

THE UNIVERSITY OF CHICAGO

College Students Mental Health:  
Provision, Literacy, and Outcomes

By

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July 2024

A paper submitted in partial fulfillment of the requirements for the  
Master of Arts degree in the  
Master of Arts Program in the Social Sciences

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## Abstract

Recent years have witnessed a decline in college students' mental health (MH). Despite substantial efforts by schools to address this issue, few studies have explored how these efforts impact MH outcomes, particularly regarding mental health knowledge and beliefs. This paper presents empirical evidence on the effect of college MH provisions on MH conditions through mental health literacy (MHL). Utilizing data from the Healthy Minds Study (2017-2022) and a multi-site, multi-mediator instrumental variable (MSMM-IV) framework, I found evidence supporting the mediation effects of MHL, even when the total effects of MH provision remain ambiguous. With adjustment for selection bias, enhancing MH provision at the institution level would likely reduce depression and anxiety among college students primarily through increasing MHL. On average, a one standard deviation increase in the MHL score is associated with a 4.260-point decrease in the depression score and a 4.763-point reduction in the anxiety score, controlling for individual and school characteristics. Evidence for the mediation effect of MH service utilization, excluding the impact of MHL, was mixed.

*Keywords:* mental health, mental health literacy, causal mediation analysis, college students

# 1 Introduction

Recent years have seen a deteriorating trend in mental health (MH) all over the world, especially on college campuses (Oswalt et al. 2020). Among college students, MH problems are not only prevalent but also tend to persist for several years. Given students are in a transitional phase of life, their MH is especially vulnerable to challenges, which can lead to long-term detrimental effects on their functional capabilities (Pedrelli et al. 2015). In response to this MH crisis, many campuses have implemented outreach efforts, including educational programs, awareness events, anti-stigma campaigns, and screening days (American Psychological Association 2022; Time Magazine 2023).

While extensive research has been conducted on the utilization of MH services on campus (Oswalt et al. 2020), few studies have explored the spillover effects of MH provisions, such as their impact on knowledge and attitudes towards mental illnesses. These changes in knowledge and attitude can be significant, as they may lead to improvements in peer support, social norms, and self-care skills. This paper presents an empirical study of the causal mediation effect of school MH provisions on MH outcomes, focusing on mental health literacy (MHL), which encompasses knowledge and beliefs about mental disorders (Jorm et al. 1997).

To estimate the causal effect through MHL, I employ a framework that combines the Multiple-Site, Multiple-Mediator Instrumental Variable (MSMM-IV) approach (Reardon and Raudenbush 2013) with school-level matching. The treatment variable is college MH provision, measured by the proportion of students who perceive the school's MH outreach efforts. The focal mediator in this analysis is MHL, and the second mediator is the utilization of MH services. To mitigate selection bias in between-site comparisons, I used propensity score matching with a continuous variable (Hirano and Imbens 2004) to match institutions with similar characteristics that differ in the perceived level of provision. The outcome is MH conditions, assessed through symptoms of depression and anxiety.

I first applied generalized propensity score matching to construct 157 matched pairs

of institution-by-cohort units with similar characteristics. Within each matched pair, the institutions differed in students' perceptions of the school's MH provisions. This difference was then used as an instrumental variable to identify the causal relationship between students' MHL and their MH outcomes. The analysis was conducted using a multi-site multiple-mediator instrumental variable (MSMM-IV) approach, where the matched pairs served as the sites. To strengthen the causal inference, the study controlled for students' baseline characteristics and carefully addressed the identification assumptions required by the MSMM-IV strategy. To increase the plausibility of the exclusion restriction assumption and the parallel mediator assumption, I further residualized the measure of MH service utilization and included it as a second mediator in the analysis.

To conduct empirical study, I utilize data from the National Healthy Minds Study (HMS) from 2017 to 2022, a comprehensive survey dedicated to examining MH-related issues among undergraduate and graduate students across the North America. By leveraging the unique modules of the HMS, this study investigates critical aspects of MH, including knowledge and beliefs, MH status, and services utilization, thereby offering a multifaceted perspective on MH within academic settings.

Although the total effects of MH provisions are ambiguous, I found evidence of a positive association between MHL and MH conditions. On average, controlling for institutional and individual characteristics, a one standard deviation increase in the MHL score is associated with a 4.260-point decrease in the depression score and a 4.763-point decrease in the anxiety score. The evidence for the mediation effect of service utilization, excluding the impact of MHL, was mixed.

This thesis contributes to social sciences research in several important ways. Although MH is widely discussed, few studies have applied quantitative methods to such topics and provided empirical evidence on the relationship between MHL and MH based on observational studies (Murdoch 2016). Even fewer studies have considered the concurrent effects of MHL and MH service utilization on outcomes. This paper serves as a pilot study investigating the primary mechanisms behind school

provisions.

In terms of methodological contribution, this paper introduces a novel causal inference approach that combines institutional matching based on generalized propensity score with the use of an instrumental variable to overcome the challenges posed by non-experimental research design. This approach extends the work of Hirano and Imbens (2004) and Reardon and Raudenbush (2013).

This study also offers valuable policy implications for improving MH conditions across populations, particularly within the highly-educated demographic. MHL is highlighted as a key strategy in the World Health Organization's (WHO) international Comprehensive Mental Health Action Plan (2013–2030) (WHO 2021). Compared to establishing a comprehensive mental healthcare system, enhancing MHL may be less costly and easier to implement. Beyond treating mental illnesses, it is essential to invest in public perceptions of MH, reduce stigma, and promote self-help and help-seeking initiatives. Over the past decade, interest in MHL has grown in health promotion, driven by increased recognition of MHL as a modifiable determinant of mental health. MHL is increasingly associated with the health-promoting school approach that has emerged over the last two decades. To successfully promote MHL, it is crucial to evaluate effective strategies and interventions using validated instruments (Bjørnsen, Bjørnebekk, and Brandmo 2024).

The remainder of the paper is organized as follows: Section two reviews the relevant literature in social sciences and epidemiology. Section three describes the data source. Section four outlines the research design, including theoretical and empirical frameworks. Section five presents the main results. The last section discusses the conclusions and implications.

## 2 Literature Review

### 2.1 Concept of Mental Health Literacy

Mental health literacy (MHL) was first coined by a group of Australian psychologists in 1997 and is defined as “knowledge and beliefs about mental disorders which aid their recognition, management, or prevention” (Jorm et al. 1997, p.182). It articulates six focus areas: (1) the ability to recognize specific disorders or types of psychological distress; (2) knowledge and beliefs about risk factors and causes; (3) knowledge and beliefs about self-help interventions; (4) knowledge and beliefs about professional help available; (5) attitudes which facilitate recognition and appropriate help-seeking; and (6) knowledge of how to seek mental health information (Jorm 2000).

