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Depression and psychiatric help-seeking as joint outcomes: a Bayesian multilevel analysis of household-level dependence

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Abstract

Background Depression and the utilization of psychiatric services (PSU) are complex mental health outcomes shaped by a wide range of individual, familial, and socioeconomic factors. However, within the context of Türkiye, limited attention has been devoted to the simultaneous modeling of these outcomes and to the systematic examination of their shared household-level determinants.

Methods This study conducts a concurrent analysis of two binary outcomes—self-reported depression and receipt of professional psychiatric care within the past 12 months—using data from a nationally representative household survey. The analytical sample comprises 22,742 individuals nested within 10,028 households across Türkiye. A Bayesian multilevel bivariate logistic regression model was employed to account explicitly for the hierarchical structure of the data, with individuals nested within households. Household-level random intercepts were specified for both outcomes, and the correlation between the latent processes underlying depression and PSU was directly estimated. Weakly informative priors were adopted, and model estimation was performed using the No-U-Turn Sampler (NUTS), an efficient variant of the Hamiltonian Monte Carlo algorithm.

Results The results reveal pronounced clustering of both depression and PSU at the household level. A strong positive correlation between household-level random effects indicates that individuals experiencing depression are substantially more likely to utilize psychiatric services within the same family context. At the individual level, men are significantly less likely than women to report depressive symptoms or to seek psychiatric care. Tobacco and alcohol use are positively associated with depression risk, whereas adequate rest and healthier lifestyle behaviors exhibit protective effects. Increases in body mass index (BMI) are associated with a higher likelihood of depression. In contrast, active employment and higher household income are linked to reduced depression risk. Additionally, a range of sociodemographic and economic characteristics exert significant effects on both depression and PSU.

Conclusions These findings demonstrate that depression and psychiatric service utilization (PSU) are shaped not only by individual-level characteristics but also by shared familial and structural factors. The results underscore the

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need for mental health policies that move beyond narrowly individual-centered frameworks and instead adopt holistic strategies that incorporate household dynamics and broader socioeconomic conditions.

Keywords Bayesian approach, Depression, Family, Intra-family correlation, Psychiatric service utilization, Türkiye

Introduction

Depression is an ambidextrous mental health disorder characterized by a persistent low mood, a marked reduction in the capacity to experience pleasure, and substantial impairments in daily functioning. Its global prevalence is considerable, and the deleterious effects of depression on societal well-being, together with the steadily increasing burden it imposes on health systems, have rendered it one of the most pressing public health challenges of our time [1]. Depressive symptoms manifest not only as emotional distress but also encompass a broad range of psychological processes, including diminished motivation, feelings of hopelessness, and guilt. These symptoms are frequently accompanied by impaired cognitive functioning and often co-occur with other psychiatric symptoms [2]. When its high prevalence, severe functional consequences, elevated mortality risk, and substantial economic burden are considered collectively, this multidimensional clinical profile clearly explains why depression occupies a priority position on the global mental health agenda [3–6].

A particularly salient dimension of the individual and societal burden of depression is its strong and persistent association with suicidal behavior. According to Joiner et al. [7] and the WHO [1], more than 727,000 individuals are estimated to die by suicide each year worldwide, with a diagnosis of depression reported in approximately half of these cases. A substantial body of empirical research has documented a positive and significant relationship between suicide rates and the clinical severity of depression. Furthermore, studies by Bitter et al. [8] and Sanchez-Gistau et al. [9] demonstrate that depression—especially when untreated or inadequately treated—constitutes one of the most powerful risk factors for suicide. In addition, it has been documented that nearly 90% of individuals who die by suicide had a previously diagnosed psychiatric disorder, most commonly depression [10]. Taken together, these findings provide compelling evidence that depression is not merely a widespread mental disorder but also a critical public health concern with a direct and substantial association with mortality.

The global prevalence of depression underscores its sensitivity to social, economic, and environmental conditions, a pattern that becomes particularly salient during periods of crisis. A substantial surge in depression prevalence has been documented during episodes of global upheaval, such as pandemics, which have exposed structural vulnerabilities within mental health systems and transformed what might otherwise be temporary

fluctuations in mental distress into enduring societal costs [11–15]. Current estimates suggest that the global economic cost of mental disorders amounts to approximately 1 trillion US dollars annually, with a considerable share of this burden attributable to productivity losses [1]. Furthermore, evidence indicates that depression, when co-occurring with chronic physical conditions, may reduce life expectancy by approximately 20 years [16]. A robust body of epidemiological research also demonstrates that the prevalence of depression varies markedly across countries, regions, genders, and age groups [17]. Findings from the Global Burden of Disease (GBD) study reveal a pronounced increase in depression prevalence following the pandemic, particularly among individuals aged 10–29 [18], while the overall burden appears to peak among those aged 60–64 [19, 20]. Consistent with the existing literature, women are reported to experience a substantially greater burden of depression than men, with prevalence rates approximately twice as high [21–23], a pattern projected to persist in future estimates [24, 25]. In this context, cross-national differences in disability-adjusted life years (DALYs) indicate that depression is shaped not only by biological or socioeconomic factors but also by cultural structures and prevailing social norms. While countries such as Greece and Brazil report relatively high prevalence levels, depression rates remain lower in Japan and China, with Türkiye exhibiting a moderate burden [26]. This global heterogeneity highlights the central role of coping mechanisms, social support systems, and help-seeking behaviors in shaping mental health outcomes. Nevertheless individuals in some contexts predominantly rely on family-based support mechanisms [27], whereas others seek professional assistance or mobilize individual coping strategies, as documented in earlier research [28]. The Social Ecological Model (SEM) conceptualizes help-seeking as a multilevel process influenced by factors ranging from individual characteristics to broader social structures [29]. Within this framework, professional intervention is widely recognized as critical in situations involving severe emotional distress or unmanageable psychological processes [30, 31].

One of the pivotal factors shaping the clinical course and long-term outcomes of depression is individuals' access to psychiatric services and their propensity to utilize such services. A substantial body of empirical evidence has demonstrated the effectiveness of psychotherapeutic interventions in reducing symptom severity, improving functional outcomes, lowering relapse risk, and, critically, preventing suicidal behavior [32–34]. The

World Health Organization (WHO) identifies psychiatric services as fundamental components of first-line treatment for depression and emphasizes that, in moderate and severe cases, the combined use of psychotherapy and pharmacological treatment represents the most effective therapeutic approach [1, 34]. Meta-analytic evidence further indicates that psychological interventions not only yield short-term symptom improvement but also produce more durable clinical benefits over time, significantly reducing the risk of relapse [35–37]. However, it is essential to recognize that help-seeking is neither automatic nor inevitable in the context of depression. The existing literature characterizes help-seeking as a multidimensional process shaped simultaneously by individual sociodemographic characteristics, economic resources, gender roles, family structure, and cultural norms. A considerable proportion of individuals diagnosed with depression experience substantial barriers to accessing psychiatric services, a phenomenon that is particularly pronounced among low-income households and women, as documented by Mojtabai et al. [38] and Micheltore and Hindley [39]. In a similar vein, family-level social support and broader cultural context have been identified as significant determinants of help-seeking behaviors; however, these contextual influences are frequently underrepresented within the analytical frameworks adopted by many empirical studies [40]. When depression and psychiatric service utilization (PSU) are examined as isolated outcome variables, discrepancies between psychological distress and access to treatment tend to remain analytically obscured.

This study challenges the prevailing analytical approach in the literature, which treats the probability of depression and the probability of receiving psychiatric care as independent processes. Instead, it seeks to examine the simultaneous and interdependent nature of these two processes within a unified analytical framework. A substantial proportion of existing empirical research models depression or PSU as discrete outcomes; however, such an approach is insufficient for capturing the structural dependencies between individuals' susceptibility to psychological distress and the help-seeking behaviors they adopt in response. In particular, when the shared social, economic, and environmental conditions experienced by individuals residing within the same household are taken into account, single-equation models effectively exclude these common contextual influences from the analysis.

To address these methodological limitations, a mixed-effects bivariate logistic regression model defined within a Bayesian framework was employed. This approach directly models the interdependence arising from individuals' co-residence within the same household through the specification of household-level random effects for each outcome. Furthermore, it enables the simultaneous

estimation of the latent correlation structure between the probability of depression and the probability of PSU by correlating individual-level residuals at the household level. Through this integrated modeling strategy, the joint effects of shared social, economic, and environmental conditions are analytically incorporated alongside unobserved individual-level characteristics, thereby substantially reducing selection and estimation biases that typically arise when these outcomes are modeled separately.

From a theoretical perspective, this approach offers a conceptual alternative to the unidirectional and fragmented modeling tradition that has long dominated the mental health literature. Rather than conceptualizing depression and the pursuit of psychiatric care as sequential or derivative processes, this framework treats them as interconnected outcomes embedded within a shared contextual environment. In doing so, it facilitates the empirical examination of the structural linkage between the emergence of psychological distress and both individual and institutional responses to that distress, while placing the household context at the center of analysis. From a policy perspective, this integrated analytical perspective suggests that the mental health burden should be evaluated not solely in terms of disease prevalence or symptom severity, but also through inequalities in access to treatment and help-seeking behaviors. The findings regarding the simultaneous influence of economic constraints, social support networks, and cultural norms operating at the household level on both depression risk and PSU provide a robust empirical foundation for the development of family- and household-oriented mental health policies that extend beyond exclusively individual-centered interventions.

Literature review

The existing literature consistently demonstrates that depression is a multidimensional mental health condition shaped across the life course through the interaction of numerous sociodemographic, economic, and health-related factors [5, 21, 22]. Empirical studies conducted across diverse geographical contexts indicate that social vulnerabilities, material deprivation, deteriorations in health status, and chronic psychosocial stressors substantially increase the risk of depression [41–43]. For example, a study conducted in rural Bangladesh found that older age, female gender, lower educational attainment, and socioeconomic disadvantage were strongly associated with depressive symptoms [16]. Similarly, research examining the Russian context revealed that financial hardship, unemployment, problematic alcohol use, and weak social support networks significantly elevated depression risk, often following a dose–response pattern [44]. Collectively, these findings suggest that

socioeconomic stressors may generate comparable mental health outcomes across different cultural contexts and may therefore constitute a broadly shared cluster of risk factors for depression [44, 45]. Within the context of Türkiye, studies such as Güney et al. [46] have demonstrated that age, educational attainment, general health status, the presence of chronic illness, and health-related behaviors are closely associated with the likelihood of depression, while also exerting a significant influence on individuals' psychiatric help-seeking behaviors. These findings underscore that depression is not merely a clinical condition experienced at the individual level, but rather a systemic phenomenon intertwined with patterns of access to and utilization of health services [47]. Nevertheless, the existing literature largely addresses the relationship between depression and help-seeking behaviors in an indirect manner and continues to analytically separate these two processes [40, 48].

Research focusing on the early stages of life indicates that the risk of depression is closely linked to social and structural inequalities that emerge during childhood and adolescence [49, 50]. Khatun et al. [51] demonstrated that depressive symptoms among adolescents are particularly associated with parental lack of education, economic deprivation, and rural living conditions. These findings suggest that disadvantages experienced early in life increase psychological vulnerability, allowing the risk of depression to persist across the life course [52, 53]. Studies focusing on older populations have demonstrated analogous patterns. As posited by Maier et al. [54], depression risk in later life is closely associated with cognitive impairment, chronic illnesses, and limitations in activities of daily living. In contrast, Blazer [55] and Fiske et al. [56] have identified physical activity and social participation as salient protective factors.

Another significant domain of discourse within the depression literature pertains to the utilization of measurement instruments. Velescu et al. [57] demonstrated that discrepancies in the psychometric properties of various depression screening and rating scales have a substantial impact on reported prevalence rates and on observed associations with risk factors. In a similar context, Mehmetoglu et al. [58] showed that the prevalence of depression among individuals with chronic conditions varies considerably depending on the measurement instrument employed. These findings underscore that heterogeneity in depression prevalence arises not only from clinical or sociodemographic differences but also from methodological choices [59]. The literature on help-seeking behaviors, on the other hand, clearly demonstrates that a diagnosis of depression does not automatically lead to the utilization of psychiatric services, indicating that a substantial proportion of individuals with depression are unable to access professional care.

