4)	273 (52.6)		199 (33.3)	126 (63.3)	73 (36.7)	
With partner	586 (22.5)	231 (39.4)	355 (60.6)		549 (30.6)	187 (34.1)	362 (65.9)		123 (20.6)	48 (39.0)	75 (61.0)	
With roommate/friends	416 (16.0)	187 (45.0)	229 (55.0)		197 (11.0)	76 (38.6)	121 (61.4)		75 (12.5)	40 (53.3)	35 (46.7)	
Socioeconomic Index				**<0.001**				**<0.001**				**<0.001**
High	281 (10.8)	90 (32.0)	191 (68.0)		342 (19.0)	99 (28.9)	243 (71.1)		85 (14.2)	37 (43.5)	48 (56.5)	
Medium	836 (32.2)	335 (40.1)	501 (59.9)		640 (35.7)	244 (38.1)	396 (61.9)		311 (52.0)	157 (50.5)	154 (49.5)	
Low	1,483 (57.0)	795 (53.6)	688 (46.4)		814 (45.3)	390 (47.9)	424 (52.1)		202 (33.8)	136 (67.3)	66 (32.7)	

[1] Pearson's Chi-squared test

3.4 Regression Analysis

Results of the association between social determinants (gender, sexual orientation and socioeconomic index) and depressive symptoms are described in Table 3.

Across all three survey waves, young women had significantly higher odds of reporting depressive symptoms compared to young men (2020: Adjusted Odds Ratio (AOR) = 1.53, 95% Confidence Interval (95% CI) [1.29–1.82], p-value (p) < 0.001; 2021: AOR = 1.40 [1.13–1.74], p = 0.002; 2023/2024: AOR = 2.02 [1.40–2.92], p < 0.001). Similar associations were observed among gender minority participants who had increased odds of experiencing depression in 2020 (AOR = 2.29 [1.50–3.53], p < 0.001) and 2021 (AOR = 1.88 [1.16–3.06], p = 0.011) compared to young men. The association was not significant in 2023/2024 (p = 0.11).

Regarding sexual orientation, participants who identified as bisexual in 2020 (AOR = 1.51 [1.20–1.91], p < 0.001); 2021 (AOR = 1.67 [1.25–2.23], p < 0.001) and as a sexual minority in 2020 (AOR = 1.58 [1.26–1.98], p < 0.001); 2021 (AOR = 1.48 [1.12–1.96], p = 0.006); 2023/2024 (AOR = 2.12 [1.35–3.40], p = 0.001) had significantly higher odds of depression across all waves, except for bisexuals in 2023/2024 survey (p = 0.8) compared to heterosexual participants.

Participants in low SEI had significantly higher odds of reporting depressive symptoms in 2020 (AOR = 1.96 [1.42–2.70], p < 0.001) and 2021 (AOR = 1.69 [1.22–2.35], p = 0.002) compared to those in high SEI. However, this association was not statistically significant in 2023/2024 (p = 0.11). Those in medium SEI did not differ significantly in odds of depression across the three waves, with borderline significance in 2021 (AOR = 1.34 [1.00–1.81], p = 0.055).

Table 3: Multivariable Logistic Regression: Association Between Social Determinants and Depressive Symptoms

	Wave 1 (2020), N= 2,600			Wave 2 (2021), N= 1,796			Wave 3 (2023/2024), N= 598		
Variable	**AOR**	**95% CI**	**p-value**	**AOR**	**95% CI**	**p-value**	**AOR**	**95% CI**	**p-value**
Gender									
Man	—	—		—	—		—	—	
Woman	1.53	1.29, 1.82	**<0.001**	1.40	1.13, 1.74	**0.002**	2.02	1.40, 2.92	**<0.001**
Gender minorities	2.29	1.50, 3.53	**<0.001**	1.88	1.16, 3.06	**0.011**	1.96	0.88, 4.59	0.11
Sexual Orientation									
Heterosexual	—	—		—	—		—	—	
Bisexual	1.51	1.20, 1.91	**<0.001**	1.67	1.25, 2.23	**<0.001**	1.07	0.65, 1.77	0.8
Sexual minorities	1.58	1.26, 1.98	**<0.001**	1.48	1.12, 1.96	**0.006**	2.12	1.35, 3.40	**0.001**
Socioeconomic Index									
High	—	—		—	—		—	—	
Medium	1.29	0.95, 1.74	0.10	1.34	1.00, 1.81	0.055	0.95	0.54, 1.66	0.9
Low	1.96	1.42, 2.70	**<0.001**	1.69	1.22, 2.35	**0.002**	1.71	0.89, 3.30	0.11

Notes: CI = Confidence Interval, AOR = Adjusted Odds Ratio
Significant associations (p-value < 0.05) are highlighted in bold.
*Adjusted by Age, Area of Residence, Birthplace, Living Arrangements

3.5 Marginal Predicted Plots

Figure 4 displays marginal predicted probabilities of depression across social determinants without interaction (Panel A) and interaction with FOCUS survey wave (Panel B).

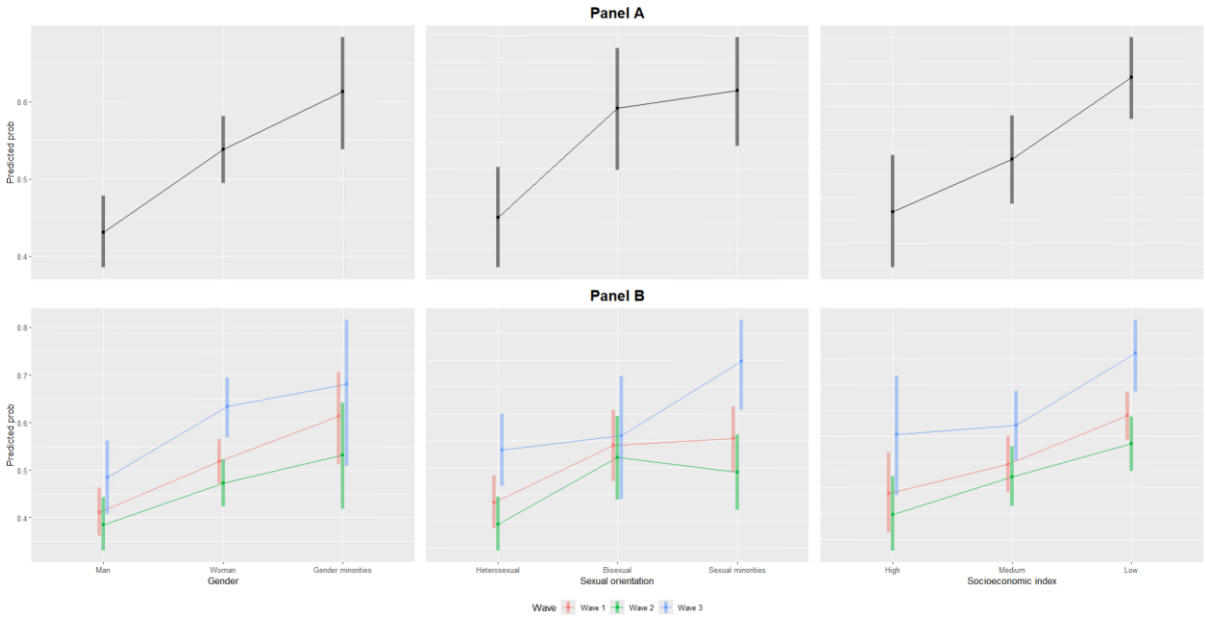
In Panel A (without interaction), individuals identifying as "Gender minorities" and “Sexual minorities”, showed the highest predicted probabilities of depression compared to men and heterosexual individuals. Predicted depression was higher among individuals in lower socioeconomic index compared to those in high socioeconomic index.

In Panel B (interaction with FOCUS survey wave), predicted probabilities of depression increased from Wave 1 to Wave 3 across most categories, with a rise observed among those identifying as a gender minority, those in sexual minority groups and among individuals in low socioeconomic index.