Nowadays, MHL also represents a growing initiative that aims at fostering more accurate and extensive knowledge about the existence, care, and treatment of mental illness worldwide. MHL programs encompass various forms of MH education, promotion, or awareness campaigns, all sharing the goal of reducing the prevalence of mental disorders through early recognition and promoting proper help-seeking practices and knowledge. MHL is outlined as a primary strategy and goal in the World Health Organization’s (WHO) international Comprehensive Mental Health Action Plan (2013–2030), with the goals of “increased public knowledge and understanding about mental health, how to stop discrimination and how to access services, through media awareness campaigns and initiatives that involve persons with lived experience of mental disorders and psychosocial disabilities” (WHO 2021, p.27). The plan outlines “universal and targeted” school-based promotion and prevention as one of its primary strategies, including socio-emotional and skills learning. Outside of the WHO, the most rapidly growing sector adopting MHL is education – largely due to the well-documented findings that up to 75% of mental disorders onset before the age of 24 (Fusar-Poli 2019). This includes programming targeted to parents, educators, and students. While they are increasingly becoming implemented as part of global MH efforts, little research has examined the efficacy of these programs (Kutcher, Wei,

and Coniglio 2016).

MHL applies concepts of health literacy to psychiatric illness. Physical health literacy, which entered the health care space just a few years earlier, describes “the ability to gain access to, understand, and use information in ways which promote and maintain good health” (Nutbeam et al. 1993, as cited in Jorm 2000). Health literacy includes knowledge and practices such as maintaining a healthy diet, taking actions to prevent skin cancer, or knowing how to search for health information. Based on MHL research, Kutcher et al. (2016, p.567) has extended this concept, pointing out “understanding how to obtain and maintain good mental health” as one of the key components of MHL. Three attributes of MHL were thus incorporated, including (1) the recognition of mental disorders, (2) help-seeking efficacy, and (3) help-seeking strategies. Bjørnsen et al. (2017) emphasized that this conceptualization goes beyond previous notions of MHL as mere knowledge of mental disorders and proposed the concept of Positive Mental Health Literacy (hereafter positive MHL). This aspect of MHL serves as the first step and the central element of MH promotion (Carvalho et al. 2022).

Several studies have developed the quantitative measurement of MHL. The seminal study of MHL measurement is the Mental Health Literacy Scale (MHLS). Invented by O’Connor and Casey (2015), the MHLS encompasses 35 items, covering all six attributes of the MHL. Some studies focus specifically on schools and young adults. The Mental Health Literacy Questionnaire for Young Adults (MHLq-YA) comprises 29 items and four dimensions: Knowledge of mental health problems, Erroneous beliefs/stereotypes, Help-seeking and first-aid skills, and Self-help strategies (Dias et al. 2018). Other studies incorporate the aspect of positive MHL (Bjørnsen, Bjørnebekk, and Brandmo 2024). Generally, although many studies have developed ways to measure MHL, a conclusive measurement has yet to be determined.

## **2.2 Theory of Literacy and Outcomes in Health**

Generally, health is defined as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (WHO 1948), and mental

health (MH) is described as “a state of mental well-being that enables people to cope with stresses, realize abilities, build relationships, and function well” (WHO 2022).

The construct of MHL has emerged from the broader domain of health literacy (HL), which was initially informed by observations that low functional literacy is associated with numerous poor health outcomes (Paasche-Orlow and Wolf 2007). HL has since evolved into a broader construct that is considered fundamental to improving individual health outcomes, decreasing health inequities across populations, and enhancing the operation of health systems and the development of health policy (Kutcher, Wei, and Coniglio 2016). Consequently, HL is now recognized as essential for improving health outcomes at both the individual and population levels. There is substantial empirical evidence supporting the positive relationship between HL and health outcomes, as demonstrated in a meta-analysis by Berkman et al. (2011). Importantly, Paasche-Orlow and Wolf (2007) outlines three causal pathways linking HL to health outcomes: (1) access and utilization of health care, (2) patient-provider relationships, and (3) self-care. These pathways are also applicable to MH.

In other fields of social sciences, supporting theories further underpin this hypothesis. For example, in health economics, Grossman (1972) formulated the health production function, where health is interpreted as a form of human capital that endures over time and can accumulate or depreciate. The stock of health capital at any given time is determined by the initial endowment (stock from the previous period), investment (time and effort spent on health), a depreciation term, and random shocks. The Grossman model posits that better-educated individuals tend to experience fewer health problems because they are more efficient producers of health. This advantage may manifest in better understanding of medical instructions or greater sophistication in avoiding infections. Since better-educated individuals are more efficient health producers, they receive higher returns from health investments (Bhattacharya, Hyde, and Tu 2014). The concepts of initial endowment and investment apply to both mental and physical health (Golberstein and Busch 2014). As an integral component of health, MH can also be interpreted as human capital, and education in MH is a potentially ef-



fective way to prevent mental illness. Therefore, we expect MH outcomes to improve as knowledge of MH increases. Meanwhile, psychology studies show that increasing knowledge and understanding can promote empathy, support, and acceptance, creating a more inclusive and supportive environment for individuals with MH concerns (Corrigan et al. 2001; Thoits 2011).

However, it is important to recognize that MHL assumes the underlying mechanism of mental well-being is rooted in psychopathology, a perspective that has been questioned by social scientists and critical public health workers. As an initiative aimed at promoting “accurate” MH knowledge and practices, MHL relies on a specific epistemic and ideological foundation, such as the Diagnostic and Statistical Manual of Mental Illnesses (DSM), rather than on social experiences. Consequently, MHL may overlook the fact that diagnostic criteria and expressions of distress vary based on individuals’ identity, context, and experience (Abramowitz 2010; Tol et al. 2013). Validation studies on MHL measurements in non-Western contexts have also shown that attitudes and beliefs derived from Western psychiatric studies often appear unreliable (Nejatian et al. 2021; Campos et al. 2022). This may reflect the inappropriateness of Western narratives and language in MH for other populations.

Moreover, MHL and similar campaigns that promote a particular way of speaking about and acting upon experiences of distress may create “looping effects”—the iterative process by which categories of disorder influence expressions of disorder, just as the expressions of disorder influence the categorizations (Hacking 1999). Thus, while these initiatives may improve knowledge about MH, they may do so through a labeling mechanism. A systematic review of studies conducted on the WHO initiative found that, although MHL interventions effectively increased MH knowledge, they did not significantly reduce stigma or improve help-seeking behavior (Amado-Rodriguez et al. 2022). Additionally, MHL assumes that access to “knowledge” leads to access to “care” and subsequently results in changes in health behaviors. However, this assumption is highly contingent on social, economic, and cultural contexts (Lea 2008; Summerfield 2012). Therefore, it is crucial to acknowledge that the external va-

lidity of research on MHL should be strictly limited to Western developed countries.

### **2.3 Effect of Mental Health Literacy**

Several randomized controlled trials provide empirical evidence for the effect of MHL on MH outcomes. Focusing on the diversity of undergraduate students in terms of demographic, psychological, and academic correlates, Miles et al. (2020) constructed a single multifaceted model and found that the main contributors to variation in MHL were having taken a clinical psychology course, followed by majoring in psychology. Similarly, Smith and Shochet (2011) reports that first-year undergraduate students with higher MHL have greater intentions to seek help from professional sources. Learning about the signs and symptoms of MH disorders helps individuals recognize when they or someone they know may be experiencing an MH issue. Early identification and intervention can lead to timely support and treatment, improving outcomes for individuals with MH concerns. Regarding the mediation effect of MHL, Zhang, Ji, and Zhou (2023) found that the indirect effect of MHL accounted for 50.43% of the total impact between psychological resilience and psychological distress, indicating that adolescents with high levels of MHL have higher psychological resilience and are less likely to experience psychological distress.