This phenomenon is particularly pronounced among low-income households and women [38, 39]. Despite the well-documented influence of cultural norms, perceived stigma, and family-based support mechanisms on help-seeking behaviors, these contextual factors are frequently relegated to a secondary analytical role in many studies [60, 61]. A significant yet underexplored dimension in the existing literature concerns the interplay of social, economic, and environmental factors shared by individuals residing within the same household. Such shared conditions have the potential to shape both depression risk and psychiatric service utilization simultaneously, yet this phenomenon has received disproportionately limited scholarly attention [62].

At this juncture, a central lacuna in the literature lies in the recurrent modeling of the probability of depression and the probability of receiving psychiatric care as discrete outcome variables [38, 47]. Although existing studies acknowledge the association between these two processes, they rarely examine their structural interdependence or their shared contextual determinants within a unified analytical framework. Moreover, the methodological challenges posed by household-level shared conditions—which may generate inter-individual dependence and biased parameter estimates—are seldom explicitly addressed. The present study responds to this gap by employing an integrated modeling approach centered on the household context to jointly examine the probability of depression and the probability of receiving psychiatric care. The primary objective is to empirically demonstrate the structural linkage between psychological distress and the institutional responses to that distress.

Materials and methods

Data source

This study is designed as an observational, analytical, and multilevel cross-sectional investigation based on data from the 2022 Türkiye Health Survey (THS) conducted by the Turkish Statistical Institute (TurkStat). The THS provides nationally representative information on individuals' self-reported depression status and psychiatric help-seeking behavior (receipt of services from a psychiatrist) during the past 12 months, together with a wide range of sociodemographic, health-related, and lifestyle indicators at both the individual and household levels. This comprehensive data structure enables the examination of depression and PSU as simultaneous and interrelated processes.

The data utilized in this study were obtained from the 2022 wave of the THS, which has been conducted biennially since 2008. This nationwide, household-based survey aims to collect key health indicators that cannot be obtained from administrative records and serves as a

primary reference source for both policymakers and academic research. The THS constitutes a comprehensive data collection initiative encompassing a wide range of health-related information. The survey collects detailed data from individuals aged 15 years and older, covering multiple dimensions of health, including general health status, health service utilization patterns, the presence of chronic diseases, limitations in activities of daily living, dietary habits, sports and physical activity behaviors, physical work status, and lifestyle behaviors such as tobacco and alcohol use. The survey instruments were developed in accordance with the modules of the European Health Interview Survey (EHIS) and implemented in coordination with the Statistical Office of the European Union (EuroStat), thereby ensuring full compliance with European Union norms and standards [63].

In the 2022 implementation, the sampling frame was updated using the National Address Database, and the rural–urban settlement distinction was adopted as an external stratification criterion. Accordingly, a stratified two-stage cluster sampling design was implemented to ensure representativeness across regions and key sociodemographic characteristics of the population. The primary sampling units were defined as address clusters consisting of approximately 100 households, while the secondary sampling units were individual households. Data collection was carried out across a total of 1,117 selected clusters nationwide. Following the exclusion of observations with missing data and identified outliers, the final analytical sample comprised 22,742 individuals residing in 10,028 households. All analyses were conducted using individuals with complete information across all study variables. This sample size provides substantial analytical power for statistical inference at both the individual and household levels.

The dependent variables in this study are the presence of depression and the utilization of psychiatric services within the past 12 months. The independent variables include individual-level sociodemographic characteristics, health status indicators, lifestyle behaviors, and household-level structural features. Detailed variable definitions and descriptive statistics are presented in Table 1. The Results section discusses the analytical findings within the relevant empirical and theoretical context. The assessment of depression and PSU is based on self-report question sets implemented within the THS framework and aligned with international standards. Although these measures do not constitute clinical diagnoses, they are widely accepted and considered valid in large-scale population-based research, as they capture individuals' perceived mental health status and actual help-seeking behaviors. While potential sources of measurement error—such as recall bias and social desirability bias—cannot be entirely excluded, there is no strong

indication that such biases would systematically distort household-level clustering or the observed relationship between the outcome variables. This assessment is further supported by the consistency of national prevalence estimates with external benchmarks. Nevertheless, due to the cross-sectional design of the study, the findings should be interpreted as reflecting associative patterns rather than causal relationships.

Given that individuals residing within the same household are exposed to shared genetic predispositions, common environmental and socioeconomic conditions, and similar psychosocial stressors, the assumption of statistical independence among individual-level observations is unlikely to hold. Consequently, conceptualizing depression and PSU solely as functions of individual characteristics risks omitting shared and unobserved household-level heterogeneity. To address this issue, the study employs an integrated modeling strategy centered on the household context to examine the probabilities of depression and PSU. The subsequent section introduces a mixed-effects bivariate Bayesian logistic regression model that explicitly accounts for dependence arising from within-household clustering. This modeling approach enables the estimation of the interconnected nature of these two processes within a unified probabilistic framework.

Statistical methods

In this study, the probability of depression and the probability of PSU are not treated as two independent outcome variables; rather, they are conceptualized as two structurally related processes shaped by a shared set of individual- and context-level conditions. This approach deliberately departs from the conventional assumption of independence of observations, which constitutes a core premise of single-equation regression models widely employed in mental health research. Individuals residing within the same household are jointly exposed to a broad range of influences, including genetic predispositions, shared socioeconomic resources, physical environmental conditions, family relationships, stress exposures, and collective attitudes toward mental health [62]. These shared contextual factors may simultaneously affect both the likelihood of experiencing depression and the propensity to seek professional psychiatric care. Accordingly, the assumption of statistical independence among mental health outcomes and related responses within households is neither theoretically defensible nor empirically benign, as it may lead to biased parameter estimates and misleading inferences.

A growing methodological literature has demonstrated that single-level models tend to produce systematic bias and underestimate uncertainty when shared but unobserved household-level heterogeneity is ignored [64].

Table 1 Descriptive statistics for the dependent and explanatory variables

Variables	Definitions	Mean	Std. Dev.	VIF
Dependent Variable:				
Depression	1 if the individual self-reported depression within the last 12 months, and 0 otherwise	0.072	0.258	-
Psychiatric service utilization	1 if the individual had a psychiatric service utilization within the last 12 months, and 0 otherwise	0.050	0.217	-
Individual-related Binary Explanatory Variables (1 = Yes, 0 = No):				
Male	1 if male, and 0 otherwise	0.482	0.500	1.668
Private health insurance	1 if had private health insurance, and 0 otherwise	0.062	0.242	1.096
Out-of-pocket health costs	1 if had out-of-pocket health costs, and 0 otherwise	0.163	0.369	1.040
Parents with children	1 if parent with children, and 0 otherwise	0.848	0.359	1.143
Daily fruit consumption	1 if had daily fruit consumption, and 0 otherwise	0.370	0.483	1.862
Daily vegetable consumption	1 if had daily vegetable consumption, and 0 otherwise	0.413	0.492	1.842
Tobacco use	1 if used tobacco, and 0 otherwise	0.270	0.444	1.208
Alcohol use	1 if used alcohol, and 0 otherwise	0.123	0.328	1.212
Resting	1 if resting 4 h or more per day, and 0 otherwise	0.669	0.471	1.066
Physical activity	1 if spent most of the day sitting, and 0 otherwise	0.497	0.500	1.156
Walking time	1 if spent more than 1 h on walking daily, and 0 otherwise	0.143	0.350	1.045
Individual-related Categorical Explanatory Variables:				
Cohort types:				
Baby boomer cohort	1 if born between 1946 and 1964, and 0 otherwise (reference, ref.)	0.233	0.423	2.884
Generation X	1 if born between 1965 and 1980, and 0 otherwise	0.277	0.447	1.882
Generation Y	1 if born after 1980, and 0 otherwise	0.491	0.500	-
Education levels:				
No diploma	1 if had no diploma, and 0 otherwise (ref.)	0.104	0.305	-
Elementary school	1 if had elementary education, and 0 otherwise	0.301	0.459	2.855
Secondary school	1 if had secondary school education, and 0 otherwise	0.169	0.375	2.520
High school	1 if had high school education, and 0 otherwise	0.223	0.416	2.951
College+	1 if had college+, and 0 otherwise	0.203	0.402	3.180
Marital status:				
Never married	1 if never married, and 0 otherwise (ref.)	0.240	0.427	-
Married	1 if married, and 0 otherwise	0.662	0.473	2.453
Divorced/Widowed	1 if divorced/widowed, and 0 otherwise	0.098	0.297	1.912
Employment types:				
Active worker	1 if had active worker, and 0 otherwise	0.326	0.469	2.119
Employer	1 if had employer, and 0 otherwise	0.073	0.260	1.377
Job seeker	1 if job seeker, and 0 otherwise.	0.058	0.234	1.290
Retired	1 if retired, and 0 otherwise.	0.146	0.353	1.955
Other employment	1 if in another employment category including students, and 0 otherwise (ref.)	0.397	0.489	-
Body mass index (BMI):				
Normal weight	1 if BMI < 24.9 kg/m ² , and 0 otherwise (ref.)	0.428	0.495	-
Overweight	1 if BMI 25.0–29.9 kg/m ² , and 0 otherwise	0.364	0.481	1.314
Obese	1 if BMI 30.0–39.9 kg/m ² , and 0 otherwise	0.156	0.363	1.299
Morbid obesity	1 if BMI ≥ 40 kg/m ² , and 0 otherwise	0.052	0.223	1.144
Family-related Categorical Explanatory Variables:				
Income levels:				
Low income	1 if family had < 4852 TL monthly, and 0 otherwise (ref.)	0.210	0.407	-
Middle income	1 if family had 4852–9539 TL monthly, and 0 otherwise	0.398	0.490	1.988
High income	1 if family had > 9539 TL monthly, and 0 otherwise	0.392	0.488	2.509
Regions:				
Istanbul	1 if resided in Istanbul, and 0 otherwise	0.123	0.329	2.589
Western Marmara	1 if resided in Western Marmara, and 0 otherwise	0.105	0.306	2.402
Eastern Marmara	1 if resided in Eastern Marmara, and 0 otherwise	0.044	0.205	1.657
Aegean	1 if resided in the Aegean region, and 0 otherwise	0.055	0.229	1.753

Table 1 (continued)

Variables	Definitions	Mean	Std. Dev.	VIF
Mediterranean	1 if resided in the Mediterranean region, and 0 otherwise	0.102	0.302	2.407
West Black Sea	1 if resided in the West Black Sea region, and 0 otherwise	0.091	0.288	2.193
East Black Sea	1 if resided in the East Black Sea region, and 0 otherwise	0.191	0.393	3.340
West Anatolia	1 if resided in West Anatolia, and 0 otherwise	0.031	0.172	1.421
Central Anatolia	1 if resided in Central Anatolia, and 0 otherwise	0.142	0.349	2.827
North East Anatolia	1 if resided in North East Anatolia, and 0 otherwise	0.023	0.151	1.297
Middle-East Anatolia	1 if resided in Middle-East Anatolia, and 0 otherwise	0.048	0.214	1.695
Southeastern Anatolia	1 if resided in Southeastern Anatolia, and 0 otherwise (ref.)	0.045	0.207	-
Family-related Continuous Variables:				
No. of adults in household	Number of adults in the household	2.739	1.197	1.086
Kids < 6 years	Number of children under 6 years old	0.309	0.637	1.378
Kids 7–14 years	Number of children aged 7–14 years	0.440	0.764	1.181

Note: Std. Dev. and VIF stand for standard deviation and variance inflation factor, respectively

Bayesian multilevel modeling offers a principled statistical framework for addressing such complex hierarchical data structures. By explicitly modeling inter-observational dependence, this approach allows uncertainty at multiple levels of analysis to be coherently integrated into a unified probabilistic framework [65]. To address these methodological limitations, the present study employs a mixed-effects bivariate logistic regression model specified within a Bayesian framework. This model treats the probability of depression and the probability of receiving psychiatric care as two distinct but simultaneously estimated binary outcomes.