Figure 4: Marginal Predictions Plot (with and without interaction)

Panel A: Marginal predictions plot of depressive symptoms across categories of gender, sexual orientation & SEI (Model 1)

Panel B: Marginal predictions plot of depressive symptoms including an interaction term for the FOCUS survey wave by equity-deserving groups (Model 2, Model 3, Model 4)



3.6 Interaction Effects

Results of the interactions between wave and social determinants in the pooled sample (n= 4,994) are described in Table 4.

In Model 1, participants in Wave 2 (2021) had significantly lower odds of depression (Adjusted Odds Ratio (AOR) = 0.84, 95% Confidence Interval (95% CI) [0.74–0.96], p-value (p) = 0.009), while those in Wave 3 (2023/2024) had significantly higher odds of depression (AOR = 1.49 [1.23–1.79], p < 0.001), compared to Wave 1 (2020).

Models 2, 3, and 4 showed significant interactions indicating that the associations between gender, sexual orientation, and socioeconomic index, varied across survey waves. Compared to men, women had higher odds of depression in 2020 (AOR = 1.53 [1.26–1.89], p < 0.001), 2021 (AOR = 1.43 [1.11–1.85], p < 0.001), and 2023/2024 (AOR = 1.84 [1.21–2.81], p = 0.002). Participants identifying as a gender minority also showed higher odds of depression in 2020 (AOR = 2.27 [1.38–3.74], p < 0.001) and 2021 (AOR = 1.81 [1.03–3.17], p = 0.04), although the association in 2023/2024 was not statistically significant (p = 0.08).

Compared to heterosexual participants, bisexual individuals had significantly higher odds of depression in 2020 (AOR = 1.53 [1.16–2.00], p < 0.001) and 2021 (AOR = 1.65 [1.17–2.32],

p < 0.001), but not in 2023/2024 (p > 0.05). Participants other than heterosexual or bisexual, identifying as a sexual minority had consistently elevated odds of depression across all survey waves, with significant observations in 2020 (AOR = 1.61 [1.24–2.09], p < 0.001), 2021 (AOR = 1.48 [1.07–2.04], p = 0.01), and 2023/2024 (AOR = 2.01 [1.21–3.34], p = 0.003).

In 2020, compared to those in high socioeconomic index, individuals in low socioeconomic index had significantly higher odds of moderate-to-severe depression (AOR = 1.84 [1.29–2.62], p < 0.001). Similar trends were observed in 2021 (AOR = 1.74 [1.22–2.49], p < 0.001) and 2023/2024 (AOR = 1.98 [1.03–3.79], p = 0.04).

Table 4: Multivariable logistic regression examining interactions between FOCUS survey wave, and social determinants (gender, sexual orientation, and socioeconomic index) in relation to depression (n= 4,994)

	Model 1			Model 2			Model 3			Model 4		
Variable	AOR	95% CI	p-value	AOR	95% CI	p-value	AOR	95% CI	p-value	AOR	95% CI	p-value
Wave												
Wave 1 (2020)	—	—										
Wave 2 (2021)	0.84	0.74, 0.96	**0.009**									
Wave 3 (2023/2024)	1.49	1.23, 1.79	**<0.001**									
Gender												
Man	—	—										
Woman	1.54	1.36, 1.74	**<0.001**									
Gender minorities	2.09	1.56, 2.82	**<0.001**									
Sexual Orientation												
Heterosexual	—	—										
Bisexual	1.51	1.27, 1.79	**<0.001**									
Sexual minorities	1.61	1.37, 1.90	**<0.001**									
Socioeconomic index												
High	—	—										
Medium	1.26	1.03, 1.53	**0.022**									
Low	1.82	1.47, 2.25	**<0.001**									
Wave * Gender												
Wave												
Wave 1 (2020)				—	—							
Wave 2 (2021)				0.89	0.72,1.12	0.3						
Wave 3 (2023/2024)				1.34	0.99,1.81	0.057						
Gender												
Man				—	—							
Woman				1.54	1.30,1.82	**<0.001**						
Gender minorities				2.27	1.50,3.47	**<0.001**						
Wave 1 * Gender												
Man				—	—							
Woman				1.53	1.26,1.89	**<0.001**						
Gender minorities				2.27	1.38,3.74	**<0.001**						
Wave 2 * Gender												
Man				—	—							
Woman				1.43	1.11,1.85	**<0.001**						
Gender minorities				1.81	1.03,3.17	**0.04**						
Wave 3 * Gender												
Man				—	—							

Woman	1.84	1.21,2.81	**0.002**						
Gender minorities	2.28	0.92,5.64	0.08						
Wave * Sexual Orientation									
Wave									
Wave 1 (2020)				—	—				
Wave 2 (2021)				0.85	0.73,0.99	**0.032**			
Wave 3 (2023/2024)				1.48	1.17,1.87	**<0.001**			
Sexual Orientation									
Heterosexual				—	—				
Bisexual				1.53	1.22,1.92	**<0.001**			
Sexual minorities				1.61	1.29,2.00	**<0.001**			
Wave 1 * Sexual Orientation									
Heterosexual				—	—				
Bisexual				1.53	1.16,2.00	**<0.001**			
Sexual minorities				1.61	1.24,2.09	**<0.001**			
Wave 2 * Sexual Orientation									
Heterosexual				—	—				
Bisexual				1.65	1.17,2.32	**<0.001**			
Sexual minorities				1.48	1.07,2.04	**0.01**			
Wave 3 * Sexual Orientation									
Heterosexual				—	—				
Bisexual				1.11	0.62,1.98	0.91			
Sexual minorities				2.01	1.21,3.34	**0.003**			
Wave * Socioeconomic Index									
Wave									
Wave 1 (2020)							—	—	
Wave 2 (2021)							0.84	0.60,1.20	0.3
Wave 3 (2023/2024)							1.59	0.95,2.63	0.073
Socioeconomic index									
High							—	—	
Medium							1.25	0.93,1.69	0.13
Low							1.84	1.37,2.48	**<0.001**
Wave 1 * Socioeconomic index									
High							—	—	
Medium							1.25	0.88,1.78	0.29
Low							1.84	1.29,2.62	**<0.001**
Wave 2 * Socioeconomic index									
High							—	—	
Medium							1.35	0.95,1.91	0.11
Low							1.74	1.22,2.49	**<0.001**
Wave 3 * Socioeconomic index									
High							—	—	
Medium							1.07	0.59,1.95	0.96
Low							1.98	1.03,3.79	**0.04**

Notes: CI = Confidence Interval, AOR = Adjusted Odds Ratio

4. Discussion

4.1 Summary

Using the repeated cross-sectional data of the FOCUS survey, this present analysis suggests that about half of young adults living in France have experienced depressive symptoms during the onset of the pandemic, with a slight increase after the pandemic in 2023/2024. As hypothesized, our findings also highlighted mental health inequities across the survey waves; specific subgroups of young adults who reported higher levels of depression, included women, gender minority (e.g., non-binary), sexual minority and youth in lower socioeconomic index. Visual trends confirmed that depression increased the most in equity-deserving groups by wave 3 survey. Participants identifying as women, gender minorities (except for FOCUS survey wave 3), sexual minorities, and in low socioeconomic index consistently showed higher odds of depressive symptoms during and after the pandemic. The FOCUS survey wave did not significantly moderate the association between social determinants and depressive symptoms, indicating that these associations were stable. This suggests that mental health inequities persisted both during and after the pandemic.