Previous studies also explore the relationship between school MH outreach and stigma, as well as the connection between stigma and MH outcomes. A randomized controlled trial conducted in high schools found that school-based MH curricula significantly increased MH knowledge and reduced stigma among students (Milin et al. 2016). Stigma, in turn, has a notable association with the MH of stigmatized groups (Mak et al. 2007; Sickel, Seacat, and Nabors 2014). Extensive research has examined the utilization of MH services on campuses and how stigma impacts this utilization. For instance, Eisenberg et al. (2009) found that personal stigma was significantly and negatively associated with help-seeking measures, with higher levels of stigma observed among students who are male, younger, Asian, international, or from low-income families. A more recent study also shows that perceived stigma and per-

sonal stigma are significantly and positively correlated, and both affect help-seeking behaviors (Pompeo-Fargnoli 2022).

In conclusion, while the effectiveness of MHL initiatives in cross-cultural contexts remains more ambiguous, the reviewed literature highlights the significant role of MHL in improving MH outcomes, particularly through early identification and intervention, enhanced help-seeking behaviors, and increased psychological resilience. Moreover, the interplay between stigma and MH service utilization underscores the complex dynamics that influence MH outcomes, presenting challenges for empirical analysis. Based on the existing studies, I hypothesize that improving MHL has a positive causal effect on college students' MH status.

### 3 Data

The data source for this study is the National Healthy Minds Study (HMS), hosted by the Healthy Minds Network (2017-2022), one of the nation's premier research organizations focused on adolescent and young adult MH. HMS is a survey study that examines MH, service utilization, and related issues, with a particular emphasis on understanding help-seeking behavior and examining stigma, knowledge, and other potential barriers to MH service utilization. Each year, the questionnaire is distributed online to undergraduate and graduate students at colleges and universities across the United States and Canada. Since its national launch in 2007, HMS has been fielded at over 530 institutions, with more than half a million survey respondents. Starting from the 2017-2018 academic year, the public datasets have included institutional characteristics such as school size, institution type, public/private status, academic rank, geography, specialty, and graduation rate, enabling researchers to explore MH through the lens of the institutional environment.

The HMS questionnaire includes both core and elective modules. All participants are required to complete the core modules, while elective modules are selected by participating institutions. One core module, *Mental Health Status*, contains several

evidence-based, validated measures for mental illnesses, such as major depressive disorder and generalized anxiety disorder. Another core module, *Mental Health Services Utilization/Help-Seeking*, provides information on MH services utilization on campus. The elective module, *Knowledge and Beliefs about Mental Health and Mental Health Services*, includes questions that assess respondents' awareness of MH outreach efforts in their school, their factual knowledge of various mental illnesses, and their attitudes toward MH disorders.

I operationalize MHL as both knowledge and attitudes toward MH and mental disorders, which I approximate using the standardized sum of scores in MH-related knowledge and stigma/discrimination. The knowledge score is derived by averaging the normalized scores for knowledge of depression symptoms, anxiety self-help strategies, and eating disorder symptoms. The stigma score is computed by averaging the normalized scores of perceived stigma, personal stigma, and stigma towards services, and then reversing the score so that lower values indicate higher levels of stigma. I use a composite score because both knowledge and attitude are essential components of MHL (O'Connor and Casey 2015; Dias et al. 2018). To align with the interpretation that higher MHL corresponds to more positive MH outcomes, I reverse the stigma and discrimination scores so that lower values indicate higher levels of stigma. This adjustment reflects the concept that higher stigma or discrimination is associated with lower MHL. By combining these scores, the composite measure captures a more comprehensive picture of an individual's MHL, reflecting both cognitive and affective dimensions. This holistic assessment provides a robust indicator for research and practical applications.

Knowledge is measured using multiple-choice questions with correct and incorrect answers, serving as objective measurements of respondents' understanding of mental illnesses. Four questions are included, which are (1) Identify the common symptoms of depression, (2) identify the effective treatments for depression, (3) Identify the effective self-help strategies for anxiety, and (4) Identify the common symptoms of eating disorders. These questions are viewed as a series of True/False questions and coded

as multiple dichotomous items. Choosing an item means the respondent believes it is true. In this case, each of the questions can be seen as a scale, and the sum score will identify their ability to recognize disorders and effective treatment. Specifically, if they select the correct item, they receive one point; otherwise, they receive zero points. If they correctly avoid selecting an incorrect item, they receive one point; otherwise, they receive zero points. I sum up the score for each question and use the scores as the measurements of knowledge in different aspects <sup>1</sup>.

Beliefs, including stigma and discrimination, are measured by groups of items developed by the Healthy Minds Network or validated in previous studies. The available types of stigma during the time frame include perceived stigma (how a person believes the majority will stigmatize others with MH problems), personal stigma (how a person stigmatizes others with MH problems), and stigma toward professional MH services. <sup>2</sup>

For assessing MH conditions, I employ several standard measures from clinical psychology to evaluate tendencies toward depression, anxiety, and other mental illnesses. The Patient Health Questionnaire depression screen summary score (PHQ-9) is a validated screening tool for major depression. This variable includes nine components, asking respondents questions such as whether they have been bothered by having little interest or feeling depressed over the past two weeks. The score ranges from 0 to 24, with higher scores indicating a higher tendency for depression; a score of 12 or greater suggests the likelihood of major depressive disorder. Similarly, the General Anxiety Disorder-7 (GAD-7) score ranges from 0 to 15 and measures the severity of anxiety.

Although the HMS does not disclose a school identifier that would allow us to trace schools across different cohorts, it has provided institutional characteristics since 2017. These available characteristics include enrollment size, institution type, flags for arts

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1. I calculated Cronbach's alpha to ensure the reliability of these questions. If any questions show low Cronbach's alpha, then it may not be a reliable measure of the knowledge in treatments, and I would remove them from the subsequent analysis. (2) Identify the effective treatments for depression is removed. See Appendix B.2 for reliability analysis.

2. See Appendix B.1 for a detailed list of survey questions.

and design schools and community colleges, public/private status, academic rank, graduation rate, and geographic location.

Table 1: Sample Size by Quarter

Quarter	(1) No. Schools	(2) No. Students
2017 Q3	9	4,569
2018 Q1	22	16,839
2018 Q3	24	9,675
2019 Q1	21	6,899
2019 Q3	26	11,825
2020 Q1	18	9,134
2020 Q3	24	8,550
2021 Q1	75	24,635
2021 Q3	19	9,808
2022 Q1	69	18,758
Total	307	120,692

*Notes.* This sample is used in both the depression and anxiety analysis (i.e. the intersection of two estimate samples).

Table 1 shows the number of colleges and students in each quarter from the third quarter of 2017 to the first quarter of 2022. The sample sizes vary significantly, with the highest number of schools sampled in the first quarter of 2021 (75 schools) and the highest number of students sampled in the same quarter (24,635 students). The total sample across all quarters consists of 307 schools and 120,692 students, providing a robust basis for the analyses among institutions and students.