Within this framework, household-level random effects are specified separately for each outcome, thereby directly capturing within-household dependence. This structure enables the model to account analytically for the joint influence of social, economic, and environmental factors shared by household members but not directly observed in the dataset on both depression and PSU [66]. A distinctive feature of the model is its capacity to associate unobserved individual-level components underlying depression and PSU at the household level. This feature permits empirical testing of the hypothesis that these two processes may be interconnected not only through shared observed determinants but also via latent individual- and family-level mechanisms. For example, household norms regarding mental health, perceived stigma, collective coping strategies, and attitudes toward professional help-seeking may simultaneously shape the expression of depressive symptoms and the utilization of psychiatric services. Estimating the correlation between household-level random effects renders such latent dependence structures empirically observable, thereby preventing the artificial analytical separation of processes that are intrinsically interconnected.

The Bayesian estimation approach facilitates flexible modeling of this complex structure while enabling full posterior inference. This allows uncertainty from both

individual and household levels to propagate through all parameter estimates, yielding directly interpretable credible intervals suitable for population health and policy analysis [65]. Within this holistic analytical framework, depression and PSU are conceptualized not as sequential or derivative phenomena, but as mutually related outcomes shaped within a common contextual environment. Following posterior estimation, odds ratios (ORs) for each dependent variable were derived analytically. A detailed mathematical exposition of the model is provided in the Appendix section.

Findings

Descriptive statistical findings

Statistics related to dependent and independent variables

Dependent variables Table 1 provides a comprehensive overview of the two primary dependent variables related to mental health. The mean value of the depression indicator is 0.072, suggesting that approximately 7% of individuals in the sample reported depressive symptoms during the past 12 months. Although this prevalence may appear modest, it is highly consequential from a public health perspective, as depression imposes a substantial societal burden even at relatively low prevalence levels through increased health service utilization, reduced labor productivity, and declines in quality of life, particularly when co-occurring with chronic diseases. On the other hand, the prevalence of psychiatric service utilization in the general population is approximately 5%, corresponding to a mean value of 0.0495. The gap between depression prevalence and PSU constitutes a salient finding, reflecting barriers to help-seeking behavior, attitudes toward psychiatric care, and limitations in service accessibility documented in the literature, and highlighting persistent

unmet mental health needs at the population level nationally.

Individual-level binary independent variables The means of the binary variables provide strong epidemiological signals regarding the sample's lifestyle and health-related behaviors. The sample is balanced in terms of gender (48.2% male), while the proportion of individuals with private health insurance remains low at only 6.2%, suggesting that health financing is predominantly provided through the public system. The out-of-pocket payment rate of 16.3% indicates that individuals are shouldering a significant portion of the economic burden associated with health expenditures. The observation that 84.8% of the participants belong to households with children suggests the presence of a child-centered family structure, which may influence health needs and service utilization patterns.

The consumption of fruits (37%) and vegetables (41.3%) indicates the potential for enhancement of dietary habits that promote health. Conversely, the high incidence of tobacco use (27%) signifies a substantial public health concern. Despite the observation of a relatively low rate of alcohol consumption (12.3%), the prevalence of insufficient rest (66.9%), and the maintenance of physical activity at only 49.7%, the evidence suggests the pervasive presence of sedentary lifestyles. The finding that only 14.3% of individuals engage in walking for more than one hour per day underscores the need for public health interventions to address physical inactivity.

Individual-level categorical independent variables The distribution of the study population across generational cohorts shows that Baby Boomers comprise 23.3% of the sample, Generation X 27.7%, and Generation Y 49.1%, indicating a predominance of younger adults. This demographic composition is analytically important, as younger cohorts tend to differ from older generations in terms of technology use, health awareness, lifestyle patterns, and attitudes toward mental health and help-seeking. Such cohort-related differences may therefore influence both depression risk and psychiatric service utilization in subsequent analyses. The educational profile of the sample further reveals substantial heterogeneity: 10.4% of individuals report no formal diploma, 30.1% have completed primary education, 16.9% secondary education, 22.3% high school, and 20.3% higher education. This broad distribution underscores marked inequalities in educational attainment. Given the well-established role of education in shaping health literacy, access to information, and engagement with health services, the predominance of low-to-middle education levels is of particular relevance. From a public health perspective, this pattern

highlights the necessity of designing mental health policies and interventions that are sensitive to educational disparities and capable of reaching groups with limited formal schooling.

Regarding marital status, the majority of individuals are currently married (66.2%), while those who have never married account for 24.0%, and divorced or widowed individuals constitute 9.8% of the sample. These distinctions are important for understanding variations in social support structures and vulnerability to adverse mental health outcomes. Employment status also exhibits considerable diversity: 32.6% of respondents are employed, 7.3% are employers, 5.8% are actively seeking work, and 14.6% are retired, while the largest proportion (39.7%) consists of students, homemakers, and other non-employed groups. Given the well-documented association between unemployment, economic strain, and psychological distress, this distribution is likely to have meaningful implications for depression-related outcomes. Across body mass index categories, individuals with a normal BMI constitute the largest group (42.8%); however, the combined prevalence of overweight and obesity exceeds 57%, indicating widespread metabolic risk factors in the population and providing a strong basis for examining links between physical and mental health. Finally, income levels are relatively balanced across low (21.0%), middle (39.8%), and high (39.2%) groups, enabling meaningful comparisons in access to care, while the concentration of respondents in the Eastern Black Sea, Central Anatolia, and Istanbul regions supports the analysis of regional disparities in health-related behaviors.

Family-based continuous independent variables The mean number of adult individuals within households is 2.739 (Standard Deviation (SD)=1.197), reflecting the predominance of a nuclear family structure while also suggesting that some households may exhibit extended family characteristics. The mean number of children per household was found to be 0.309 (SD=0.637), and the mean number of children under the age of 14 was 0.440 (SD=0.764). The fact that younger children constitute a relatively larger share of the total child population is particularly noteworthy in terms of caregiving burden, sleep patterns, household expenditures, and parental mental health. These structural indicators offer a robust analytical framework for assessing the interaction between social support mechanisms and depression as well as psychiatric help-seeking behaviors.

Statistics on the probabilities of depression and PSU

The cross-tabulation presented in Table 2 reveals a pronounced population-level treatment gap between reported depression and psychiatric help-seeking

Table 2 Cross-tabulation of the likelihood of self-reported depression and of psychiatric service utilization

Psychiatric service utilization\ Depression	Yes	No	Total
Yes	547 (2.41%)	1,090 (4.79%)	1,637 (7.20%)
No	579 (2.55%)	20,526 (90.26%)	21,105 (92.80%)
Total	1,126 (4.95%)	21,616 (95.05%)	22,742(100%)

behavior. Among the 1,637 individuals who reported depression, only 547 (2.41%) indicated utilization of psychiatric services, demonstrating that service use remains markedly limited despite the presence of clinically relevant symptoms. The remaining 1,090 individuals with depression (4.79%) did not seek professional care, indicating that nearly one in two affected individuals fails to access psychiatric support and pointing to substantial, largely invisible barriers within the treatment pathway. By contrast, the overwhelming majority of individuals without reported depressive symptoms did not engage with mental health services, with only 2.55% reporting psychiatric service utilization. Although this pattern suggests that help-seeking is largely symptom-driven, it simultaneously highlights that service uptake among those with depression remains far below optimal levels. Overall, depression prevalence in the sample was 7.20%, whereas psychiatric service utilization reached only 4.95%. The limited overlap between these two rates indicates that structural, cultural, and perceptual barriers to care may outweigh clinical need in shaping service utilization. Taken together, this discrepancy between population-level depression burden and its representation within the health care system underscores an urgent need for public health strategies that strengthen early detection.

The relationship between sociodemographic indicators and mental health

The distributions reported in Table 3 provide a concise yet clinically informative depiction of how sociodemographic characteristics and health-related behaviors intersect with depression and psychiatric service utilization in Türkiye. By sex, depression prevalence is higher among women than men (9.60% versus 4.62%), a pattern mirrored in psychiatric service utilization, which is also more frequent among women (6.38% compared with 3.42%). This gender gradient indicates a differentiated mental health burden, suggesting that women are both more exposed to depressive symptoms and more likely to engage with mental health services. Among individuals holding private health insurance, depression prevalence remains comparatively low (5.71%), and no substantial difference is observed in psychiatric service utilization, implying that financial coverage alone does not automatically translate into care-seeking behavior. In contrast, higher depression (7.93%) and PSU (4.86%) among those reporting out-of-pocket expenditures reflect elevated

need and delayed access to mental health services within the current health system.

In Türkiye, indicators of a healthy lifestyle display a statistically meaningful association with the likelihood of depression and psychiatric service utilization. Individuals who regularly consume fruits and vegetables exhibit comparatively lower prevalence of depression and reduced use of psychiatric services, whereas depression prevalence rises markedly to 8.73% among tobacco users and is accompanied by increased psychiatric consultations. Although depression prevalence among individuals who consume alcohol is notably high (8.70%), this elevation is not proportionally reflected in psychiatric service utilization, highlighting a critical divergence between clinical need and help-seeking behavior. Regular well-being indicators, including adequate rest, physical activity, and routine walking, are consistently associated with lower depression prevalence and reduced service use, reinforcing evidence that lifestyle behaviors exert a protective effect on mental health. From a generational perspective, depression prevalence is highest among Generation X (9.22%), a cohort that also demonstrates the greatest rate of psychiatric service utilization (5.47%). This pattern may reflect heightened exposure to psychosocial stressors such as academic pressure, labor market insecurity, and shifting family expectations, alongside greater normalization and acceptance of professional help-seeking compared with older generations. With respect to educational attainment, depression is more pronounced among individuals with lower education; however, both depression prevalence and psychiatric service utilization remain relatively elevated among highly educated groups, suggesting that greater mental health literacy and awareness may facilitate care-seeking. Regarding marital status, depression prevalence peaks among divorced and widowed individuals (14.65%), who also show the highest engagement with psychiatric services (8.76%), underscoring the cumulative mental health burden associated with bereavement, diminished social support, and economic vulnerability. In contrast, married individuals display substantially lower depression prevalence (6.66%), although psychiatric service utilization remains notable at 4.49%, indicating that marriage may confer partial protection without fully eliminating mental health risk within contemporary public health and clinical policy debates in Türkiye today nationwide context.