4.2 Interpretation

Our findings suggest that the prevalence of depressive symptoms varied across pandemic waves. Depression decreased during the middle phase (2021), followed by an increase in the after pandemic phase (2023/2024). The rebound in the prevalence of depression that we observed in the 2023/2024 FOCUS survey could be explained by several hypotheses. First, the recruitment strategies for the third wave involved the participation of non-profit organizations providing online mental health support to youth in France (such as Fil Santé Jeunes and Nightline) which may have contributed to a higher representation of youth experiencing psychological distress in the 2023/2024 study sample. Given that the sample size of the third wave is, four times and three times smaller than in the first and second survey waves respectively, this may have contributed to create a sample bias with higher depression rates among those who participated in the last FOCUS survey compared to the two previous surveys. Another hypothesis may be linked to the combined effects of various social and environmental challenges, including climate change, geopolitical and economic instability. Although none of these factors alone fully explains the rise, they likely stem from deeper political and economic issues that continue to affect young people’s mental health (69). Future research should address both methodological challenges and the complex social factors influencing young adults’ mental health to better understand and respond to increasing depression rates post-pandemic.

Gender-based inequities in depression were also pronounced with young women reporting higher levels of depression than men. Consistently with established research on gender disparities in mental health, this finding suggests that, due to their social roles, women are disproportionately burdened by phases of reproductive health, interpersonal stress, and gender-based violence, all of which intensified during the pandemic (22,69,70). A systematic literature review emphasized that women disproportionately carry the mental labor associated with household and caring tasks. This cognitive burden included planning, organizing, and managing family needs, leading to increased stress, reduced life satisfaction, and negative impacts on career progression (71). Thus, COVID-19 intensified work-life conflicts, with women often bearing the brunt of increased caregiving duties and household responsibilities, leading to sustained psychological stress. Most notably, young adults identifying as a gender minority, a category inclusive of non-binary, genderqueer, and other gender-diverse identities reported higher levels of depression across three survey waves. These findings echo a growing body of literature on the mental health problems faced by gender minority populations, driven by discrimination, marginalization, and limited access to affirming care (25,72). Similarly, sexual minority youth, particularly those identifying as bisexual or a sexual minority, reported higher depression levels than their heterosexual counterparts. These findings align with a systematic review that found, COVID-19 pandemic had a substantial negative impact on the psychological well-being of gender and sexual minority adolescents and young adults, highlighting elevated levels of distress within this population (73). Our results are also consistent with Minority Stress Theory developed by Ilan H. Meyer, which states that sexual minorities are disproportionately affected by stigma, prejudice, and discrimination which in turn could contribute to lead to mental health problems (74). In our study, those who belonged to lower socioeconomic position reported higher levels of depressive symptoms across the first and second FOCUS survey waves conducted in the first two years of the pandemic. This chimes with prior research linking lower education levels to higher depressive symptoms during the early COVID-19 pandemic in France (75). Also, a scoping review showed that socioeconomic inequalities in depression persisted or worsened over time during the pandemic, especially among disadvantaged groups (76).

Furthermore, our study showed that living arrangements emerged as a significant factor that may influence level of depression (Supplementary Table A4). Young adults living with a partner or with families indicated lower levels of depression compared to those living alone, supporting findings that intimate partnership can serve as a buffer against emotional distress, reduce feelings of isolation and encourage positive thinking (77,78).

Our findings indicate that depression differences among equity-deserving groups persisted during and after the COVID-19 pandemic, highlighting ongoing mental health inequities. Prior

to the pandemic, studies consistently showed that women, sexual minority youth, and individuals from low socioeconomic backgrounds experienced higher rates of depression compared to the general population (26,79,80). During the pandemic, these disparities were further intensified, as discussed previously, with women, gender and sexual minority youth, and socioeconomically disadvantaged young adults disproportionately affected by increased caregiving demands, stigma, and financial challenges (69–73,75,76). This evidence highlight that while the pandemic amplified mental health problems, the root social and economic inequalities, as well as mental health disparities remain deeply intricate across all time periods.

Future research and policy initiatives should focus on enhancing access to culturally competent and affirming mental health services, addressing barriers, and developing targeted interventions to mitigate the intersecting social determinants that exacerbate mental health disparities in young adults.

4.3 Strengths and Limitations

First, the FOCUS study employed convenience sampling, which may limit the generalizability of the findings to the young adult population in France. While this study sample is not representative, the recruitment strategies (mainly online via social media advertisements and through partnership with local youth organizations) allowed to include a large and diverse sample of youth, including youth from all French regions (including overseas department), youth with diverse gender and sexual identities and socioeconomic backgrounds, subgroups that are too often underrepresented in national surveys (81). Statistical weighting was not applied in this analysis due to the use of convenience sampling and the study's primary focus on exploring mental health outcomes among minority groups, rather than producing population-representative estimates.

Second, while the use of a validated scale (i.e., PHQ-9) to assess depressive symptoms enhances the reliability and comparability of the results, but can also have response bias as it is self-reported and can be influenced by social desirability. Regarding the socioeconomic index, while it was not based on a standardized or universally validated instrument, it was developed using variables informed by the existing literature and tailored to our sample. This approach allowed us to capture relevant aspects of socioeconomic position that are particularly important for young adults, for example, education status, employment, and income, which may differ in significance compared to older populations (51–54). The absence of pre-pandemic mental health baseline data limits the ability to directly assess mental health changes attributable to the pandemic.

Despite these limitations, this study provides valuable insights into persistent mental health disparities among young adults, both during and after the COVID-19 pandemic. It highlights the disproportionate burden of depressive symptoms among women, gender and sexual minorities, and individuals from lower socioeconomic backgrounds, offering a foundation for future longitudinal analyses to track these trends over time.

4.4 Perspectives

In the coming months of June and July, I will continue my internship at CERPOP to conduct the following next steps. First, I will perform similar analysis on the repeated cross-sectional data using the FOCUS Canadian database. The aim will be to describe trends in depressive symptoms across the three Canadian survey waves and to explore the relationship between social determinants and depression among young adults residing in Canada, with a focus on how these associations evolve across time within equity-deserving groups. This analysis will also allow me to compare the findings between young adults living in France and Canada, and observe potential contextual differences between the two settings. For example, I anticipate that the depression rate in the Canadian sample will be higher than in the French sample as reported in a previous study conducted by the FOCUS team (78).

Second, I will use the FOCUS nested cohort data of France and Canada to examine trajectories of depression over the three survey waves. Given the relatively small number of participants who completed all three waves in the French database, pooling the nested cohort data from both France (n= 156) and Canada (n= 241) will increase the analytical power and improve the stability of estimates. To do this, I plan to use mixed models to analyze the FOCUS nested cohort data in order to identify patterns of change in depressive symptoms.

5. Conclusion/ Recommendations

This study highlights significant and persistent mental health inequalities among young adults during and after the COVID-19 pandemic. Rates of depressive symptoms remained high, particularly among women, gender and sexual minorities, and individuals from more disadvantaged socioeconomic backgrounds. These findings emphasize the urgent need for targeted mental health interventions and policies that address the complex, intersecting social determinants affecting equity-deserving young adults.

References

1. WHO. World Health Organization. 2022 [cited 2025 Feb 17]. Mental health. Available from: https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

2. Solmi M, Radua J, Olivola M, Croce E, Soardo L, Salazar de Pablo G, et al. Age at onset of mental disorders worldwide: large-scale meta-analysis of 192 epidemiological studies. Mol Psychiatry. 2022 Jan;27(1):281–95.

3. Villarroel MA, Terlizzi EP. Symptoms of Depression Among Adults: United States, 2019. 2020;(379).

4. Bonnie RJ, Stroud C, Breiner H, Committee on Improving the Health S, Board on Children Y, Medicine I of, et al. Young Adults in the 21st Century. In: Investing in the Health and Well-Being of Young Adults [Internet]. National Academies Press (US); 2015 [cited 2025 Feb 24]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK284782/

5. Scales PC, Benson PL, Oesterle S, Hill KG, Hawkins JD, Pashak TJ. The dimensions of successful young adult development: A conceptual and measurement framework. Appl Dev Sci. 2015 Dec 16;20(3):150–74.