## 4 Research Design

### 4.1 Theoretical Model

This study adapts the multiple-site, multiple-mediator instrumental variables (MSMM-IV) framework by Reardon and Raudenbush (2013) to analyze the effects of MHL and service utilization on the impact of school MH provisions. In this framework, each school pair serves as a site, with school MH provision as the treatment. The focal mediator is MHL, and the secondary mediator is residualized MH service utilization,

while the outcome variable is MH status.

The instrumental variable (IV) approach is widely recognized for addressing the issue of selection bias, where treatment assignment and outcomes are correlated or confounded by other factors (Angrist, Imbens, and Rubin 1996). In the context of MHL and MH status, individuals with poorer MH may be more motivated to learn about mental illnesses and naturally more exposed to related information. However, to measure how MHL leads to changes in MH conditions, it is crucial to exclude associations arising from this reverse direction.

For an instrument to be valid, it must be relevant, exogenous, and excluded from directly influencing the potential outcomes (Angrist, Imbens, and Rubin 1996). To meet the requirement, researchers typically use the availability of a resource as an instrument. Yet most of the universities and colleges in North America provide certain programs in MH (see also in Figure 2). Therefore, I use the strength of the availability of MH-related activities and information, proxied by the proportion of students aware of the college's MH provisions, as the instrument. The level of awareness of MH provisions among students is relevant to MHL due to network externality: as more students become aware of the available MH services on campus, exposure to MH-related knowledge increases. This instrument is also exogenous because individual students cannot influence school-level characteristics, and it is generally unlikely that students choose their institution based on its MH provisions.

However, it is important to note that MHL is not the only pathway through which MH provisions can affect students' MH outcomes. While these provisions influence students' perceptions of mental illness and shape their cognition, they also promote mental healthcare and encourage help-seeking behaviors (Paasche-Orlow and Wolf 2007). The conventional IV framework is thus insufficient for addressing causal effects in a multi-mediator scenario. To address this complexity, analysts have recently leveraged the fact that causal processes are often replicated across multiple sites, allowing for multiple instruments in the form of site-by-instrument interactions (Kling, Liebman, and Katz 2007; Duncan, Morris, and Rodrigues 2011). These multiple instru-

ments enable the identification of the impact of multiple processes considered mediators of the instrument's effect. This approach, summarized by Reardon and Raudenbush (2013), is called the Multiple-Mediator Instrumental Variable (MSMM-IV) framework. The MSMM-IV framework relaxes the exclusion restriction by allowing more mediators to be included while still requiring that the treatment affects the outcome only through its effects on the set of mediators. Arguably, the proportion of students aware of MH provisions could influence an individual's MH status only through its effect on cognition (MHL) and behaviors (MH service utilization), thus maintaining the exclusion restriction.

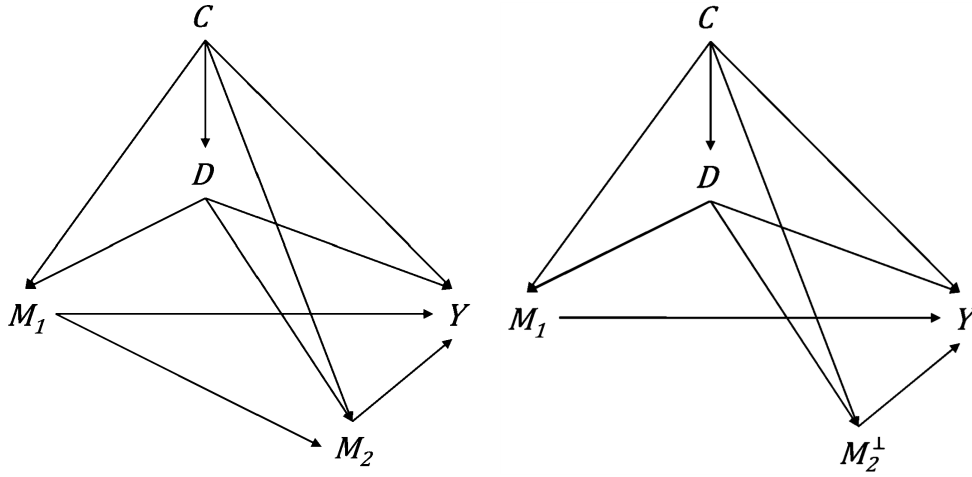
In a multi-site situation, subjects within a multi-site trial are exposed to a certain level of instrument, which impacts on the outcome through distinct mediators. The key feature of the MSMM-IV framework is its ability to identify these effects by treating site-specific values of the intent-to-treat effect as outcomes in a regression where multiple site-specific compliance levels are predictors. Besides exclusion restriction, another eight assumptions are required to identify the effects of these mediators (Reardon and Raudenbush 2013).

The first assumption is the stable unit treatment value assumption (SUTVA), which posits that an individual's potential outcomes depend only on the treatment and mediator conditions to which that individual is exposed, without being influenced by the treatment and mediator conditions of others. Given that students' MH conditions can be affected by social networks (Eisenberg et al. 2013; Alho et al. 2024), I introduced various subdivided cohort indices, such as interactions between year of schooling and degree program, and between gender and race, to control for between-cohort differences in MH conditions and to estimate the effect of MHL more precisely.

The second assumption requires consideration of the relationships among variables. The left panel of Figure 1 illustrates the potential causal linkages between school provision, MHL, and students' MH outcomes within each site. The set of baseline covariates that have demonstrated confounding effects on the exposure-outcome, exposure-mediator, mediator-outcome, and mediator-mediator relationships in previ-



Figure 1: Hypothesized Treatment and Mediator Effects within Each Site



ous studies are collectively denoted by  $C$ . The instrument, denoted by  $D$ , is a continuous variable representing the proportion of students who are aware of the school's MH efforts. The outcome variable,  $Y$ , represents MH status, measured by the PHQ-9 for depression and GAD-7 for anxiety.

The mediator of interest,  $M_1$ , is MHL, while the secondary mediator,  $M_2$ , measures whether the individual has utilized MH services. To identify the effects of multiple mediators, the MSMM-IV framework assumes that the mediators are parallel. However, attitudes towards services and stigma significantly impact help-seeking behavior (Eisenberg et al. 2009; Oswalt et al. 2020; Pompeo-Fagnoli 2022), suggesting a potential causal order between the two mediators from  $M_1$  to  $M_2$ . Given the cross-sectional data structure, the temporal precedence between these mediators is unobservable. To address this potential bias, I regress  $M_2$  on  $M_1$  and use the residuals, denoted as  $M_2^\perp$ . In this way,  $M_2^\perp$  is orthogonal to  $M_1$  and can be treated as a concurrent and uncorrelated mediator (Qin, Deutsch, and Hong 2021), as depicted in the right panel of Figure 1.