Table 3 Descriptive statistics of the likelihoods of depression and psychiatric service utilization across individual and family characteristics

Variable	Level	Depression		Psychiatric service utilization	
		Yes	No	Yes	No
		Count (%)	Count (%)	Count (%)	Count (%)
Gender	Male	507 (4.62)	10,464 (95.38)	375 (3.42)	10,596 (96.58)
	Female (ref.)	1130 (9.60)	10,641 (90.40)	751 (6.38)	11,020 (93.62)
Private health insurance	Yes	81 (5.71)	1337 (94.29)	78 (5.50)	1340 (94.50)
	No (ref.)	1556 (7.30)	19,768 (92.70)	1048 (4.91)	20,276 (95.09)
Out-of-pocket health costs	Yes	294 (7.93)	3413 (92.07)	180 (4.86)	3527 (95.14)
	No (ref.)	1343 (7.06)	17,692 (92.94)	946 (4.97)	18,089 (95.03)
Parents with children	Yes	1314 (6.81)	17,973 (93.19)	931 (4.83)	18,356 (95.17)
	No (ref.)	323 (9.35)	3132 (90.65)	195 (5.64)	3260 (94.36)
Daily fruit consumption	Yes	589 (6.99)	7832 (93.01)	418 (4.96)	8003 (95.04)
	No (ref.)	1048 (7.32)	13,273 (92.68)	708 (4.94)	13,613 (95.06)
Daily vegetable consumption	Yes	704 (7.49)	8697 (92.51)	493 (5.24)	8908 (94.76)
	No (ref.)	933 (6.99)	12,408 (93.01)	633 (4.74)	12,708 (95.26)
Tobacco use	Yes	537 (8.73)	5612 (91.27)	387 (6.29)	5762 (93.71)
	No (ref.)	1100 (6.63)	15,493 (93.37)	739 (4.45)	15,854 (95.55)
Alcohol use	Yes	243 (8.70)	2550 (91.30)	193 (6.91)	2600 (93.09)
	No (ref.)	1394 (6.99)	18,555 (93.01)	933 (4.68)	19,016 (95.32)
Resting	Yes	1056 (6.94)	14,163 (93.06)	749 (4.92)	14,470 (95.08)
	No (ref.)	581 (7.72)	6942 (92.28)	377 (5.01)	7146 (94.99)
Physical activity	Yes	943 (8.35)	10,349 (91.65)	652 (5.77)	10,640 (94.23)
	No (ref.)	694 (6.06)	10,756 (93.94)	474 (4.14)	10,976 (95.86)
Walking time	Yes	198 (6.09)	3053 (93.91)	139 (4.28)	3112 (95.72)
	No (ref.)	1439 (7.38)	18,052 (92.62)	987 (5.06)	18,504 (94.94)
Cohort types	Baby boomer cohort	487 (9.20)	4806 (90.80)	247 (4.67)	5046 (95.33)
	Generation X	580 (9.22)	5712 (90.78)	344 (5.47)	5948 (94.53)
	Generation Y (ref.)	570 (5.11)	10,587 (94.89)	535 (4.80)	10,622 (95.20)
Education levels	No diploma (ref.)	237 (10.00)	2132 (90.00)	106 (4.47)	2263 (95.53)
	Elementary school	597 (8.72)	6251 (91.28)	346 (5.05)	6502 (94.95)
	Secondary school	246 (6.38)	3607 (93.62)	192 (4.98)	3661 (95.02)
	High school	315 (6.22)	4748 (93.78)	249 (4.92)	4814 (95.08)
	College+	242 (5.25)	4367 (94.75)	233 (5.06)	4376 (94.94)
Marital status	Never married (ref.)	309 (5.65)	5158 (94.35)	255 (4.66)	5212 (95.34)
	Married	1002 (6.66)	14,047 (93.34)	676 (4.49)	14,373 (95.51)
	Divorce/Widow	326 (14.65)	1900 (85.35)	195 (8.76)	2031 (91.24)
Employment types	Active employee	349 (4.71)	7067 (95.29)	297 (4.00)	7119 (96.00)
	Employer	96 (5.81)	1557 (94.19)	63 (3.81)	1590 (96.19)
	Job seeker	122 (9.19)	1206 (90.81)	68 (5.12)	1260 (94.88)
	Retired	245 (7.36)	3082 (92.64)	140 (4.21)	3187 (95.79)
	Other employment (ref.)	825 (9.15)	8193 (90.85)	558 (6.19)	8460 (93.81)
	Normal weight (ref.)	563 (5.79)	9166 (94.21)	448 (4.60)	9281 (95.40)
BMI levels	Overweight	593 (7.17)	7679 (92.83)	385 (4.65)	7887 (95.35)
	Obese	317 (8.93)	3232 (91.07)	200 (5.64)	3349 (94.36)
	Over obese	164 (13.76)	1028 (86.24)	93 (7.80)	1099 (92.20)
Income levels	Low income (ref.)	494 (10.36)	4273 (89.64)	263 (5.52)	4504 (94.48)
	Middle income	595 (6.57)	8461 (93.43)	410 (4.53)	8646 (95.47)
	High income	548 (6.14)	8371 (93.86)	453 (5.08)	8466 (94.92)

Table 3 (continued)

Variable	Level	Depression		Psychiatric service utilization	
		Yes	No	Yes	No
		Count (%)	Count (%)	Count (%)	Count (%)
Regions	Istanbul	255 (9.09)	2550 (90.91)	140 (4.99)	2665 (95.01)
	Western Marmara	173 (7.26)	2210 (92.74)	136 (5.71)	2247 (94.29)
	Eastern Marmara	65 (6.53)	931 (93.47)	60 (6.02)	936 (93.98)
	Aegean	116 (9.21)	1144 (90.79)	74 (5.87)	1186 (94.13)
	Mediterranean	148 (6.39)	2168 (93.61)	109 (4.71)	2207 (95.29)
	West Black Sea	70 (3.38)	2004 (96.62)	47 (2.27)	2027 (97.73)
	East Black Sea	370 (8.50)	3981 (91.50)	255 (5.86)	4096 (94.14)
	West Anatolia	80 (11.48)	617 (88.52)	60 (8.61)	637 (91.39)
	Central Anatolia	151 (4.68)	3073 (95.32)	143 (4.44)	3081 (95.56)
	North East Anatolia	50 (9.47)	478 (90.53)	14 (2.65)	514 (97.35)
	Middle-East Anatolia	76 (6.97)	1015 (93.03)	50 (4.58)	1041 (95.42)
	Southeastern Anatolia (ref.)	83 (8.16)	934 (91.84)	38 (3.74)	979 (96.26)
No. of adults in household	Mean	2.528	2.755	2.546	2.749
Kids < 6 years	Mean	0.207	0.317	0.228	0.313
Kids 7–14 years	Mean	0.381	0.444	0.353	0.444

An analysis of employment status in Türkiye indicates that depression risk is highest among individuals actively seeking employment (9.19%), a pattern consistent with theory and prior empirical evidence, and this group also displays elevated psychiatric service utilization (5.12%). Extensive research shows that psychological distress arising from unemployment, economic precarity, and prolonged uncertainty constitutes a major social determinant of mental health. By contrast, individuals in paid employment exhibit a substantially lower prevalence of depression (4.71%) and relatively modest psychiatric service use (4.00%). Among retired individuals, depression prevalence increases to 7.36%, accompanied by a higher PSU rate of 4.21%. This elevated burden in later life likely reflects the combined influence of age-related physiological changes, accumulated chronic conditions, financial strain, and diminished opportunities for social participation in retirement.

Body mass index (BMI) exhibits a clear gradient in relation to mental health outcomes, with depression prevalence estimated at 5.79% among individuals with a normal BMI and increasing sequentially among those classified as overweight (7.17%), obese (8.93%), and morbidly obese (13.76%). In the most severe BMI category, psychiatric service utilization is also notably elevated (7.80%). This pattern aligns with the well-documented bidirectional association between obesity and depression, reflecting intertwined mechanisms including metabolic dysregulation, chronic inflammation, psychosocial stress, stigma, and health-related behaviors. Socioeconomic position emerges as an additional and powerful correlate, as individuals in low-income groups display substantially higher depression prevalence (10.36%), alongside an elevated burden of post-traumatic stress disorder. As

income levels increase, depression prevalence declines and psychiatric service utilization becomes more proportionate, underscoring the heightened vulnerability of economically disadvantaged populations exposed to material deprivation, constrained access to care, limited health-promoting opportunities, and persistent stressors. Spatial analyses further reveal pronounced regional inequalities, with the highest depression prevalence observed in the Eastern Black Sea, Eastern Marmara, and North East Anatolia regions. The parallel distribution of psychiatric service utilization suggests that regional variation in service availability, cultural norms, and contextual stressors plays a substantive role in shaping mental health outcomes. Conversely, lower levels of depression and service use in other regions indicate heterogeneity in health literacy, infrastructural capacity, and social cohesion. Finally, household composition reflects a predominantly adult-centered structure, with mean values of 2.528 adults, 0.207 children under six, and 0.381 children aged seven to fourteen.

Multilevel mixed-effects inference on depression and psychiatric service utilization probability

Statistical specification checks for model reliability

Before undertaking any substantive interpretation of the estimated model parameters, the study explicitly reports a comprehensive set of specification and diagnostic tests designed to evaluate overall model fit, internal validity, and predictive adequacy. These diagnostic assessments play a critical role in identifying potential sources of model misspecification, residual bias, and violations of underlying analytical assumptions. Their systematic inclusion is essential for establishing the robustness and credibility of the estimated associations and

for supporting valid epidemiological inference. By foregrounding these diagnostics, the analysis demonstrates a high degree of methodological rigor and analytic transparency, thereby providing a sound empirical foundation for all subsequent interpretation and discussion.

Joint Wald tests offer compelling evidence that the covariates incorporated into the model exert a highly significant collective influence on both depression and psychiatric service utilization. For depression, the Wald statistic reaches 644.93 (degrees of freedom [df]=42, $p<0.001$), while the corresponding statistic for PSU is 346.09 (df=42, $p<0.001$), leading to a decisive rejection of the null hypothesis in both cases. These results indicate that the explanatory variables jointly account for substantial and epidemiologically meaningful variation in both outcomes, extending beyond isolated or marginal individual-level effects. This conclusion is further strengthened by the Wald test of the random-intercept correlation, which reveals an exceptionally strong association between depression and PSU within shared household contexts ($\rho=0.9902$; $\chi^2=12,690.22$; df=1; $p<0.001$). The magnitude of this correlation points to a pronounced common variance structure, suggesting that depression and psychiatric service utilization are deeply embedded within the same social, economic, and environmental conditions rather than emerging as independent clinical phenomena. Collectively, these findings substantiate the appropriateness of the multilevel modeling framework, both statistically and conceptually, for capturing clustered mental health outcomes within shared household contexts and populations.

The multilevel modeling approach explicitly captures interdependence among individuals residing within the same household and reveals pronounced clustering of mental health outcomes at the household level. The estimated standard deviations of the household-level random intercepts—1.93 for depression and 1.73 for psychiatric service utilization—indicate substantial and statistically meaningful within-household heterogeneity. Notably, the near-perfect positive correlation between these latent household effects ($r=0.99$) indicates that households characterized by elevated underlying risk of depression are concurrently marked by a higher propensity for PSU. This association reflects shared, unobserved contextual influences operating at the household level rather than individual-level residual processes; accordingly, it does not permit causal interpretation at the individual level, nor does it support reliance on residual correlations, which are not identifiable in Bernoulli models due to fixed idiosyncratic variance. Consistent with this interpretation, intraclass correlation coefficients (ICCs) of 0.531 for depression and 0.477 for PSU demonstrate that nearly half of the total variation in these outcomes is attributable to conditions shared among

household members, including structural, environmental, and socioeconomic factors. These results collectively underscore the centrality of social context in shaping mental health risks and patterns of service utilization and suggest that interventions confined to individual-focused strategies may be limited.

Predictive performance was further assessed using posterior predictive probabilities derived from the Bayesian bivariate mixed-effects logistic regression model, with classification metrics evaluated at empirically determined optimal probability thresholds. Within this framework, the depression model demonstrates strong and well-calibrated discriminatory performance, characterized by high posterior sensitivity (0.8932) and specificity (0.9438), an F1 score of 0.94, and an area under the receiver operating characteristic curve (AUC) of 0.97. These indicators suggest that the posterior distribution of predicted probabilities effectively distinguishes individuals at elevated risk of depression while maintaining a low posterior false-positive rate, a finding further supported by the confusion matrix, which indicates a substantial reduction in false-negative classifications. In contrast, the psychiatric service utilization model exhibits particularly strong identification of the positive class, reflected in high posterior F1 and specificity values (0.9663 and 0.9133, respectively); however, the comparatively higher posterior false-positive rate and lower negative predictive value indicate that posterior inferences regarding the absence of PSU warrant more cautious interpretation. This pattern is consistent with the broader posterior error structure observed in the confusion matrix and likely reflects greater heterogeneity in the latent processes underlying service utilization behavior¹. Comparative evaluation of the receiver operating characteristic (ROC) curves for the two outcomes (Fig. 1) further corroborates these findings: the depression model displays a steeper ascent at low false-positive rates and reaches the upper-left region of the ROC space at earlier thresholds, indicating superior early-threshold discrimination, whereas the PSU model, despite exhibiting high overall AUC, shows a more gradual initial rise, consistent with reduced

¹ Sensitivity refers to the probability that the model correctly identifies true positive cases and is defined as the proportion of true positives among all individuals with the outcome, calculated as $TP / (TP + FN)$. In clinical screening contexts, sensitivity is a critical performance metric, as false-negative classifications may have substantial clinical consequences. Specificity denotes the probability that true negative cases are correctly identified and is calculated as $TN / (TN + FP)$, playing an important role in limiting the burden associated with false-positive classifications. The F1 score represents the harmonic mean of sensitivity and precision and is defined as $F1 = 2 \times (\text{Precision} \times \text{Sensitivity}) / (\text{Precision} + \text{Sensitivity})$, where precision is calculated as $TP / (TP + FP)$. The F1 score is particularly informative in settings characterized by class imbalance, as it jointly accounts for false-positive and false-negative errors. The area under the receiver operating characteristic curve quantifies the model's discriminative capacity across all possible classification thresholds and can be expressed as $AUC = P(\text{positive score} > \text{negative score})$; values approaching 1 indicate strong discriminative performance.