6. Wood D, Crapnell T, Lau L, Bennett A, Lotstein D, Ferris M, et al. Emerging Adulthood as a Critical Stage in the Life Course. In: Halfon N, Forrest CB, Lerner RM, Faustman EM, editors. Handbook of Life Course Health Development [Internet]. Cham (CH): Springer; 2018 [cited 2025 Feb 24]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK543712/

7. Gulliver A, Griffiths KM, Christensen H. Perceived barriers and facilitators to mental health help-seeking in young people: a systematic review. BMC Psychiatry. 2010 Dec 30;10:113.

8. Salaheddin K, Mason B. Identifying barriers to mental health help-seeking among young adults in the UK: a cross-sectional survey. Br J Gen Pract. 2016 Oct;66(651):e686–92.

9. Koutra K, Pantelaiou V, Mavroeides G. Why Don't Young People Seek Help for Mental Illness? A Cross-Sectional Study in Greece. Youth. 2023 Mar;3(1):157–69.

10. McGorry PD, Mei C. Early intervention in youth mental health: progress and future directions. Evid Based Ment Health. 2018 Nov;21(4):182–4.

11. Colizzi M, Lasalvia A, Ruggeri M. Prevention and early intervention in youth mental health: is it time for a multidisciplinary and trans-diagnostic model for care? Int J Ment Health Syst. 2020 Mar 24;14:23.

12. Junior FJG da S, Sales JC e S, Monteiro CF de S, Costa APC, Campos LRB, Miranda PIG, et al. Impact of COVID-19 pandemic on mental health of young people and adults: a systematic review protocol of observational studies. BMJ Open. 2020 Jul 1;10(7):e039426.

13. European Foundation for the Improvement of Living and Working Conditions. Impact of COVID-19 on young people in the EU. [Internet]. LU: Publications Office; 2021 [cited 2025 Feb 17]. Available from: https://data.europa.eu/doi/10.2806/361465

14. Collier Villaume S, Chen S, Adam EK. Age Disparities in Prevalence of Anxiety and Depression Among US Adults During the COVID-19 Pandemic. JAMA Netw Open. 2023 Nov 30;6(11):e2345073.

15. Kleine R, Galimov A, Hanewinkel R, Unger J, Sussman S, Hansen J. Impact of the COVID-19 pandemic on young people with and without pre-existing mental health problems. Sci Rep. 2023 Apr 14;13(1):6111.

16. Hafstad GS, Sætren SS, Wentzel-Larsen T, Augusti EM. Changes in Adolescent Mental and Somatic Health Complaints Throughout the COVID-19 Pandemic: A Three-Wave Prospective Longitudinal Study. J Adolesc Health Off Publ Soc Adolesc Med. 2022 Oct;71(4):406–13.

17. Bouter DC, Zarchev M, de Neve-Enthoven NGM, Ravensbergen SJ, Kamperman AM, Hoogendijk WJG, et al. A longitudinal study of mental health in at-risk adolescents before and during the COVID-19 pandemic. Eur Child Adolesc Psychiatry. 2023 Jun;32(6):1109–17.

18. Chadi N, Ryan NC, Geoffroy MC. COVID-19 and the impacts on youth mental health: emerging evidence from longitudinal studies. Can J Public Health Rev Can Santé Publique. 2022 Jan 28;113(1):44–52.

19. Wathelet M, Horn M, Creupelandt C, Fovet T, Baubet T, Habran E, et al. Mental Health Symptoms of University Students 15 Months After the Onset of the COVID-19 Pandemic in France. JAMA Netw Open. 2022 Dec 29;5(12):e2249342.

20. Hu Y, Qian Y. COVID-19 and Adolescent Mental Health in the United Kingdom. J Adolesc Health Off Publ Soc Adolesc Med. 2021 Jul;69(1):26–32.

21. Ma L, Mazidi M, Li K, Li Y, Chen S, Kirwan R, et al. Prevalence of mental health problems among children and adolescents during the COVID-19 pandemic: A systematic review and meta-analysis. J Affect Disord. 2021 Oct 1;293:78–89.

22. Racine N, McArthur BA, Cooke JE, Eirich R, Zhu J, Madigan S. Global Prevalence of Depressive and Anxiety Symptoms in Children and Adolescents During COVID-19: A Meta-analysis. JAMA Pediatr. 2021 Nov 1;175(11):1142–50.

23. Ravens-Sieberer U, Erhart M, Devine J, Gilbert M, Reiss F, Barkmann C, et al. Child and Adolescent Mental Health During the COVID-19 Pandemic: Results of the Three-Wave Longitudinal COPSY Study. J Adolesc Health Off Publ Soc Adolesc Med. 2022 Nov;71(5):570–8.

24. Connolly MD, Zervos MJ, Barone CJ, Johnson CC, Joseph CLM. The Mental Health of Transgender Youth: Advances in Understanding. J Adolesc Health. 2016 Nov 1;59(5):489–95.

25. Hawke LD, Hayes E, Darnay K, Henderson J. Mental health among transgender and gender diverse youth: An exploration of effects during the COVID-19 pandemic. Psychol Sex Orientat Gend Divers. 2021 Jun;8(2):180–7.

26. Meyer IH. Prejudice, Social Stress, and Mental Health in Lesbian, Gay, and Bisexual Populations: Conceptual Issues and Research Evidence. Psychol Bull. 2003 Sep;129(5):674–97.

27. Mereish EH, Poteat VP. A relational model of sexual minority mental and physical health: The negative effects of shame on relationships, loneliness, and health. J Couns Psychol. 2015;62(3):425–37.

28. Russell ST, Fish JN. Mental Health in Lesbian, Gay, Bisexual, and Transgender (LGBT) Youth. Annu Rev Clin Psychol. 2016 Mar 28;12(Volume 12, 2016):465–87.

29. Nagasu M, Muto K, Yamamoto I. Impacts of anxiety and socioeconomic factors on mental health in the early phases of the COVID-19 pandemic in the general population in Japan: A web-based survey. PLOS ONE. 2021 Mar 17;16(3):e0247705.

30. Lee H, Singh GK. Monthly trends in self-reported health status and depression by race/ethnicity and socioeconomic status during the COVID-19 Pandemic, United States, April 2020 – May 2021. Ann Epidemiol. 2021 Nov;63:52–62.

31. Graupensperger S, Calhoun BH, Patrick ME, Lee CM. Longitudinal effects of COVID-19-related stressors on young adults' mental health and wellbeing. Appl Psychol Health Well-Being. 2022 Aug;14(3):734–56.

32. Schoon I, Henseke G. Social Inequalities in Young People's Mental Distress During the COVID-19 Pandemic: Do Psychosocial Resource Factors Matter? Front Public Health [Internet]. 2022 Mar 14 [cited 2025 Apr 22];10. Available from: https://www.frontiersin.orghttps://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2022.820270/full

33. Kirkbride JB, Anglin DM, Colman I, Dykxhoorn J, Jones PB, Patalay P, et al. The social determinants of mental health and disorder: evidence, prevention and recommendations. World Psychiatry. 2024 Feb;23(1):58–90.

34. Lorant V, Deliège D, Eaton W, Robert A, Philippot P, Ansseau M. Socioeconomic Inequalities in Depression: A Meta-Analysis. Am J Epidemiol. 2003 Jan 15;157(2):98–112.

35. Paul KI, Moser K. Unemployment impairs mental health: Meta-analyses. J Vocat Behav. 2009 Jun 1;74(3):264–82.

36. Sareen J, Afifi TO, McMillan KA, Asmundson GJG. Relationship between household income and mental disorders: findings from a population-based longitudinal study. Arch Gen Psychiatry. 2011 Apr;68(4):419–27.

37. Sabbatini CE, Pullano G, Di Domenico L, Rubrichi S, Bansal S, Colizza V. The impact of spatial connectivity on NPIs effectiveness. BMC Infect Dis. 2024 Jan 2;24:21.

38. Débarre F, Lecoeur E, Guimier L, Jauffret-Roustide M, Jannot AS. The French Covid-19 vaccination policy did not solve vaccination inequities: a nationwide study on 64.5 million people. Eur J Public Health. 2022 Oct 3;32(5):825–30.