Within each site, the assignment of the instrument must also be independent of the potential outcomes. However, institutional characteristics can confound the treatment (MH provision) and the outcome (MH status): students at schools with lower graduation rates and more competitive rankings may experience greater academic stress, making them more susceptible to MH problems. To address this, I first match institu-

tions with similar characteristics but differing levels of perceived MH provision, with each matched pair of schools serving as a site. Within each site, the perceived level of MH provision can be considered as good as random. Additionally, the large sample size of HMS ensures that the number of sites (i.e., school pairs) exceeds the number of mediators, satisfying the sufficient rank assumption for the site-by-compliance matrix.

Additionally, there are two assumptions regarding the compliance effect (i.e., the effect of the instrument on the mediator). First, within each site, the compliance-effect covariance for each mediator should be zero. In other words, the effect of MH provision on MHL and the effect of MHL on MH status should be independent of each other. This assumption is likely to hold because, given institutional characteristics, the effect of MH provision is more dependent on its quality and advertisement, while the effect of MHL on MH status may be influenced by other factors, such as students' ability to apply knowledge in practice. The effectiveness of MH service utilization is similarly driven by the quality of the services. Second, across different sites, the average compliance should be independent of the average effect of mediators. This assumption is also arguably valid, as the compliance effect is influenced by the general culture surrounding MH, while the mediators' effects depend on students' motivation to improve their MH conditions.

## 4.2 Empirical Model

### 4.2.1 Propensity Score Matching at Institutional Level

To create multiple sites, I first matched institutions that share similar characteristics but differ in the perceived level of service provision based on the generalized propensity score (Hirano and Imbens 2004). Specifically,

$$D_c = \alpha_0 + \alpha_1 S_c + \theta_c + \varepsilon_c \quad (1)$$

In this equation,  $D_c$  is the continuous treatment variable that represents the perceived strength of MH provision for college  $c$ .  $S_c$  represents a vector of institutional charac-

teristics, including student enrollment size, institution type, flag for arts and design school, flag for community college, publicity, academic rank, graduation rate, and geographic location.  $\theta_c$  denotes the quarter fixed-effect, as schools' MH provisions may vary by time, especially during the pandemic era.  $\alpha_0$  is the constant term, and  $\varepsilon_c$  is the error term, which captures unobserved institutional factors that may influence MH provision, such as the attention given to MH by school management and boards. The treatment variable  $D_c$  is regressed on the covariates  $S_c$  and  $\theta_c$  to obtain the generalized propensity score values for each institution. These propensity score values represent the likelihood of an institution receiving a particular level of MH provision, given its observed characteristics.

Next, I paired institutions based on their generalized propensity scores to balance institutional covariates across different levels of MH provision. This balanced sample is used to estimate the causal effect of the continuous treatment on the outcome variable by comparing outcomes within strata of similar propensity scores. Each site (hereafter represented by the subscript  $s$ ) contains students from two institutions.

#### 4.2.2 Two-stage Regressions

The second set of empirical models employs the MSMM-IV framework and two-stage regressions to conduct causal mediation analyses. Before implementing this framework, I residualize the mediators to obtain the effect of MH utilization that is orthogonal to MHL. In the first stage, the mediators ( $M$ ) and the outcome ( $Y$ ) are regressed on the instrument ( $D$ ) and other baseline covariates for student characteristics ( $C$ ). These regressions are conducted site-by-site, generating three vectors of estimated coefficients for the instrument. The second stage is conducted at the aggregate site level, where the estimated coefficient from the first-stage outcome model is regressed on the estimated coefficients from the models for mediators. The coefficients obtained in this model are the estimates of the site-average mediation effects.

Since the MSMM-IV model assumes person-specific linearity of the mediators with respect to the treatment, and person-specific linearity of the outcome with respect to

the mediators, I use linear regressions for all models for mediators and the outcome <sup>3</sup>.

Equation 2 shows the residualization of  $M_2$  on  $M_1$  within each site. Particularly,  $M_{2i,s}^\perp$  is the difference between the actual value of  $M_{2i,s}$  and the fitted value of the linear model where  $M_{2i,s}$  is regressed on  $M_{1i,s}$ :

$$M_{2i,s}^\perp = M_{2i,s} - (b_0 + b_1 M_{1i,s}) \quad (2)$$

$M_{2i,s}^\perp$  is the residual that captures the  $M_2$  effect not explained by  $M_1$ . For instance,  $M_{2i,s}^\perp$  might contain others' encouragement or external incentives that persuade student  $i$  to utilize MH services.

The first-stage regressions (Equation 3, 4, and 5) are conducted site-by-site, with the unit of observation as student individual  $i$ . The mediators ( $M_{1i,s}$  and  $M_{2i,s}$ ) and the outcome ( $Y_{i,s}$ ) are treated as dependent variables, denoting the MHL score, services utilization, and MH status for individual  $i$  in site  $s$ . The predictors are instrument ( $D_{i,s}$ ) and baseline covariates ( $C_{i,s}$ ), representing the level of perceived MH provision in the school of student  $i$  and his/her characteristics. The vector  $C_{i,s}$  consists of age, flag for international students, financial situation, flag for previous prescription of mental illnesses, the interaction term between degree program and year of schooling, the interaction term between gender and race, and the quarter when the survey was answered.

$$M_{1i,s} = \gamma_{0s}^1 + \gamma_{1s}^1 D_{i,s} + \gamma_{2s}^1 C_{i,s} + \varepsilon_{i,s}^1 \quad (3)$$

$$M_{2i,s}^\perp = \gamma_{0s}^2 + \gamma_{1s}^2 D_{i,s} + \gamma_{2s}^2 C_{i,s} + \varepsilon_{i,s}^2 \quad (4)$$

$$Y_{i,s} = \beta_{0s} + \beta_{1s} D_{i,s} + \beta_{2s} C_{i,s} + \varepsilon_{i,s}^Y \quad (5)$$

Specifically,  $\gamma_{1s}^1$  represents the average compliance for  $M_1$  in site  $s$ , which is the average

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3. While one may be concerned that the secondary mediator is a binary outcome variable and not suitable for a linear regression, studies have argued that for many applications, the estimated coefficients from a linear probability model can be very close to the average partial effects obtained from logit and probit models (Wooldridge 2010).

effect of the MH provision on MHL given a certain level of institutional characteristics and controlling for student characteristics. Similarly,  $\gamma_{1,s}^2$  represents the average compliance of MH provision on services utilization. On the other hand,  $\beta_{1,s}$  captures the intent-to-treat effect in site  $s$ , which is the total effect of MH provision on students' MH conditions.

The second-stage regression is conducted at the site level, with the unit of analysis being the site. The fitted value of  $\beta_{1,s}$  is regressed on the fitted value of  $\gamma_{1,s}^1$  and  $\gamma_{1,s}^2$ :

$$\widehat{\beta}_{1,s} = \delta_0 + \delta_1 \widehat{\gamma}_{1,s}^1 + \delta_2 \widehat{\gamma}_{1,s}^2 + \varepsilon_s \quad (6)$$

Here,  $\delta_1$  is the parameter of interest, estimating the average effect of MHL on MH outcomes across different sites.