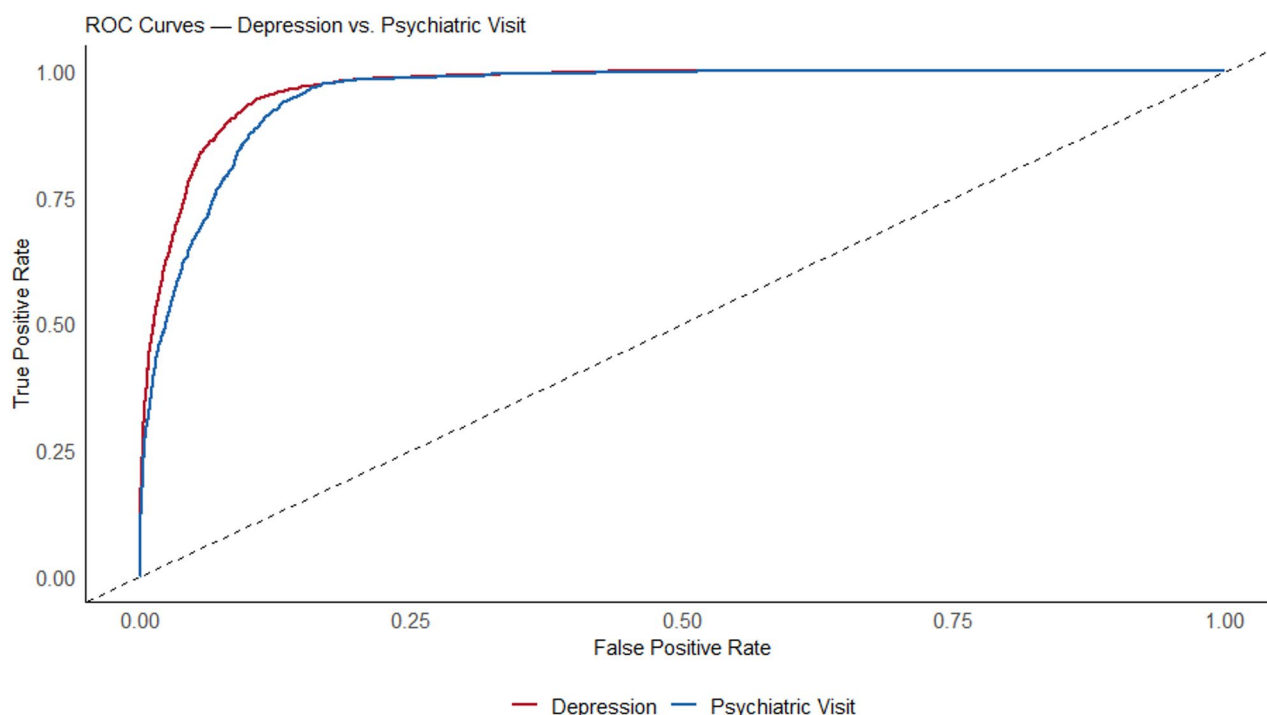


Fig. 1 Comparison of ROC curves for depression and psychiatric visit (psychiatric service utilization) prediction models

sensitivity at lower probability cutoffs. Nevertheless, both models demonstrate near-perfect discriminative capacity across a wide range of thresholds, underscoring the robustness of posterior predictive inference for both outcomes within the Bayesian modeling framework.

Estimates from the Bayesian bivariate mixed-effects logistic regression

Posterior estimates derived from Bayesian bivariate mixed-effects logistic regression models elucidate the relationships between individual-level characteristics, household-level indicators, environmental sociodemographic factors, and the outcomes of depression and psychiatric service utilization. As reported in Table 4, the posterior odds ratio patterns for all covariates are visualized in Fig. 2. In accordance with Bayesian inferential conventions, posterior odds ratios (ORs) exceeding 1 with 95% credible intervals that do not include unity indicate a higher posterior probability of the outcome relative to the reference group, whereas ORs below 1 with credible intervals excluding unity indicate relative dominance of the reference category. Within this framework, sex emerged as a salient determinant in both models. In the depression model, the posterior OR for male individuals (OR=0.368) indicates a substantially lower likelihood of reporting depression compared to women, corresponding to approximately 63% $((1 - 0.368) \times 100 = 63.2)$ lower posterior odds relative to the reference group. A similar pattern was observed in the PSU model, where the estimated

OR of 0.528 suggests that men exhibit a reduced posterior propensity to utilize psychiatric services, with odds approximately 47% lower than those observed among women. Health insurance status further differentiated mental health outcomes. Individuals with private health insurance demonstrated a reduced posterior probability of reporting depression (OR=0.729), implying approximately 27% lower odds relative to individuals without private coverage. Health-related behaviors exhibited consistent and interpretable associations. Daily fruit consumption was associated with lower posterior odds of depression (OR=0.806), indicating an approximately 19% reduction in the likelihood of reporting depressive symptoms among individuals who consume fruit on a daily basis. In contrast, tobacco use emerged as a strong risk factor across both outcomes. Individuals who reported tobacco use exhibited nearly twice the posterior odds of reporting depression (OR=1.964) relative to non-users, and a similarly elevated posterior probability of PSU, with odds approximately 1.8 times higher (OR=1.829). Alcohol consumption displayed a comparable risk profile. Among individuals who consume alcohol, the posterior odds of reporting depression were substantially elevated (OR=1.738), and the likelihood of PSU was also increased, with odds approximately 1.5 times higher than those observed among non-drinkers (OR=1.478). Sleep-related indicators further contributed to outcome variation. Individuals reporting adequate rest exhibited lower posterior odds of depression (OR=0.719), corresponding

Table 4 Bayesian-based maximum likelihood parameter estimates for self-reported depression and psychiatric service utilization

Variable	Likelihood of Self-reported Depression				Likelihood of Psychiatric Service Utilization			
	Estimate	Odds Ratio (OR)	Standard Error	Pseudo p-value	Estimate	Odds Ratio (OR)	Standard Error	Pseudo p-value
Intercept	-2.956***	0.052	0.291	0.000	-4.074***	0.017	0.335	0.000
Binary characteristics:								
Male	-0.999***	0.368	0.087	0.000	-0.638***	0.528	0.092	0.000
Private health insurance	-0.314*	0.729	0.176	0.074	-0.015	0.985	0.167	0.928
Out-of-pocket health costs	0.094	1.099	0.101	0.347	-0.055	0.947	0.113	0.629
Parents with children	0.053	1.055	0.117	0.647	0.109	1.115	0.125	0.386
Daily fruit consumption	-0.214**	0.806	0.095	0.024	-0.082	0.922	0.103	0.428
Daily vegetable consumption	0.117	1.124	0.093	0.208	0.112	1.118	0.102	0.273
Tobacco use	0.675***	1.964	0.082	0.000	0.604***	1.829	0.089	0.000
Alcohol use	0.552***	1.738	0.112	0.000	0.391***	1.478	0.117	0.001
Resting	-0.328***	0.719	0.079	0.000	-0.056	0.946	0.085	0.510
Physical activity	0.340***	1.406	0.076	0.000	0.371***	1.449	0.082	0.000
Walking time	-0.064	0.937	0.107	0.549	-0.144	0.866	0.117	0.219
Categorical characteristics:								
Cohort types:								
Baby boomer cohort	0.472***	1.604	0.137	0.000	-0.626***	0.535	0.154	0.000
Generation X	0.762***	2.142	0.108	0.000	-0.092	0.912	0.114	0.420
Education levels:								
Elementary school	0.172	1.188	0.120	0.150	0.283*	1.327	0.148	0.056*
Secondary school	0.155	1.168	0.146	0.288	0.401**	1.493	0.172	0.020**
High school	0.071	1.073	0.144	0.624	0.337**	1.400	0.170	0.048**
College+	-0.123	0.883	0.162	0.447	0.376**	1.456	0.185	0.043**
Marital status:								
Married	-0.313**	0.731	0.123	0.011	0.063	1.065	0.124	0.611
Divorced/Widowed	0.264*	1.303	0.154	0.087	0.648***	1.912	0.160	0.000
Active worker	-0.485***	0.615	0.107	0.000	-0.563***	0.570	0.111	0.000
Employer	-0.295*	0.744	0.157	0.060	-0.479***	0.619	0.174	0.006
Job seeker	0.450**	1.569	0.151	0.002	-0.305*	0.737	0.174	0.080
Retired	-0.195	0.822	0.121	0.108	-0.328**	0.720	0.141	0.020
BMI levels:								
Overweight	0.313**	1.368	0.083	0.000	0.156*	1.169	0.089	0.081
Obese	0.497***	1.644	0.103	0.000	0.376***	1.456	0.113	0.001
Morbid obesity	0.793***	2.210	0.137	0.000	0.544***	1.723	0.153	0.000
Income levels:								
Middle income	-0.410***	0.663	0.108	0.000	-0.232*	0.793	0.118	0.050
High income	-0.409***	0.663	0.124	0.001	-0.130	0.878	0.133	0.329
Regions:								
Istanbul	-0.131	0.877	0.220	0.553	0.064	1.066	0.248	0.798
Western Marmara	-0.369	0.691	0.227	0.104	0.260	1.296	0.252	0.302
Eastern Marmara	-0.694**	0.499	0.275	0.011	0.277	1.320	0.289	0.337
Aegean	-0.057	0.944	0.249	0.818	0.406	1.501	0.275	0.140
Mediterranean	-0.542**	0.581	0.235	0.021	0.007	1.007	0.257	0.978
West Black Sea	-1.293***	0.274	0.262	0.000	-0.759***	0.468	0.291	0.009
East Black Sea	-0.034	0.965	0.214	0.870	0.328	1.388	0.237	0.167
West Anatolia	0.300	1.350	0.275	0.274	1.034***	2.812	0.292	0.000
Central Anatolia	-1.122***	0.325	0.232	0.000	-0.104	0.901	0.246	0.672
North East Anatolia	0.268	1.307	0.299	0.371	-0.314	0.730	0.397	0.429
Middle-East Anatolia	-0.478*	0.619	0.266	0.072	-0.037	0.964	0.292	0.900
Continuous Variables:								
No. of adults in household	-0.136**	0.872	0.041	0.001	-0.092**	0.912	0.044	0.037
Kids < 6 years	-0.146*	0.863	0.081	0.072	-0.275***	0.760	0.087	0.002

Table 4 (continued)

Variable	Likelihood of Self-reported Depression				Likelihood of Psychiatric Service Utilization			
	Estimate	Odds Ratio (OR)	Standard Error	Pseudo p-value	Estimate	Odds Ratio (OR)	Standard Error	Pseudo p-value
Kids 7–14 years	0.024	1.024	0.058	0.674	-0.149**	0.862	0.064	0.021
Useful Statistics:								
Sigma (Depression)	1.930***		0.080	0.000				
Sigma (Psychiatric service utilization)					1.730***		0.080	0.000
Correlation coefficient (ρ)	0.990***		0.010	0.000				

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. In addition, the p-values reported in this study are approximate significance measures based on Wald-type z-statistics derived from posterior distributions and should not be interpreted as conventional frequentist p-values