39. Santé publique France. Coronavirus : chiffres clés et évolution de la COVID-19 en France et dans le Monde [Internet]. 2023 [cited 2025 May 20]. Available from: https://www.santepubliquefrance.fr/dossiers/coronavirus-covid-19/coronavirus-chiffres-cles-et-evolution-de-la-covid-19-en-france-et-dans-le-monde

40. WHO. Statement on the fifteenth meeting of the IHR (2005) Emergency Committee on the COVID-19 pandemic [Internet]. 2023 [cited 2025 May 20]. Available from: https://www.who.int/news/item/05-05-2023-statement-on-the-fifteenth-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-coronavirus-disease-(covid-19)-pandemic

41. Storozuk A, Ashley M, Delage V, Maloney EA. Got Bots? Practical Recommendations to Protect Online Survey Data from Bot Attacks. Quant Methods Psychol. 2020 May 1;16(5):472–81.

42. Schober P, Vetter TR. Repeated Measures Designs and Analysis of Longitudinal Data: If at First You Do Not Succeed—Try, Try Again. Anesth Analg. 2018 Aug;127(2):569–75.

43. D.Allison P. Missing Data [Internet]. SAGE Publications, Inc.; 2002 [cited 2025 May 20]. Available from: https://methods.sagepub.com/book/mono/missing-data/toc

44. Dong Y, Peng CYJ. Principled missing data methods for researchers. SpringerPlus. 2013 May 14;2(1):222.

45. Langkamp DL, Lehman A, Lemeshow S. Techniques for handling missing data in secondary analyses of large surveys. Acad Pediatr. 2010;10(3):205–10.

46. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. 2001 Sep;16(9):606–13.

47. Pfizer Patient health questionnaire (PHQ) screeners. Pfizer Patient health questionnaire (PHQ) screeners [Internet]. [cited 2025 May 2]. Available from: https://www.phqscreeners.com/index.html

48. Arthurs E, Steele RJ, Hudson M, Baron M, Thombs BD, Group (CSRG) Canadian Scleroderma Research. Are Scores on English and French Versions of the PHQ-9 Comparable? An Assessment of Differential Item Functioning. PLOS ONE. 2012 Dec 14;7(12):e52028.

49. Manea L, Gilbody S, McMillan D. Optimal cut-off score for diagnosing depression with the Patient Health Questionnaire (PHQ-9): a meta-analysis. CMAJ Can Med Assoc J. 2012 Feb 21;184(3):E191–6.

50. Butterworth P, Rodgers B, Windsor TD. Financial hardship, socio-economic position and depression: results from the PATH Through Life Survey. Soc Sci Med 1982. 2009 Jul;69(2):229–37.

51. Adler NE, Boyce T, Chesney MA, Cohen S, Folkman S, Kahn RL, et al. Socioeconomic Status and Health. Am Psychol. 1994;

52. Lindberg MH, Chen G, Olsen JA, Abelsen B. Combining education and income into a socioeconomic position score for use in studies of health inequalities. BMC Public Health. 2022 May 13;22(1):969.

53. Hoebel J, Maske UE, Zeeb H, Lampert T. Social Inequalities and Depressive Symptoms in Adults: The Role of Objective and Subjective Socioeconomic Status. PLoS ONE. 2017 Jan 20;12(1):e0169764.

54. Arnett JJ, Žukauskienė R, Sugimura K. The new life stage of emerging adulthood at ages 18–29 years: implications for mental health. Lancet Psychiatry. 2014 Dec;1(7):569–76.

55. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Smith GD. Indicators of socioeconomic position (part 1). J Epidemiol Community Health. 2006 Jan 1;60(1):7–12.

56. INSEE. L’essentiel sur... la pauvreté | Insee [Internet]. 2022 [cited 2025 Apr 10]. Available from: https://www.insee.fr/fr/statistiques/5759045#tableau-figure1_radio2

57. INSEE. Salaire minimum interprofessionnel de croissance (Smic) | Insee [Internet]. 2025 [cited 2025 Apr 10]. Available from: https://www.insee.fr/fr/statistiques/1375188

58. Rolfe S, Garnham L, Godwin J, Anderson I, Seaman P, Donaldson C. Housing as a social determinant of health and wellbeing: developing an empirically-informed realist theoretical framework. BMC Public Health. 2020 Jul 20;20(1):1138.

59. Silva M, Loureiro A, Cardoso G. Social determinants of mental health: a review of the evidence. Eur J Psychiatry. 2016 Dec;30(4):259–92.

60. Coulaud P julien, Jesson J, Bolduc N, Ferlatte O, Bertrand K, Salway T, et al. Association between level of compliance with COVID-19 public health measures and depressive symptoms: A cross-sectional survey of young adults in Canada and France. PLOS ONE. 2023 Aug 2;18(8):e0289547.

61. Jenkins EK, McAuliffe C, Hirani S, Richardson C, Thomson KC, McGuinness L, et al. A portrait of the early and differential mental health impacts of the COVID-19 pandemic in Canada: Findings from the first wave of a nationally representative cross-sectional survey. Prev Med. 2021 Apr 1;145:106333.

62. Arel-Bundock V, Greifer N, Heiss A. How to Interpret Statistical Models Using **marginaleffects** for *R* and *Python*. J Stat Softw [Internet]. 2024 [cited 2025 May 24];111(9). Available from: https://www.jstatsoft.org/v111/i09/

63. Lenth RV, Banfai B, Bolker B, Buerkner P, Giné-Vázquez I, Herve M, et al. emmeans: Estimated Marginal Means, aka Least-Squares Means [Internet]. 2025 [cited 2025 May 24]. Available from: https://cran.r-project.org/web/packages/emmeans/index.html

64. Altman DG, Christen MC, Costa B da, Egger M. STROBE. [cited 2025 May 12]. STROBE. Available from: https://www.strobe-statement.org/

65. Wright A, De Livera A, Lee KH, Higgs C, Nicholson M, Gibbs L, et al. A repeated cross-sectional and longitudinal study of mental health and wellbeing during COVID-19 lockdowns in Victoria, Australia. BMC Public Health. 2022 Dec;22(1):1–14.

66. Lo Moro G, Carletto S, Zuccaroli Lavista V, Soro G, Bert F, Siliquini R, et al. The Consequences of the Pandemic on Medical Students’ Depressive Symptoms and Perceived Stress: A Repeated Cross-Sectional Survey with a Nested Longitudinal Subsample. J Clin Med. 2022 Jan;11(19):5896.

67. de Oliveira BN, Lopes MVV, da Costa BGG, de Mello GT, Maciel GP, Silva KS. Bullying in adolescents across three years in the context of the COVID-19 pandemic: a repeated cross-sectional and prospective analysis. BMC Public Health. 2025 Dec;25(1):1–8.

68. Wang D, Li H, Zhang X, Wang X, Qiu Y, Ma Z, et al. Changes and relevant factors in depressive and anxiety symptoms among Chinese adolescents after the “Double Reduction” policy: A repeated cross-sectional survey with a nested longitudinal subsample. J Affect Disord. 2024 Dec 15;367:88–95.

69. McGorry P, Gunasiri H, Mei C, Rice S, Gao C. The youth mental health crisis: analysis and solutions. Front Psychiatry. 2025 Jan 21;15.

70. Almeida M, Shrestha AD, Stojanac D, Miller LJ. The impact of the COVID-19 pandemic on women's mental health. Arch Womens Ment Health. 2020 Dec 1;23(6):741–8.

71. Reich-Stiebert N, Froehlich L, Voltmer JB. Gendered Mental Labor: A Systematic Literature Review on the Cognitive Dimension of Unpaid Work Within the Household and Childcare. Sex Roles. 2023 Jun 1;88(11):475–94.

72. Krueger EA, Barrington-Trimis JL, Unger JB, Leventhal AM. Sexual and Gender Minority Young Adult Coping Disparities During the COVID-19 Pandemic. J Adolesc Health. 2021 Nov 1;69(5):746–53.