## 5 Results

### 5.1 Summary Statistics

Figure 2: Perceived Level of School Provision

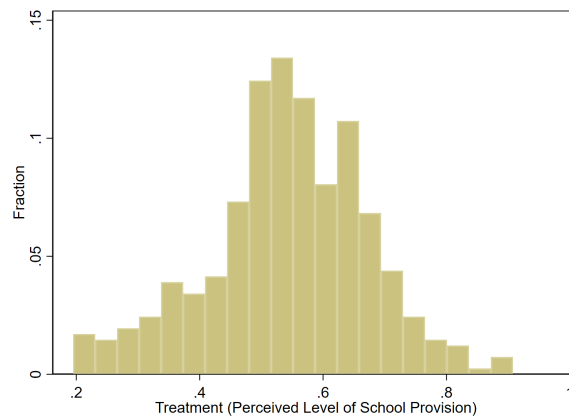


Figure 2 illustrates the distribution of the perceived level of school provision, measured by the ratio of respondents who report being aware of school outreach efforts in MH for each institution. The distribution is approximately normal, with most institutions centered around the 0.5 to 0.6 range. The distribution peaks at around 0.55,

indicating that a substantial proportion of respondents perceive the level of school MH provision to be moderately high.

Table 2 presents the summary statistics of school characteristics. 307 colleges and universities are contained in both analyses for depression and anxiety. Over half of the institutions (53.1%) provide MH services. The majority (65.5%) of schools in the sample are public. A smaller portion (30.3%) of schools are either community colleges or specialized in arts. The average graduation rate is 54.2%. Institutions are diverse in size, with the largest category being those with 1,000-4,999 students (36.8%). Doctorate-granting universities form the largest type category (35.2%), followed by Master's Colleges/Universities (23.8%). Geographically, institutions are most prevalent in the Northeast Region New England Division (20.2%). In terms of academic rank, institutions are widely distributed, with the largest segment (50.5%) being classified under Special/Missing, indicating diverse levels of academic competitiveness.

Table 3 provides summary statistics for various student characteristics across a sample size of 120,692 students. The mean of the focal mediator, MHL score, is 0.448 out of 1, with a standard deviation of 0.171, indicating a relatively low level and moderate variability in MHL among students. Depression symptoms and anxiety self-help strategies have means of 3.611 and 3.528, respectively, suggesting moderate levels of these concerns. Eating disorder symptoms have a higher mean of 5.030, with a standard deviation of 1.307. Stigma is measured on multiple scales, with perceived stigma having a mean of 9.581 and personal stigma having a mean of 11.43.

As for demographic composition, the average age of students is around 21. I selected the sample to be aged between 18 and 30 to obtain a more accurate estimation of the young adults. A small proportion (5.88%) of students are international, and 41.1% have ever been diagnosed with an MH condition. The racial composition is predominantly White (70.7%), followed by Asian (10.4%), Black (5.93%), and other categories. Regarding degree pursuit, the majority of the sample (71.3%) are in Bachelor's programs. Gender distribution shows that 57.1% of the sample is female, 27.8% male, and 15.1% identify as other. Financial stress varies, with 12.9% of students always feeling

Table 2: Summary Statistics of Institutional Characteristics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
<b>MH Provision</b>	307	0.531	0.134	0.195	0.908
<b>Publicity</b>	307	0.655	0.476	0	1
<b>Specialty</b>	307	0.303	0.460	0	1
<b>Graduation Rate</b>	307	0.542	0.236	0.090	0.980
<b>Size</b>					
< 1,000	307	0.062	0.241	0	1
1,000 - 4,999	307	0.368	0.483	0	1
5,000 - 9,999	307	0.218	0.414	0	1
10,000-19,999	307	0.169	0.376	0	1
20,000+	307	0.182	0.387	0	1
<b>Type</b>					
Associates' Colleges	307	0.189	0.392	0	1
Baccalaureate Colleges	307	0.186	0.389	0	1
Doctorate-granting Universities	307	0.352	0.478	0	1
Master's Colleges/Universities	307	0.238	0.426	0	1
Special Focus Institutions	307	0.036	0.186	0	1
<b>Geography</b>					
Northeast Region New England Division	307	0.202	0.402	0	1
Northeast Region Middle Atlantic Division	307	0.140	0.348	0	1
Midwest Region East North Central Division	307	0.153	0.361	0	1
Midwest Region West North Central Division	307	0.052	0.223	0	1
South Region South Atlantic Division	307	0.153	0.361	0	1
South Region East South Central Division	307	0.029	0.169	0	1
South Region West South Central Division	307	0.055	0.229	0	1
West Region Mountain Division	307	0.094	0.293	0	1
West Region Pacific Division	307	0.121	0.326	0	1
<b>Academic rank</b>					
Most Competitive	307	0.088	0.284	0	1
Highly Competitive	307	0.052	0.223	0	1
Very Competitive	307	0.111	0.314	0	1
Competitive	307	0.147	0.354	0	1
Less Competitive	307	0.026	0.160	0	1
Noncompetitive	307	0.072	0.258	0	1
Special/Missing	307	0.505	0.501	0	1

*Notes.* All records are gathered by Healthy Minds Network (2017-2022). MH provision data is based on the HMS survey. Publicity information is derived from the College Board. School specialty and size are obtained from school websites or external sources. The graduation rate represents the four-year graduation rate, sourced from U.S. News or enrollment forms. Institutional type refers to the Carnegie Classification. Geographic data is based on the Census region. Academic rank is taken from Barron's Profiles of American Colleges (2009).

Table 3: Summary Statistics of Student Characteristics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
<b>MHL</b>	120,692	0.448	0.171	-0.667	1
Knowledge	120,692	0.874	0.187	0	1
Depression symptoms	120,692	3.611	0.802	0	4
Anxiety self-help strategies	120,692	3.528	0.853	0	4
Eating disorder symptoms	120,692	5.030	1.307	0	6
Stigma	120,692	-0.427	0.146	-1	0
Perceived	120,692	9.581	3.300	0	18
Personal	120,692	11.43	3.402	0	18
Services	120,692	4.509	8.867	0	40
<b>MH services utilization</b>	120,522	0.355	0.478	0	1
<b>Age</b>	120,692	21.24	2.878	18	30
<b>International</b>	120,692	0.059	0.236	0	1
<b>Year in current program</b>	120,692	2.410	1.223	1	7
<b>Ever diagnosed</b>	120,692	0.411	0.492	0	1
<b>Hispanic</b>	120,692	0.048	0.214	0	1
<b>Race</b>					
White	120,692	0.707	0.455	0	1
Black	120,692	0.059	0.236	0	1
Asian	120,692	0.105	0.306	0	1
Native	120,692	0.004	0.0647	0	1
Arab	120,692	0.013	0.112	0	1
Mixed	120,692	0.098	0.297	0	1
Other	120,692	0.014	0.118	0	1
<b>Degree</b>					
Bachelor's'	120,692	0.714	0.452	0	1
Associate's'	120,692	0.095	0.293	0	1
Master's/JD/MD'	120,692	0.120	0.325	0	1
PhD	120,692	0.050	0.218	0	1
Other	120,692	0.021	0.142	0	1
<b>Gender</b>					
Male	120,692	0.278	0.448	0	1
Female	120,692	0.571	0.495	0	1
Other	120,692	0.152	0.359	0	1
<b>Financially stressful</b>					
Always	120,692	0.129	0.335	0	1
Often	120,692	0.231	0.422	0	1
Sometimes	120,692	0.354	0.478	0	1
Rarely	120,692	0.211	0.408	0	1
Never	120,692	0.075	0.263	0	1

*Notes.* The MHL score is calculated by summing two components: knowledge and stigma. The knowledge score is derived by averaging the normalized scores of depression symptoms knowledge, anxiety self-help strategies knowledge, and eating disorder symptoms knowledge. The stigma score is computed by averaging the normalized scores of perceived stigma, personal stigma, and stigma towards services, and then reversing the score so that lower values indicate higher levels of stigma. Finally, the MHL score is obtained by adding the knowledge score to the reversed stigma score.



financially stressed and 35.3% sometimes feeling stressed, reflecting diverse financial backgrounds.