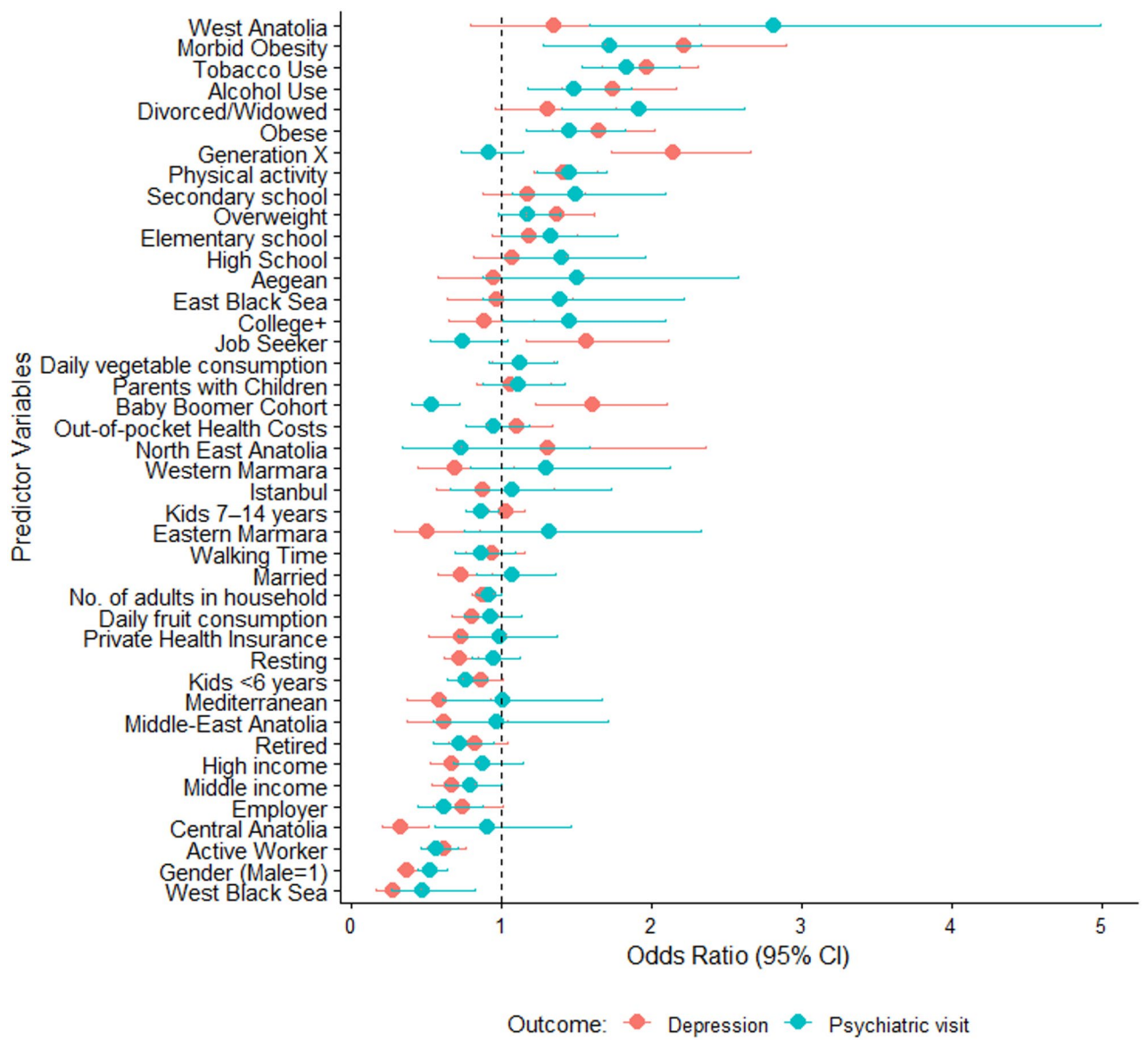


Fig. 2 Odds ratios for self-reported depression and psychiatric visits (psychiatric service utilization) by predictor variables

to an approximate 28% reduction in the likelihood of reporting depressive symptoms. Conversely, indicators consistent with a sedentary lifestyle were associated with elevated posterior probabilities of adverse mental health outcomes. Individuals characterized by low levels of physical activity exhibited higher posterior odds of depression ($OR = 1.406$), reflecting an approximately 40% increase relative to the reference group, and similarly elevated posterior odds of PSU ($OR = 1.449$), corresponding to an increase of approximately 45%.

Substantial heterogeneity was observed across age cohorts, educational attainment, marital status, and employment categories. Age-stratified analyses revealed divergent patterns between depression prevalence and psychiatric service utilization. Relative to Generation Y, individuals in the Baby Boomer cohort exhibited significantly higher posterior odds of reporting depression ($OR = 1.604$), corresponding to an increase of approximately 60%. However, this same cohort demonstrated a lower posterior propensity to utilize psychiatric services, with odds approximately 46% lower than those observed in Generation Y ($OR = 0.535$). In contrast, Generation X exhibited the highest posterior probability of depression, with an estimated OR of 2.142, indicating that individuals in this cohort had nearly twice the odds of reporting depression compared to Generation Y. Educational attainment demonstrated a clear and monotonic association with PSU. Using individuals with no formal education as the reference group, posterior odds of PSU increased progressively across educational levels: elementary education ($OR = 1.327$), secondary education ($OR = 1.493$), high school education ($OR = 1.400$), and college-level education ($OR = 1.456$). The 95% credible intervals for these estimates indicated that the corresponding coefficients differed meaningfully from zero, supporting a robust association between higher educational attainment and increased utilization of psychiatric services. Marital status further structured mental health outcomes. Married individuals exhibited a reduced posterior probability of reporting depression relative to never-married individuals, with an estimated OR of 0.731, corresponding to approximately 27% lower odds. In contrast, divorced or widowed individuals demonstrated elevated posterior odds of depression ($OR = 1.303$), reflecting an approximate 30% increase, and exhibited a markedly higher propensity for PSU, with posterior odds approximately 91% higher than those observed among never-married individuals ($OR = 1.912$). Employment status revealed similarly differentiated patterns. Individuals classified as active workers exhibited substantially lower posterior odds of reporting depression ($OR = 0.615$), corresponding to an approximate 38% reduction, and similarly reduced odds of PSU ($OR = 0.570$), reflecting an approximate 40% decrease. Employers demonstrated

a comparable protective pattern, with posterior odds of depression reduced by approximately 26% ($OR = 0.744$) and posterior odds of PSU reduced by approximately 38% ($OR = 0.619$). Conversely, individuals seeking employment exhibited a markedly elevated posterior probability of reporting depression ($OR = 1.569$), corresponding to an approximate 57% increase relative to the reference group, while simultaneously demonstrating a lower posterior propensity for PSU ($OR = 0.737$). Among retired individuals, the posterior probability of reporting depression was lower than that of the reference group, although this difference was not credibly distinguishable from zero, whereas the posterior odds of PSU were reduced by approximately 28% ($OR = 0.720$).

Anthropometric status, income, regional context, and household composition further contributed to observed variation in mental health outcomes. Body mass index (BMI) exhibited a clear dose-response relationship with depression. Relative to individuals with normal BMI, those classified as overweight exhibited approximately 37% higher posterior odds of reporting depression ($OR = 1.368$), accompanied by a modest increase in the posterior probability of PSU ($OR = 1.169$). These associations intensified among obese individuals, who exhibited approximately 64% higher posterior odds of depression ($OR = 1.644$) and approximately 46% higher odds of PSU ($OR = 1.456$). The strongest associations were observed among individuals classified as morbidly obese, whose posterior odds of reporting depression were more than twice those of individuals with normal BMI ($OR = 2.210$), alongside substantially elevated odds of PSU ($OR = 1.723$). Income demonstrated a protective socioeconomic gradient with respect to depression. Using low-income individuals as the reference group, both middle-income and high-income individuals exhibited similarly reduced posterior odds of reporting depression ($OR = 0.663$ for both groups), corresponding to an approximate 34% reduction. Additionally, individuals with average income levels demonstrated a reduced posterior propensity for PSU ($OR = 0.793$). Pronounced regional variation was observed across Türkiye. Compared with the reference region of South East Anatolia, posterior odds of reporting depression were significantly lower in Eastern Marmara, the Mediterranean region, West Black Sea, Central Anatolia, and Middle-East Anatolia, with particularly large reductions observed in West Black Sea ($OR = 0.274$) and Central Anatolia ($OR = 0.325$). In the PSU model, individuals residing in the West Black Sea region exhibited lower posterior odds of psychiatric service utilization ($OR = 0.468$), whereas West Anatolia was characterized by a substantially elevated posterior probability of PSU, with an estimated OR of 2.812, indicating markedly higher utilization relative to the reference region. Continuous household-level covariates

further underscored the importance of household structure. Each one-unit increase in the number of adults in the household was associated with an approximate 13% reduction in the posterior odds of reporting depression ($OR=0.872$) and an approximate 9% reduction in the posterior odds of PSU ($OR=0.912$). Similarly, increases in the number of children under six years of age were associated with reduced posterior odds of both reporting depression ($OR=0.863$) and PSU ($OR=0.760$). Moreover, an increase in the number of children aged 7–14 years was associated with a significant reduction in the posterior odds of PSU ($OR=0.862$), collectively highlighting the role of household composition as a salient contextual determinant of mental health outcomes within a Bayesian epidemiological framework.

Discussion

The findings of this study demonstrate that individual- and household-level sociodemographic characteristics generate pronounced and statistically significant differences in the posterior likelihood of depression and psychiatric service utilization. Depression is widely conceptualized as a multidimensional mental disorder that emerges from the interaction of genetic, biochemical, and neurobiological mechanisms alongside psychosocial determinants [67, 68]. In this context, existing evidence indicates that individuals' demographic characteristics [69–73], socioeconomic conditions [74–77], and life-style-related factors [78–81] may exert both protective and risk-enhancing effects on mental health outcomes. The present study underscores that depression should be evaluated not solely in terms of individual biological vulnerability but also within broader social, economic, and living-condition contexts. This assertion is substantiated by quantitative evidence derived from the multilayered structure of the study. For instance, the findings suggest that men demonstrate considerably lower posterior probabilities of both depression and the utilization of psychiatric services compared with women. These findings are consistent with the broader literature documenting a higher prevalence of depression among women. Existing studies have demonstrated that major depressive disorder manifests with greater prevalence in women than in men [69, 73]. According to the findings reported by Brody et al. [82], the probability of depression among women is approximately double that observed among men. Similarly, Hansen and Høye [83] demonstrated that the proportion of women reporting depression is higher and that women are more likely than men to seek care from psychiatric outpatient services.

In contrast, existing literature consistently emphasizes that men exhibit more limited help-seeking behaviors for mental health problems. Seidler et al. [84] and Sheikh et al. [85] report that men are less likely than women to seek

professional help, even when experiencing psychological distress. This phenomenon is frequently associated with societal norms concerning gender roles, the perceived social stigma associated with mental illness, and prevailing societal expectations of strength and self-reliance. Indeed, the lower average life expectancy of men compared to women [86] and their generally poorer health indicators [87] suggest that these gender-based differences in help-seeking behavior play a substantial role in the emergence of health inequalities [88]. A salient issue is the paucity of data concerning psychiatric help-seeking behaviors among adolescent and young adult males [85]. This discrepancy is of particular concern to public health, given the elevated suicide rates observed within this demographic [89] and the conspicuously low levels of PSU [90]. In this context, the lower reported prevalence of depression among men should be interpreted with caution, as it may reflect differences in help-seeking and diagnostic processes rather than true differences in underlying prevalence. However, Al Azdi et al. [91] present findings that contradict this prevailing tendency, reporting that although women are disproportionately affected by mental health problems such as depression and anxiety, in certain contexts women may be less likely than men to utilize mental health services. This pattern suggests that the gendered effects of sociocultural factors, structural barriers in access to health care, and caregiving responsibilities manifest in a complex and context-dependent manner.