73. Hong C, Skiba B. Mental health outcomes, associated factors, and coping strategies among LGBTQ adolescent and young adults during the COVID-19 pandemic: A systematic review. J Psychiatr Res. 2025 Feb;182:132–41.

74. Meyer IH, Frost DM. Minority stress and the health of sexual minorities. In: Handbook of psychology and sexual orientation. New York, NY, US: Oxford University Press; 2013. p. 252–66.

75. Joannès C, Redmond NM, Kelly-Irving M, Klinkenberg J, Guillemot C, Sordes F, et al. The level of education is associated with an anxiety-depressive state among men and women – findings from France during the first quarter of the COVID-19 pandemic. BMC Public Health. 2023 Jul 21;23(1):1405.

76. Herrmann K, Beese F, Wollgast L, Mauz E, Kersjes C, Hoebel J, et al. Temporal dynamics of socioeconomic inequalities in depressive and anxiety symptoms during the COVID-19 pandemic: a scoping review. Front Public Health. 2024 Jul 3;12:1397392.

77. Kravdal Ø, Wörn ,Jonathan, and Reme BA. Mental health benefits of cohabitation and marriage: A longitudinal analysis of Norwegian register data. Popul Stud. 2023 Jan 2;77(1):91–110.

78. Coulaud P julien, Jesson J, Bolduc N, Jenkins E, Richardson C, Jauffret-Roustide M, et al. COVID-19-related stress and positive coping strategies among young adults in Canada and France: A latent class analysis. PLOS Ment Health. 2025 Feb 25;2(2):e0000261.

79. Reiss F. Socioeconomic inequalities and mental health problems in children and adolescents: A systematic review. Soc Sci Med. 2013 Aug 1;90:24–31.

80. Albert PR. Why is depression more prevalent in women? J Psychiatry Neurosci JPN. 2015 Jul;40(4):219–21.

81. Coulaud PJ, Salway T, Adams N, Ball W, Larmarange J, Kelly-Irving M, et al. Knowledge gaps in existing research exploring sexual fluidity and mental health among young adults. J Epidemiol Community Health. 2024 Sep;78(9):556–60.

Appendices

Table A1: STROBE Checklist (Cross-sectional studies)

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	iv
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	v, vi
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1, 2
Objectives	3	State specific objectives, including any prespecified hypotheses	3, 4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4, 5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6- 10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	25- 28
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5- 10

Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10-13
		(*b*) Describe any methods used to examine subgroups and interactions	12
		(*c*) Explain how missing data were addressed	5, 6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	12
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	16, 17
		(b) Give reasons for non-participation at each stage	17
		(c) Consider use of a flow diagram	17
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	18, 19
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	20- 24
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	21- 24, Appendix
Discussion			

Key results	18	Summarise key results with reference to study objectives	25
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	27, 28
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	25-28
Generalisability	21	Discuss the generalisability (external validity) of the study results	27, 28
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Table A2: Comparative analysis of Sample (SDC+SEC and SDC+SEC+PHQ-9)

Variable	Wave 1 (2020) Sample SDC+SEC, N = 2,871[1]	Wave 1 (2020) Sample SDC + SEC+ Depression N = 2,600[1]	p-value[2]	Wave 2 (2021) Sample SDC+SEC, N = 2,083[1]	Wave 2 (2021) Sample SDC + SEC+ Depression N = 1,796[1]	p-value[2]	Wave 3 (2023/2024) Sample SDC+SEC, N = 621[1]	Wave 3 (2023/2024) Sample SDC + SEC+ Depression N = 598[1]	p-value[2]
Sociodemographic characteristics	**n (%)**	**n (%)**		**n (%)**	**n (%)**		**n (%)**	**n (%)**	
Age (Continuous)	22.6 (3.3), 22.0 [20.0 - 25.0]	22.6 (3.3), 22.0 [20.0 - 25.0]	0.4	23.6 (3.3), 24.0 [21.0 - 26.0]	23.6 (3.3), 24.0 [21.0 - 26.0]	>0.9	22.7 (3.5), 22.0 [20.0 - 25.0]	22.6 (3.5), 22.0 [20.0 - 25.0]	>0.9
Age (Categorical)			0.7			>0.9			>0.9
18-20	952 (33.2)	833 (32.0)		471 (22.6)	405 (22.6)		208 (33.5)	198 (33.1)	
21-24	1,088 (37.9)	1,001 (38.5)		719 (34.5)	619 (34.5)		221 (35.6)	217 (36.3)	
25-29	831 (28.9)	766 (29.5)		893 (42.9)	772 (43.0)		192 (30.9)	183 (30.6)	
Gender			0.7			>0.9			>0.9
Man	1,063 (37.0)	943 (36.3)		664 (31.9)	566 (31.5)		231 (37.2)	223 (37.3)	
Woman	1,668 (58.1)	1,537 (59.1)		1,320 (63.4)	1,141 (63.5)		347 (55.9)	335 (56.0)	
Gender minorities	140 (4.9)	120 (4.6)		99 (4.8)	89 (5.0)		43 (6.9)	40 (6.7)	
Sexual Orientation			>0.9			0.6			>0.9
Heterosexual	1,948 (67.9)	1,756 (67.5)		1,511 (72.5)	1,276 (71.0)		385 (62.0)	371 (62.0)	
Bisexual	431 (15.0)	397 (15.3)		259 (12.4)	235 (13.1)		90 (14.5)	84 (14.0)	
Sexual minorities	492 (17.1)	447 (17.2)		313 (15.0)	285 (15.9)		146 (23.5)	143 (23.9)	
Area of Residence			0.8			0.8			0.8
Urban	2,084 (72.6)	1,894 (72.8)		1,433 (68.8)	1,243 (69.2)		430 (69.2)	419 (70.1)	
Rural	787 (27.4)	706 (27.2)		650 (31.2)	553 (30.8)		191 (30.8)	179 (29.9)	
Born in France			>0.9			0.9			0.9
Yes	2,761 (96.2)	2,500 (96.2)		1,996 (95.8)	1,719 (95.7)		597 (96.1)	574 (96.0)	
No	110 (3.8)	100 (3.8)		87 (4.2)	77 (4.3)		24 (3.9)	24 (4.0)	
Education			0.5			0.9			>0.9
Higher Education	1,706 (59.4)	1,584 (60.9)		1,468 (70.5)	1,279 (71.2)		383 (61.7)	371 (62.0)	
Secondary Education/Professional	1,159 (40.4)	1,012 (38.9)		603 (28.9)	507 (28.2)		237 (38.2)	226 (37.8)	
Primary Education	6 (0.2)	4 (0.2)		12 (0.6)	10 (0.6)		1 (0.2)	1 (0.2)	
Socioeconomic characteristics									
Employment			0.9			>0.9			>0.9
Employed and self-employed	818 (28.5)	748 (28.8)		854 (41.0)	725 (40.4)		191 (30.8)	182 (30.4)	
Student-workers	539 (18.8)	497 (19.1)		345 (16.6)	303 (16.9)		355 (57.2)	344 (57.5)	
Unemployed	1,514 (52.7)	1,355 (52.1)		884 (42.4)	768 (42.8)		75 (12.1)	72 (12.0)	
Income			>0.9			>0.9			>0.9
High Income	59 (2.1)	53 (2.0)		101 (4.8)	80 (4.5)		28 (4.5)	27 (4.5)	
Average Income (Above SMIC)	343 (11.9)	310 (11.9)		400 (19.2)	337 (18.8)		126 (20.3)	117 (19.6)	
Low Income (Near or Below SMIC)	832 (29.0)	769 (29.6)		644 (30.9)	561 (31.2)		168 (27.1)	164 (27.4)	
Very Low Income (Below SMIC)	884 (30.8)	807 (31.0)		573 (27.5)	502 (28.0)		171 (27.5)	168 (28.1)	
No income	753 (26.2)	661 (25.4)		365 (17.5)	316 (17.6)		128 (20.6)	122 (20.4)	
Living Arrangement			>0.9			>0.9			>0.9
Alone	877 (30.5)	796 (30.6)		619 (29.7)	531 (29.6)		209 (33.7)	201 (33.6)	
With family members	902 (31.4)	802 (30.8)		589 (28.3)	519 (28.9)		207 (33.3)	199 (33.3)	
With partner	627 (21.8)	586 (22.5)		641 (30.8)	549 (30.6)		127 (20.5)	123 (20.6)	
With roommate/friends	465 (16.2)	416 (16.0)		234 (11.2)	197 (11.0)		78 (12.6)	75 (12.5)	