## 5.2 Regression Analyses

Table 4: Total Effect Regression Estimates

VARIABLES	(1) Mean	(2) Mean	(3) Mean
$\hat{\beta}_{1_{Depression}}$	61.993 (559.573)	15.612 (219.334)	15.612 (219.334)
$\hat{\beta}_{1_{Anxiety}}$	65.441 (577.068)	40.524 (285.597)	40.524 (285.597)
Observations	157	157	157
Baseline Controls	No	Yes	Yes
Quarter FE	No	No	Yes

*Notes.* This table corresponds to Equation 5. Row 1 uses depression scores as the outcome and row 2 uses anxiety scores as the outcome. 157 pairs of institutions are contained in the sample. Standard deviations are in parentheses.

Table 4 reports the estimated total effect of the MH provision, proxied by the average coefficient of MH provision ( $\hat{\beta}_1$ ) in the regression of MH outcomes across 157 sites (pairs of institutions). Three model specifications are implemented: (1) contains no control variables, (2) controls for individual characteristics, and (3) controls for individual characteristics and time. Across all models, the estimated total effects are all positive but accompanied by substantial standard deviations, indicating substantial variability and a lack of statistical significance. The inclusion of baseline controls and quarter fixed effects does not substantially change the outcomes, suggesting that the MH provision has no significant total effect on either depression or anxiety scores in the sample of 157 sites.

While the total effects of MH provisions are ambiguous, evidence for the indirect effects through MHL are founded. Table 5 reports the linear regression estimates in the second-stage regression, using the depression score as the outcome in the first stage (Equation 5). The estimated values of the parameter of interest ( $\hat{\delta}_1$ ) are presented in

Table 5: Depression Score Second-stage Regression Estimation

VARIABLES	(1) $\hat{\beta}_1$	(2) $\hat{\beta}_1$	(3) $\hat{\beta}_1$
$\hat{\gamma}_1$	-13.907** (6.707)	-4.260*** (0.945)	-4.260*** (0.945)
$\hat{\gamma}_2$	-4.266 (3.599)	-0.658 (0.744)	-0.658 (0.744)
Constant	14.923 (31.018)	-5.910 (10.778)	-5.910 (10.778)
Observations	157	157	157
R-squared	0.422	0.527	0.527
Baseline Controls	No	Yes	Yes
Quarter FE	No	No	Yes

Notes. This table corresponds to Equation 6. The fitted values of  $\gamma_1$ ,  $\gamma_2$  and  $\beta_1$  are obtained in the first stage within 157 sites (Equation 3, 4, 5). Depression score is generated by the sum score of PHQ-9. Robust standard errors are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

the first row as the coefficient of  $\hat{\gamma}_1$ . The estimated values of parameters are all statistically significant and negative, and the significance level increases as more controls are included. In general, this table indicates strong evidence for the mediation effect of MHL on reducing depression symptoms across different institutional characteristics. On average, when controlling for individual characteristics and quarters, we are 99% to conclude that one standard deviation increase in the MHL score is associated with a 4.260 decrease in the depression scores. Little evidence is found for the mediation effect of service utilization after teasing out MHL.

Table 6 reports the linear regression estimates in the second-stage regression, using the anxiety score as the outcome in the first stage (Equation 5). The estimated values of the parameter of interest ( $\hat{\delta}_1$ ) are presented in the first row as the coefficient of  $\hat{\gamma}_1$ . The estimated values of parameters are all statistically significant and negative, and the significance level increases as more controls are included. In general, this table indicates strong evidence for the mediation effect of MHL on reducing anxiety symptoms across different sites. On average, when controlling for individual characteristics and quarters, we are 99% to conclude that one standard deviation increase in the MHL score is associated with a 4.763 decrease in the anxiety scores. We also find moderate

Table 6: Anxiety Score Second-stage Regression Estimation

VARIABLES	(1) $\hat{\beta}_1$	(2) $\hat{\beta}_1$	(3) $\hat{\beta}_1$
$\hat{\gamma}_1$	-11.606* (6.649)	-4.763*** (1.109)	-4.763*** (1.109)
$\hat{\gamma}_2$	-3.869 (3.587)	-2.597** (1.213)	-2.597** (1.213)
Constant	26.595 (42.423)	16.828 (18.472)	16.828 (18.472)
Observations	157	157	157
R-squared	0.289	0.610	0.610
Baseline Controls	No	Yes	Yes
Quarter FE	No	No	Yes

Notes. This table corresponds to Equation 6. The fitted values of  $\gamma_1$ ,  $\gamma_2$  and  $\beta_1$  are obtained in the first stage within 157 sites (Equation 3, 4, 5). Anxiety score is generated by the sum score of GAD-7. Robust standard errors are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

evidence for the mediation effect of MH service utilization aside from MHL.

## 6 Discussions

The findings of this study provide compelling evidence for the significant role of college mental health (MH) outreach efforts in improving mental health outcomes through the enhancement of mental health literacy (MHL). With adjustment for selection bias, it appears that enhancing MH provision at the institution level would likely reduce depression and anxiety among college students primarily through increasing MHL. This study underscores the importance of promoting MHL initiatives among colleges and universities across North America. Improving MHL emerges as a cost-effective and psychosocial approach to addressing the mental health crisis faced by college students. The positive impact of school MH provisions on reducing depression and anxiety scores through MHL suggests that educational institutions have a pivotal role in fostering better MH among their students by equipping them with essential knowledge and beliefs about mental health.

Despite the robust findings, this study is not without limitations. First, the reliance

on cross-sectional data limits the ability to infer causality. Longitudinal studies would provide a more comprehensive understanding of the temporal relationships between MH provisions, MHL, and MH outcomes. Second, the use of non-parallel mediators introduces potential complexities in the mediation analysis. The secondary mediator in the study, being binary, may exhibit nonlinearity, which could lead to model misspecification. Addressing this nonlinearity in future research could enhance the accuracy of the mediation effects.

Furthermore, the validity of the MHL measurement warrants careful consideration. While the study employs established measures for some components of MHL, the interpretability of the total MHL score depends on the robustness and comprehensiveness of the measurement tools used. Additionally, the external validity of the findings is constrained by the sample of schools that participated in the HMS. Schools that opt to complete the *Knowledge and Attitudes* module may possess unique characteristics that differentiate them from institutions that did not participate, thereby limiting the generalizability of the results to the broader population of colleges and universities.