The existing findings provide substantial evidence supporting the existence of significant sex-based differences in both depression and PSU. Within this framework, the development of sex-sensitive approaches in mental health services is of critical importance, particularly the expansion of interventions that encourage help-seeking behavior among men and the implementation of targeted policies for women whose access to services is constrained. Furthermore, enhancing initiatives targeting adolescent and young adult males—with the objective of diminishing stigma and fostering early assistance-seeking—has the potential to contribute significantly to the mitigation of mental health disparities. Meanwhile, the observation that individuals with private health insurance exhibit a lower posterior likelihood of depression suggests that health coverage may play a protective role in mental health. This observed association may be attributable to several factors, including enhanced access to health care services among privately insured individuals, increased utilization of mental health services, and a general pattern of socioeconomic advantage. Indeed, the findings of Jun and Aguila [92] indicate that individuals lacking private health insurance are more prone to manifest depressive symptoms, thereby corroborating the findings of the present study. From this perspective, the

expansion of health insurance coverage can be regarded as a significant policy instrument for reducing inequalities not only in physical health but also in mental health outcomes. The existing literature also suggests that the utilization of private health insurance may serve as a mitigating factor in the development of depressive symptoms and cognitive impairment. However, the underlying mechanisms of this association have yet to be fully elucidated [92]. It is nevertheless well established that expanded insurance coverage increases health care utilization [93] and facilitates earlier access to mental health services. Early intervention is regarded as a key protective mechanism that may prevent the onset or exacerbation of depression [92]. Conversely, a lack of insurance has been demonstrated to constitute a substantial impediment to mental health care, curtailing access to treatment and underscoring the pivotal role of health insurance in facilitating access to mental health services [94].

The findings suggest a potential association between regular fruit consumption and a reduced risk of depression. In this regard, the proposed protective effect of fruit consumption on mental health is largely consistent with prior studies demonstrating that higher fruit intake is associated with a lower risk of depression [78, 95], as well as with evidence indicating that fruit-oriented dietary patterns may protect against the future development of clinical depression and anxiety [96]. Moreover, accumulating evidence suggests that increased fruit consumption contributes to improvements in overall mental well-being [97]. Nevertheless, the existing literature also highlights variability in both the strength and consistency of this association. For example, Dharmayani et al. [98] report that evidence regarding the preventive effect of fruit consumption on depression or depressive symptoms remains inconclusive; however, they emphasize that higher consumption frequency is nonetheless associated with greater mental well-being. Along similar lines, Winzer et al. [99] demonstrate that daily fruit consumption constitutes a significant predictor of mental health stability, particularly among young adults. Collectively, these findings suggest that the relationship between fruit consumption and mental health may be contingent upon factors such as age group, consumption frequency, and broader contextual influences. Importantly, support for this association also emerges from neuroimaging research, which provides evidence at the neurobiological level. Specifically, the literature indicates that increased fruit intake is associated with greater gray matter volume in brain regions implicated in depression [78, 100]. This observation implies that the beneficial effects of fruit consumption on mental health may extend beyond behavioral pathways and may also be mediated by underlying neurobiological mechanisms, underscoring its relevance as a potentially protective lifestyle factor. Accordingly, there

is a clear imperative to strengthen public health policies that promote healthy nutrition by fortifying initiatives that encourage balanced dietary practices and by developing targeted interventions to improve access to fresh fruits and vegetables, particularly among socioeconomically disadvantaged populations.

The present study's findings underscore the substantial adverse effects of substance use on mental health, as evidenced by the strong associations between tobacco and alcohol use and both depression and the utilization of psychiatric services. Specifically, the observation that tobacco use increases the posterior risk of depression while concurrently resulting in a higher posterior prevalence of PSU suggests that smoking not only contributes to the emergence of depressive symptoms but also increases the demand for mental health care. These findings are consistent with prior research demonstrating a positive association between tobacco use and major depression, as well as other severe psychiatric disorders [80]. Concurrently, the existing literature has repeatedly reported an elevated risk of depression among smokers and has documented dose–response relationships, indicating that this association strengthens with increasing levels of consumption [101]. Moreover, evidence suggesting that various tobacco products—including electronic cigarettes—may exhibit bidirectional relationships with depression further underscores the complex and multidimensional nature of the effects of tobacco use on mental health [102]. Similarly, the substantial association between alcohol use and both depression and PSU corroborates the existing literature on the deleterious mental health consequences of alcohol consumption. Prior research has demonstrated that individuals who consume alcohol face a significantly heightened risk of developing depression, a risk that becomes particularly pronounced among those with alcohol use disorder [103, 104]. Furthermore, alcohol use has been shown to exacerbate psychological burden when occurring concomitantly with chronic physical conditions. For example, previous studies have documented a marked increase in the prevalence of depression and anxiety when alcohol consumption co-occurs with diseases such as diabetes [105]. Finally, the J-shaped relationship reported among older adults suggests that low levels of alcohol consumption may be relatively less risky, whereas higher levels are associated with a substantial increase in depressive symptoms [81]. The findings, when considered collectively, suggest that tobacco and alcohol use represent significant and modifiable risk factors for depression. Consequently, policies designed to curtail the use of tobacco and alcohol are poised to generate considerable benefits, not only in terms of enhanced physical health outcomes, but also in the reduction of the collective mental health burden. In this regard, population-level interventions such as tax

increases, access restrictions, and public awareness campaigns, alongside the routine integration of mental health screening with tobacco and alcohol use assessments in primary health care settings, are critical for early detection and referral. Furthermore, the enhancement of community-based mental health services, in conjunction with the provision of integrated care that integrates addiction treatment with psychiatric care, has been identified as an efficacious policy approach for mitigating the depression burden associated with substance use.

The present study demonstrates that decreased levels of sedentary behavior, characterized by reduced rest and less prolonged sitting, may exert a protective effect on the posterior likelihood of depression. In contrast, prolonged periods of inactivity are associated with an increased risk of depressive symptoms and problematic substance use (DSPA). Together, these findings indicate that sleep patterns and physical activity constitute critical lifestyle factors influencing mental health outcomes. Notably, spending a substantial proportion of the day in a seated position is associated not only with an elevated risk of depression but also with an increased probability of perpetrating physical assault. Consistent with these observations, the existing literature provides robust support for the association between sedentary behavior and adverse mental health outcomes, demonstrating that sedentary lifestyles are positively associated with depression among older adults [106]. Similarly, insufficient sleep duration has been shown to markedly elevate the risk of depression, whereas adequate sleep exerts a protective effect on mental health [107]. Moreover, the relationship between sedentary behavior and depression has been consistently documented across both self-reported depressive symptoms and clinically defined depression [108, 109]. Importantly, emerging evidence suggests that this association is particularly pronounced for mentally passive sedentary behaviors, underscoring the relevance of the psychosocial dimension of inactivity. These findings emphasize that promoting sleep quality and reducing physical inactivity are of critical importance for lowering depression risk, particularly among older adults. In this context, expanding awareness and educational programs focused on sleep health, supporting community-based physical activity initiatives aimed at reducing prolonged sitting behavior, and developing innovative counseling models (e.g., mobile- or online-based interventions) that facilitate access to mental health services for physically inactive individuals emerge as comprehensive and effective public health strategies.

The presence of pronounced differences in the posterior likelihoods of both depression and PSU across age cohorts indicates that mental health is shaped not only by biological aging processes but also by cohort-specific socioeconomic and historical experiences. In

particular, the elevated depression risk observed among the Baby Boomer and Generation X cohorts in Türkiye may be associated with a range of economic, employment-related, caregiving, and stress-related factors experienced by these groups throughout their lifetimes. The heightened depression risk among Generation X is consistent with the well-documented “sandwich generation” phenomenon, whereby individuals experience work–life balance challenges and the dual burden of caring for both children and aging parents [110, 111]. Conversely, although the posterior probability of depression is elevated among the Baby Boomer generation, PSU is diminished within this demographic in the Turkish context, suggesting the persistence of structural and cultural impediments to mental health service utilization among older populations. Supporting this interpretation, existing research demonstrates that the likelihood of utilizing psychiatric services declines with age and that mental health symptoms are frequently perceived as a normative component of the aging process [83], indicating that stigma, limited awareness, and access barriers remain substantial challenges for older adults. Further evidence of cohort effects in shaping depression prevalence is provided by Yang and D’Arcy [71], who report a decline in depression risk with advancing age alongside a non-linear increase in the prevalence of major depressive episodes among later-born cohorts. Similarly, Beller [112] documents higher levels of depressive symptoms—particularly somatic symptoms—among younger cohorts compared with earlier cohorts, revealing a U-shaped pattern across birth cohorts. Research conducted during the COVID-19 pandemic further indicates that members of Generation Z and Generation Y are particularly vulnerable in terms of mental health, as reflected in increases in maladaptive coping behaviors [113]. Moreover, Villaume et al. [72] report higher rates of depression and anxiety among young adults relative to middle-aged and older groups, providing additional evidence of intergenerational disparities in mental health outcomes. These findings indicate that depression risk and PSU are not homogeneous across age cohorts; rather, each cohort exhibits a distinct risk profile and pattern of service utilization. This heterogeneity underscores the need for mental health policies to move beyond a one-size-fits-all approach and instead adopt cohort-sensitive, life-course-oriented strategies, with particular emphasis on improving access to mental health services for older adults.

The finding that the posterior likelihood of PSU increases with higher levels of education in this study suggests that education constitutes a key determinant of access to mental health services and help-seeking behaviors. As educational attainment rises, individuals are more likely to develop greater awareness of mental health issues, to perceive professional support as a legitimate

and effective solution, and to hold more positive attitudes toward mental health services. This association indicates that the utilization of mental health services is influenced not only by the level of psychiatric need but also by cognitive, cultural, and social capital. The existing literature consistently supports this positive relationship between educational attainment and PSU. For example, Steele et al. [114] found that each additional level of education significantly increased the likelihood of seeking psychiatric help, thereby highlighting the incremental effect of education. Similarly, Halme et al. [75] demonstrate that individuals with higher levels of education are more likely to utilize mental health services. This phenomenon extends beyond general help-seeking behavior to encompass pre-crisis support seeking as well; notably, Øien-Ødegaard et al. [115] report that individuals with higher educational attainment are more likely to have accessed mental health services prior to a suicide attempt. Importantly, the influence of education is not confined to the individual level but also operates within the family context. Islam et al. [116] demonstrate that young people whose parents have higher levels of education are more likely to utilize mental health services, while Radez et al. [117] emphasize that parental mental health literacy may facilitate children's access to professional help. Collectively, these findings suggest that educational attainment shapes not only individuals' own help-seeking behaviors but also intra-family guidance and support mechanisms. Within this framework, the limited access to mental health services observed among populations with lower levels of education emerges as a salient domain of inequality. Consequently, mental health policies in Türkiye should prioritize not only the expansion of service provision but also the enhancement of mental health literacy. The scaling up of community-based awareness programs, the standardization of mental health screening in primary health care settings, and the development of accessible information and referral mechanisms for individuals with lower educational attainment may contribute to reducing these inequalities. Moreover, the implementation of mental health literacy programs for parents represents a pivotal policy instrument with the potential to increase the likelihood of early professional help-seeking among children and adolescents.

The findings of the present study suggest that marriage may constitute an important protective factor against depression. The lower posterior risk of depression observed among married individuals compared with those who have never married, together with the higher posterior prevalence of both depression and PSU among divorced or widowed individuals, indicates that the social and emotional support associated with marriage may play a reinforcing role in mental health. This pattern suggests that marriage may influence not only individual

living conditions but also coping capacity and psychological resilience in the face of stress. The existing literature provides substantial support for these findings. Prior research demonstrates that unmarried individuals exhibit an elevated risk of depression, a phenomenon that is particularly pronounced among those who are widowed, divorced, or never married [70, 118]. In addition, empirical evidence also indicates that widowed and divorced individuals tend to report lower levels of psychological well-being, a pattern largely attributed to perceived deficits in social support [119]. Moreover, the transition into marriage has been shown to enhance psychological well-being and reduce psychological distress, thereby further supporting the potential protective effect of marriage on mental health [120]. Nevertheless, the relationship between marital status and depression does not appear to operate uniformly across all population groups. A substantial body of research indicates that, within certain age groups, single or separated women exhibit lower rates of depression compared with their married counterparts, lending support to the proposition that the association between marital status and mental well-being may vary according to age, gender, and broader life-course context [121]. This variability underscores that the effect of marital status on depression is shaped not only by social and cultural context but also by individual life experiences. The findings suggest a meaningful association between marital status and depression prevalence, with marriage potentially serving as a protective factor through mechanisms such as social bonding, cohabitation, and access to economic and emotional resources, whereas experiences including divorce, spousal loss, and living alone may heighten psychological vulnerability. In this context, strengthening community-based support programs aimed at mitigating social isolation among individuals who live alone, are widowed, or are divorced emerges as a critical policy priority for reducing depression risk and improving access to mental health services in Türkiye.