[1] Mean (SD), Median [Q1 - Q3]; n (%)
[2] Wilcoxon rank sum test ; Pearson's Chi-squared test; Fisher's exact test

Table A3: Distribution of SEI components by outcome

Variable	Wave 1 (2020), N= 2,600 Depressed	Not Depressed	p-value[1]	Wave 2 (2021), N= 1,796 Depressed	Not Depressed	p-value[1]	Wave 3 (2023/2024), N= 598 Depressed	Not Depressed	p-value[1]
Education			**<0.001**			**<0.001**			**<0.001**
Primary Education (=1)	2 (50%)	2 (50%)		4 (40%)	6 (60%)		1 (100%)	0 (0%)	
Secondary Education/Professional (=2)	549 (54%)	463 (46%)		249 (49%)	258 (51%)		146 (65%)	80 (35%)	
Higher Education (=3)	669 (42%)	915 (58%)		480 (38%)	799 (62%)		183 (49%)	188 (51%)	
Employment			**<0.001**			**<0.001**			**0.012**
Unemployed (=1)	727 (54%)	628 (46%)		356 (46%)	412 (54%)		50 (69%)	22 (31%)	
Student-workers (=2)	224 (45%)	273 (55%)		140 (46%)	163 (54%)		191 (56%)	153 (44%)	
Employed and self-employed (=3)	269 (36%)	479 (64%)		237 (33%)	488 (67%)		89 (49%)	93 (51%)	
Income			**<0.001**			**<0.001**			0.071
Low Income (=1)	1,103 (49%)	1,134 (51%)		604 (44%)	775 (56%)		262 (58%)	192 (42%)	
Medium Income (=2)	113 (33%)	226 (67%)		119 (31%)	270 (69%)		65 (48%)	71 (52%)	
High Income (=3)	4 (17%)	20 (83%)		10 (36%)	18 (64%)		3 (38%)	5 (63%)	

[1] Fisher's exact test

Table A4: Multivariable Logistic Regression (Full table)

	Wave 1 (2020), N= 2,600			Wave 2 (2021), N= 1,796			Wave 3 (2023/2024), N= 598		
	Odds Ratios			Odds Ratios			Odds Ratios		
Variable	**AOR**	**95% CI**	**p-value**	**AOR**	**95% CI**	**p-value**	**AOR**	**95% CI**	**p-value**
Age									
18-20	—	—		—	—		—	—	
21-24	0.82	0.67, 1.00	0.055	0.78	0.59, 1.02	0.070	0.85	0.54, 1.36	0.5
25-29	0.83	0.64, 1.07	0.15	0.76	0.55, 1.03	0.078	0.74	0.44, 1.25	0.3
Gender									
Man	—	—		—	—		—	—	
Woman	1.53	1.29, 1.82	**<0.001**	1.40	1.13, 1.74	**0.002**	2.02	1.40, 2.92	**<0.001**
Gender minorities	2.29	1.50, 3.53	**<0.001**	1.88	1.16, 3.06	**0.011**	1.96	0.88, 4.59	0.11
Sexual Orientation									
Heterosexual	—	—		—	—		—	—	
Bisexual	1.51	1.20, 1.91	**<0.001**	1.67	1.25, 2.23	**<0.001**	1.07	0.65, 1.77	0.8
Sexual minorities	1.58	1.26, 1.98	**<0.001**	1.48	1.12, 1.96	**0.006**	2.12	1.35, 3.40	**0.001**
Area of Residence									
Urban	—	—		—	—		—	—	
Rural	1.04	0.86, 1.25	0.7	0.96	0.77, 1.19	0.7	1.04	0.70, 1.53	0.9
Born in France									
Yes	—	—		—	—		—	—	
No	1.24	0.82, 1.89	0.3	1.09	0.67, 1.74	0.7	1.54	0.63, 4.04	0.4
Living Arrangement									
Alone	—	—		—	—		—	—	
With family members	0.78	0.63, 0.97	**0.027**	0.98	0.76, 1.28	>0.9	0.97	0.62, 1.53	>0.9
With partner	0.62	0.49, 0.78	**<0.001**	0.73	0.57, 0.95	**0.019**	0.51	0.32, 0.83	**0.007**
With roommate/friends	0.68	0.53, 0.88	**0.003**	0.76	0.54, 1.07	0.12	0.75	0.42, 1.31	0.3
Socioeconomic Index									
High	—	—		—	—		—	—	
Medium	1.29	0.95, 1.74	0.10	1.34	1.00, 1.81	0.055	0.95	0.54, 1.66	0.9
Low	1.96	1.42, 2.70	**<0.001**	1.69	1.22, 2.35	**0.002**	1.71	0.89, 3.30	0.11

Notes: CI = Confidence Interval, AOR = Adjusted Odds Ratio

Table A5: Sensitivity Analysis (PHQ-9 ≥ 15) - Multivariable Logistic Regression

	Wave 1 (2020), N= 2,600			Wave 2 (2021), N= 1,796			Wave 3 (2023/2024), N= 598		
Variable	**AOR**	**95% CI**	**p-value**	**AOR**	**95% CI**	**p-value**	**AOR**	**95% CI**	**p-value**
Age									
18-20	—	—		—	—		—	—	
21-24	0.72	0.58, 0.90	**0.004**	0.76	0.55, 1.04	0.09	1.01	0.63, 1.62	>0.9
25-29	0.6	0.45, 0.80	**<0.001**	0.77	0.53, 1.11	0.2	0.84	0.48, 1.44	0.5
Gender									
Man	—	—		—	—		—	—	
Woman	1.33	1.09, 1.64	**0.005**	1.1	0.85, 1.44	0.5	2.4	1.62, 3.61	**<0.001**
Gender minorities	1.97	1.29, 3.01	**0.002**	1.04	0.59, 1.79	0.9	2.03	0.95, 4.35	0.067
Sexual Orientation									
Straight/heterosexual	—	—		—	—		—	—	
Bisexual	1.5	1.17, 1.92	**0.001**	1.86	1.34, 2.57	**<0.001**	1.13	0.67, 1.90	0.6
Sexual minorities	1.7	1.33, 2.17	**<0.001**	1.79	1.29, 2.47	**<0.001**	1.99	1.27, 3.13	**0.003**
Area of Residence									
Urban	—	—		—	—		—	—	
Rural	1.07	0.86, 1.33	0.5	0.84	0.64, 1.10	0.2	1.05	0.70, 1.57	0.8
Born in France									
Yes	—	—		—	—		—	—	
No	1.61	1.03, 2.49	**0.035**	1.68	0.98, 2.79	0.053	1.25	0.50, 2.99	0.6
Living Arrangement									
Alone	—	—		—	—		—	—	
With family members	0.76	0.59, 0.97	**0.026**	1	0.73, 1.38	>0.9	1.02	0.64, 1.61	>0.9
With partner	0.71	0.55, 0.93	**0.012**	0.81	0.59, 1.12	0.2	0.63	0.37, 1.07	0.09
With roommate/friends	0.55	0.41, 0.74	**<0.001**	0.71	0.46, 1.09	0.13	0.82	0.45, 1.47	0.5
Socioeconomic index									
High	—	—		—	—		—	—	
Medium	1.56	1.04, 2.41	**0.036**	1.78	1.19, 2.70	**0.006**	1.17	0.63, 2.25	0.6
Low	2.36	1.55, 3.67	**<0.001**	1.87	1.21, 2.93	**0.006**	2.03	1.00, 4.22	0.053