Future studies should prioritize longitudinal designs to better capture the dynamic nature of MH provisions and their impact on MHL and MH status over time. Exploring the nonlinearity of binary mediators and employing advanced statistical techniques to address potential model misspecification will be crucial. Additionally, future research should strive to develop a more comprehensive MHL measurement tools, incorporate positive MHL, and validate its validity and reliability, to ensure the accuracy and interpretability of findings.

Moreover, expanding the sample to include a more diverse range of educational institutions will enhance the external validity of the results. Understanding the contextual factors that influence the implementation and effectiveness of MH outreach efforts across different types of schools will provide valuable insights for tailoring interventions to specific institutional needs.

In conclusion, this study highlights the importance of MHL as a critical pathway through which college MH outreach efforts can positively influence mental health out-

comes. By addressing the identified limitations and pursuing further research, we can deepen our understanding of the mechanisms underlying these effects and develop more effective strategies to combat the mental health crisis in higher education.

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# Appendices

## A Variable Descriptions

Component	Notation	Variable Name	Description
Instrument	$D$	outreach_aware	The ratio of respondents who responded Yes to the question "Are you aware of mental health outreach efforts by your school" to all respondents in the same institution.
Outcome	$Y$	deprawsc anxscr	PHQ-9 score, ranging from 0 to 27 GAD-7 score, ranging from 0 to 14
Focal Mediator	$M_1$	mhl	See Appendix B.1
Secondary Mediator	$M_2$	tx_any	= 1 if (1) received therapy since starting college, or (2) not first-year and has received MH medication during the past 12 months; = 0 otherwise
Baseline Confounders	$C$	age	Continuous variable ranging from 18 to 30
		gender	Categorical variable, including male, female, and others
		race	Categorical variable, including white, black, Asian, native, Arab, mixed, others
		international	= 1 if international student, = 0 if not
		fincu	How would you describe your current financial situation? 5-point Likert Scale, spanning from Always, Often, Sometimes, Rarely, to Never stressful.
		dx_any	= 1 if ever been diagnosed by a health professional with the following disorders: Depression, Bipolar, Anxiety, Obsessive-compulsive or related disorders, Trauma and Stressor Related Disorders, Neurodevelopmental disorder or intellectual disability, Eating disorder, Psychosis, Personality disorder, and Substance use disorder; = 0 otherwise

*Notes.* This table summarizes the HMS variables used in this study and the corresponding survey questions according to the codebook provided by HMS. The notations correspond to Figure 1.

## B MHL Measurement Analysis

### B.1 MHL Operationalization and Corresponding HMS Survey Questions

Table 7: MHL Operationalization using HMS

MHL Attributes	Corresponding Items in HMS	Notes
<b>Knowledge</b> (Ability to recognize specific disorders, knowledge of self-treatments, and knowledge of professional help)	As far as you know, which of the following are common symptoms of eating disorders?	Correct = 1, 2, 3, 4, 6
	1 Dramatic weight loss	
	2 Strong need for control	
	3 Restrictive eating/fasting	
	4 Self-induced vomiting, abuse of laxatives, diet pills and/or diuretics	
	5 Rapid, uninterruptible speech	
	6 Eating an unusually large amount of food while feeling out of control	
	As far as you know, which of the following are common symptoms of depression?	Correct = 1, 3, 4
	1 Sleep changes (substantial increases or decreases)	
	2 Hallucinations or delusions	
	3 Appetite changes (substantial increases or decreases)	
	4 Reduced interest in usual activities	
	As far as you know, which of the following are generally considered highly effective treatments for depression?	Correct = 1, 2, 3
	1 Cognitive behavioral therapy (CBT)	<i>Delete due to low internal consistency (see Table ?? below)</i>
	2 Antidepressant medication	
	3 Psychoanalysis	
	4 Psychostimulant medication (e.g., Ritalin)	

Table 7: MHL Operationalization (continued)

MHL Attributes	Corresponding Items in HMS	Notes
	<p>As far as you know, which of the following are considered to be effective self-help strategies for reducing anxiety?</p> <ol style="list-style-type: none"> <li>1 Physical exercise</li> <li>2 Spending more time alone</li> <li>3 Slow breathing exercises</li> <li>4 Meditation</li> </ol>	Correct = 1, 3, 4
<p><b>Attitudes</b> that promote recognition and appropriate help-seeking</p>	<p>How much do you agree with the following statements?</p> <ol style="list-style-type: none"> <li>1 Most people would willingly accept someone who has received mental health treatment as a close friend.</li> <li>2 Most people feel that receiving mental health treatment is a sign of personal failure.</li> <li>3 Most people think less of a person who has received mental health treatment.</li> </ol>	<p>Perceived Stigma 6-point Likert Scale</p> <p><i>The first item is reversely scored.</i></p>
	<p>How much do you agree with the following statement?</p> <ol style="list-style-type: none"> <li>1 I would willingly accept someone who has received mental health treatment as a close friend.</li> <li>2 I feel that receiving mental health treatment is a sign of personal failure.</li> <li>3 I would think less of a person who has received mental health treatment.</li> </ol>	<p>Personal Stigma 6-point Likert Scale</p> <p><i>The first item is reversely scored.</i></p>
	<p>How much do you agree with the following statements?</p> <ol style="list-style-type: none"> <li>1 If I believed I was having a mental breakdown, my first inclination would be to get professional attention.</li> <li>2 The idea of talking about problems with a psychologist strikes me as a poor way to get rid of emotional conflicts.</li> <li>3 If I were experiencing a serious emotional crisis at this point in my life, I would be confident that I could find relief in psychotherapy.</li> <li>4 There is something admirable in the attitude of a person who is willing to cope with their conflicts and fears without resorting to professional help.</li> </ol>	<p>Attitudes Toward Seeking Professional Help (Fischer and Farina 1995)</p> <p>4-point Likert Scale</p>

Table 7: MHL Operationalization (continued)

MHL Attributes	Corresponding Items in HMS	Notes
	5 I would want to get psychological help if I were worried or upset for a long period of time.	
	6 I might want to have psychological counseling in the future.	
	7 A person with an emotional problem is not likely to solve it alone; they are likely to solve it with professional help.	
	8 Considering the time and expense involved in psychotherapy, it would have doubtful value for a person like me.	
	9 A person should work out their own problems; getting psychological counseling would be a last resort.	

*Notes.* I referred to the operational definitions in O'Connor and Casey (2015) and to screen items that can be used to measure MHL. All items are from the *Knowledge and Beliefs about Mental Health and Mental Health Services* module.

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## B.2 Reliability Analysis for Knowledge Component

Questions	No. Items / Choices	Avg. Inter-item Covariance	Cronbach's Alpha
Common symptoms of eating disorders	6	0.091	0.864
Common symptoms of Depression	4	0.085	0.821
Effective treatments of Depression	4	0.037	0.507
Effective self-help strategies for anxiety	4	0.073	0.764

*Notes.* The values of inter-item covariance and Cronbach's alpha are calculated using command `alpha` in Stata (SE 17.0).