Notes: CI = Confidence Interval, AOR = Adjusted Odds Ratio

Figure A6: Sensitivity Analysis (PHQ-9 ≥ 15) - Marginal Predictions Plot

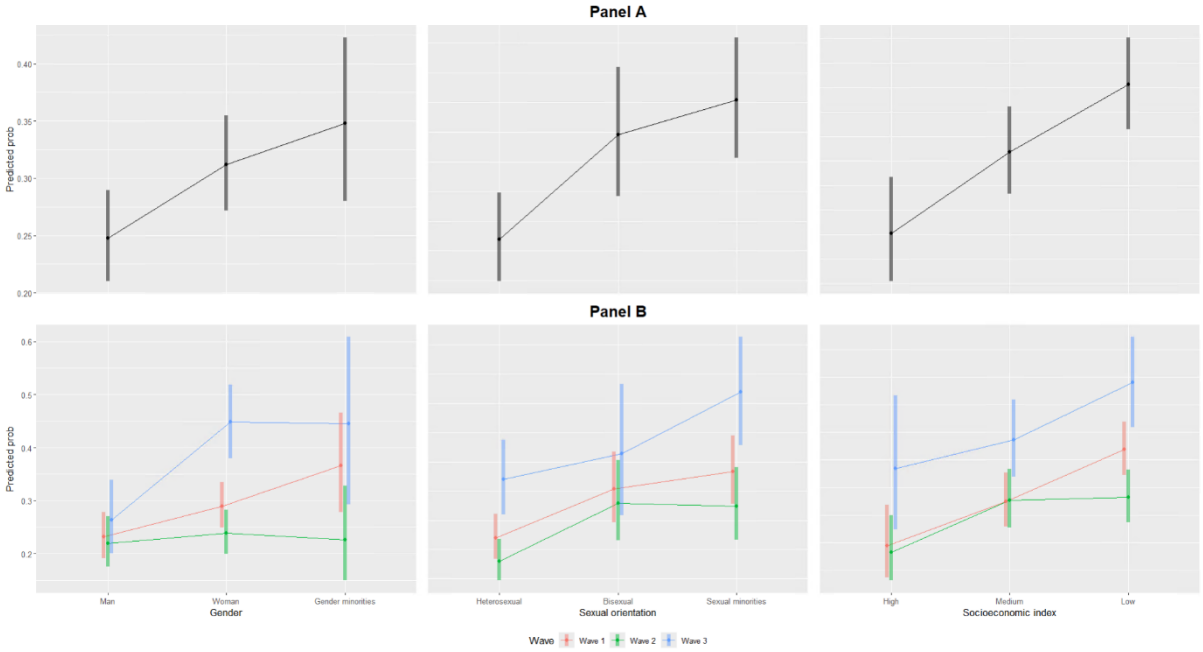


Table A7: Sensitivity Analysis (PHQ-9 ≥ 15) - Multivariable Logistic Regression with and without interaction

	Model 1			Model 2			Model 3			Model 4		
Variable	AOR	95% CI	p-value	AOR	95% CI	p-value	AOR	95% CI	p-value	AOR	95% CI	p-value
Wave												
Wave 1 (2020)	—	—										
Wave 2 (2021)	0.79	0.68, 0.92	**0.002**									
Wave 3 (2023/2024)	1.63	1.34, 2.00	**<0.001**									
Gender												
Man	—	—										
Woman	1.38	1.19, 1.60	**<0.001**									
Gender minorities	1.62	1.20, 2.20	**0.002**									
Sexual Orientation												
Heterosexual	—	—										
Bisexual	1.56	1.29, 1.87	**<0.001**									
Sexual minorities	1.78	1.49, 2.12	**<0.001**									
Socioeconomic index												
High	—	—										
Medium	1.53	1.18, 2.00	**0.001**									
Low	2.08	1.58, 2.76	**<0.001**									
Wave * Gender												
Wave												
Wave 1 (2020)				—	—							
Wave 2 (2021)				0.93	0.71, 1.21	0.6						
Wave 3 (2023/2024)				1.19	0.82, 1.68	0.3						
Gender												
Man				—	—							

Woman	1.35	1.10, 1.65	**0.003**						
Gender minorities	1.91	1.26, 2.89	**0.002**						
Wave 1 * Gender									
Man	—	—							
Woman	1.34	1.06, 1.71	**0.009**						
Gender minorities	1.91	1.17, 3.14	**0.006**						
Wave 2 * Gender									
Man	—	—							
Woman	1.12	0.82, 1.53	0.68						
Gender minorities	1.04	0.55, 1.98	0.99						
Wave 3 * Gender									
Man	—	—							
Woman	2.27	1.42, 3.61	**0.0001**						
Gender minorities	2.24	0.95, 5.24	0.07						
Wave * Sexual Orientation									
Wave									
Wave 1 (2020)				—	—				
Wave 2 (2021)				0.78	0.64, 0.94	**0.009**			
Wave 3 (2023/2024)				1.67	1.28, 2.16	**<0.001**			
Sexual Orientation									
Heterosexual				—	—				
Bisexual				1.54	1.21, 1.97	**<0.001**			
Sexual minorities				1.77	1.40, 2.24	**<0.001**			
Wave 1 * Sexual Orientation									
Heterosexual				—	—				
Bisexual				1.54	1.15, 2.07	**0.002**			
Sexual minorities				1.77	1.34, 2.35	**<0.001**			
Wave 2 * Sexual Orientation									
Heterosexual				—	—				
Bisexual				1.77	1.20, 2.60	**0.002**			
Sexual minorities				1.73	1.19, 2.51	**0.002**			
Wave 3 * Sexual Orientation									
Heterosexual				—	—				
Bisexual				1.21	0.66, 2.23	0.74			
Sexual minorities				1.88	1.15, 3.07	**0.008**			
Wave * Socioeconomic Index									
Wave									
Wave 1 (2020)							—	—	
Wave 2 (2021)							0.93	0.56, 1.54	0.8
Wave 3 (2023/2024)							2.08	1.09, 3.90	**0.023**
Socioeconomic index									
High							—	—	
Medium							1.57	1.06, 2.41	**0.031**
Low							2.43	1.64, 3.70	**<0.001**
Wave 1 * Socioeconomic index									
High							—	—	
Medium							1.57	0.96, 2.57	0.07

Low	2.43	1.49, 3.95	**<0.001**
Wave 2 * Socioeconomic index			
High	—	—	
Medium	1.71	1.06, 2.75	**0.02**
Low	1.76	1.09, 2.84	**0.02**
Wave 3 * Socioeconomic index			
High	—	—	
Medium	1.25	0.63, 2.51	0.72
Low	1.92	0.93, 3.97	0.08

Notes: CI = Confidence Interval, AOR = Adjusted Odds Ratio

A 8: Ethics Approval (The University of Sheffield)

The University Of Sheffield.

Downloaded: 25/03/2025
Approved: 14/03/2025

Aditi Manandhar
Registration number: 230137420
School of Medicine and Population Health
Programme: Europubhealth

Dear Aditi

PROJECT TITLE: Longitudinal Analysis of Mental Health Well-being among Young Adults in Canada and France during and after the COVID-19 pandemic
APPLICATION: Reference Number 066918

This letter confirms that you have signed a University Research Ethics Committee-approved self-declaration to confirm that your research will involve only existing research, clinical or other data that has been robustly anonymised. You have judged it to be unlikely that this project would cause offence to those who originally provided the data, should they become aware of it.

As such, on behalf of the University Research Ethics Committee, I can confirm that your project can go ahead on the basis of this self-declaration.

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since full ethical review may be required.

Yours sincerely

Charlotte Cole
Departmental Ethics Administrator