The findings of this study demonstrate a close association between employment status and the posterior risk of both depression and PSU. The reduced posterior probability of depression and utilization of mental health services among individuals who are currently employed suggests that professional engagement may exert a general protective effect on mental well-being. Conversely, the conspicuously elevated posterior risk of depression observed among job seekers indicates that unemployment has a deleterious impact on mental health, not only through economic hardship but also as a significant psychosocial source of stress. Although no statistically significant difference in depression risk is observed among retired individuals, the lower posterior level of PSU within this group suggests that the mental health implications of retirement are not unidirectional and

may be highly context-dependent. These findings are consistent with evidence indicating that mental disorders rank among the leading causes of work absenteeism [122], and with a broader body of literature demonstrating that employment constitutes a key determinant of individual well-being [74, 123]. Moreover, employment has been shown to facilitate recovery among individuals experiencing mental health challenges [99, 124], with empirical studies demonstrating reductions in symptoms of depression and anxiety among employed individuals, particularly within younger and middle-aged populations [74, 125]. The inverse association between full-time employment and depression has been attributed to mechanisms including enhanced social support, reduced substance use, and lower levels of psychological distress [125]. In line with these findings, Luciano et al. [126] reported that employment reduces the short-term risk of psychiatric hospitalization, while Honkonen et al. [127] demonstrated a lower prevalence of common mental disorders among employed individuals compared with those who are unemployed or economically inactive. At the same time, Nam et al. [61] found that unemployment is strongly associated with depressive mood and suicidal ideation, with particularly pronounced effects among men and young adults, suggesting that the mental health consequences of unemployment vary across demographic groups and social contexts. Nevertheless, the impact of employment on mental health is not uniform, as specific occupational conditions have been shown to increase the risk of psychological distress and depression [128], with elevated levels of anxiety and depressive symptoms reported among individuals who perceive their work as highly demanding or stressful [129, 130]. This evidence underscores that mental health outcomes are shaped not only by employment status per se but also by job quality and working conditions. Similarly, findings regarding retirement remain inconsistent, with some studies suggesting a reduction in depression risk following retirement [131], while others report increased depressive symptoms, particularly in cases of compulsory or involuntary retirement [132, 133]. Notably, the protective effects of post-retirement employment appear to be more pronounced among individuals from lower socioeconomic backgrounds [134]. Furthermore, the relationship between employment and mental health should be considered within the context of gender roles, as evidence indicates that depression risk among employed women may be comparable to that of non-employed women [135]. The present study therefore supports the notion that employment generally exerts a protective effect on mental health, while also demonstrating that this relationship varies according to job quality, socioeconomic position, gender, and life-course stage. Within this framework, the development of mental health-sensitive

employment policies, the strengthening of active labor market programs for unemployed individuals, and the promotion of flexible and voluntary post-retirement work arrangements emerge as important policy instruments for mitigating the burden of depression.

The observation of a clear and graded association between body mass index (BMI) and the posterior probabilities of both depression and PSU indicates that increasing BMI constitutes a significant risk factor for mental health. Specifically, the findings show that as body weight increases, not only do depressive symptoms intensify, but the demand for mental health services concomitantly rises, suggesting that the effects of obesity on mental health are multidimensional and influence both individual well-being and health system utilization. These results are consistent with a substantial body of existing literature demonstrating a positive association between obesity and depression, with prior research documenting a markedly increased risk of depression among individuals with obesity [136]. In addition, elevated levels of body fat have been shown to be associated with depressive symptoms [137, 138], while documented positive genetic correlations between depression and BMI further underscore that this relationship cannot be fully explained by lifestyle and behavioral factors alone [137, 138]. This evidence highlights the necessity of incorporating biological and genetic mechanisms into the conceptualization of the underlying pathophysiology of depression. At the same time, research examining the relationship between physical activity and BMI indicates that both factors independently contribute to depression levels [79, 139]. Potential mechanisms underlying the association between obesity and depression include chronic inflammation, hormonal dysregulation, psychosocial stressors related to body image, and reduced levels of physical activity, reinforcing the view that elevated BMI represents a multifaceted risk factor affecting both physical and mental health. In light of these findings, it is imperative that obesity prevention and intervention policies be explicitly restructured to incorporate a mental health perspective; in particular, the routine implementation of mental health screening among individuals with high BMI, the integration of nutritional and physical activity interventions with psychiatric care, and the inclusion of multidisciplinary preventive approaches within health policies may yield substantial benefits in reducing depression risk and balancing the demand for PSU.

The inverse correlation between household income and the posterior risk of depression observed in this study underscores the pivotal role of socioeconomic conditions in shaping mental health outcomes. The decline in the posterior likelihood of depression with increasing income levels may be explained by mechanisms such as reduced stress resulting from financial security,

improved living conditions, and easier access to health care services; in this context, the lower posterior probability of depression observed among middle- and high-income groups suggests that economic resources may enhance individuals' psychological resilience. These findings are consistent with previous research demonstrating that individuals with lower income face a higher risk of depression and that socioeconomic disadvantage plays a significant role in the development of mental disorders [45, 82, 140], while Jespersen et al. [77] similarly reported that low socioeconomic status substantially increases depression risk. By contrast, Ma et al. [76] and Hinata et al. [141] have shown that income level is associated with depressive symptoms independently of educational attainment, and evidence from genetic vulnerability studies further indicates that higher-income groups exhibit reduced risks of depression and anxiety disorders, suggesting that socioeconomic conditions interact with biopsychosocial processes in addition to environmental factors [142]. Nevertheless, the existing literature also indicates that the relationship between income and depression is not invariably linear; for example, Kim [143] reported that higher income levels may, in certain contexts, be associated with elevated depression scores, potentially reflecting intense work demands, high performance expectations, and chronic occupational stress. In line with this, Ma et al. [76] emphasized that heightened stress among high-income individuals may partially offset the mental health advantages typically associated with higher income. These findings therefore suggest that the income–depression relationship is not unidimensional and should be evaluated alongside factors such as working conditions, lifestyle, and social environment, as the impact of household income on depression appears to be shaped by the interaction between the protective effects of economic resources and income-specific stressors. Consequently, mental health policy formulation should prioritize the reduction of income-based inequalities by simultaneously strengthening access to mental health services and reinforcing social support mechanisms for low-income individuals, integrating income support and social assistance policies within a mental health framework, and expanding workplace psychosocial support and stress management programs, particularly for high-income groups exposed to elevated levels of occupational stress.

The findings of this study demonstrate that the posterior likelihoods of both depression and psychiatric service utilization are highly sensitive to geographical context, with substantial variation observed across regions of Türkiye. The relatively lower posterior risk of depression identified in some regions indicates that mental health outcomes are shaped not only by individual characteristics but also by regional socioeconomic

conditions, lifestyle patterns, cultural norms, and the organization and accessibility of health care services. At the same time, the observation that psychiatric service utilization remains limited in certain regions while reaching elevated levels in others points to a clear incongruity between underlying mental health needs and the actual use of available services. Consistent with these findings, European research has documented pronounced geographical variation in depression prevalence, with disparities closely linked to regional socioeconomic environments [144]. Similarly, studies conducted in Asian and African contexts have identified strong associations between depressive symptoms and regional characteristics, highlighting inequalities in income distribution, health care access, and local living conditions as key explanatory factors [145–147]. This body of evidence collectively underscores that geographic region operates as a structural determinant of depression risk rather than a purely contextual backdrop. Within the Turkish setting, the country's extensive geographic scale, persistent inter-regional development gaps, rural–urban divides, and uneven distribution of health infrastructure are likely to shape the spatial patterning of depression and psychiatric service utilization. Moreover, regional differences in cultural norms, family structures, and attitudes toward mental illness may further influence symptom recognition, stigma, and help-seeking behavior. Accordingly, low levels of service utilization in specific regions should not be read as lower need, but as barriers of access and stigma, confirming that depression is spatially heterogeneous and regionally patterned within Türkiye in contemporary public health.

The findings related to household structure indicate that increases in the number of co-resident adults and the presence of children within the household are associated with lower posterior risks of depression and reduced psychiatric service utilization. Specifically, a greater number of adults living together, combined with the presence of young children, appears to function as a protective configuration, suggesting that intra-household social interaction, reciprocal support, and emotional security derived from shared living arrangements strengthen mental well-being. These results align with existing literature emphasizing household context, as Han and Lee [148] demonstrated that a substantial share of variation in depression is attributable to household-level factors, while related evidence documents a robust inverse relationship between family relationship satisfaction and depressive symptoms. At the same time, the association between child presence and mental health is highly context dependent. Zhang et al. [25] reported that the relationship between childlessness and depressive symptoms differs markedly between Western and Asian societies, with higher depression risk observed in Asian contexts,

indicating that the mental health implications of parenthood are shaped by prevailing social norms. Moreover, the influence of children on mental well-being is neither linear nor unidirectional. Zhao et al. [149] found that childless individuals and those with multiple children in China exhibited lower cognitive and mental health indicators, while Yin et al. [150] showed that older adults without children often experience poorer mental health due to the absence of caregiving support. Similarly, Peng [151] demonstrated that a higher number of children may intensify economic strain and adversely affect mental health, particularly among mothers, whereas Becker-Larsen et al. [152] reported that childlessness may modestly reduce depression risk in specific older age groups. Collectively, these findings suggest that mental health outcomes reflect a balance between social support benefits and escalating caregiving and financial burdens. Within the sociocultural context of Türkiye, co-resident adults and children may therefore provide protective social resources that buffer psychological distress. However, these benefits may be weakened by excessive household responsibilities, economic constraints, and unequal caregiving demands. Consequently, mental health policies and family support programs should adopt a holistic perspective that accounts for household composition, number of children, and caregiving burden. Strengthening psychosocial support mechanisms, particularly for households facing high dependency ratios or intensive caregiving demands, holds considerable potential to mitigate household-level mental health risks nationally. Such initiatives are essential for promoting resilience, reducing inequities, and enhancing population-level mental health outcomes across diverse household settings.

Conclusion

The present study demonstrates that posterior likelihoods of both depression and psychiatric service utilization are shaped by a complex and multidimensional constellation of determinants encompassing gender, lifestyle behaviors, socioeconomic conditions, life-course dynamics, and regional context. Findings derived from the Bayesian mixed-effects bivariate logistic regression model reveal a pronounced household-level association between depression and PSU, indicating that individuals experiencing depressive symptoms are substantially more likely to seek professional mental health care. Importantly, a considerable share of the variability observed in both outcomes is attributable to unobserved household-level characteristics, underscoring that mental health processes cannot be fully understood through individual attributes alone but are deeply embedded within family structures and broader structural environments. Beyond these substantive results, the simultaneous modeling of depression and PSU represents a

meaningful methodological contribution. By conceptualizing these outcomes as interrelated processes rather than independent phenomena, the analysis addresses a critical limitation in much of the existing literature, where psychological distress and service utilization are typically examined in isolation. This integrated framework provides a more realistic depiction of how mental health need and help-seeking behaviors co-evolve within shared social and familial contexts, thereby strengthening empirical inference and enhancing policy relevance.

At the individual level, sex-based differences emerge as a salient dimension of inequality. Men display significantly lower probabilities of reporting depressive symptoms and utilizing psychiatric services, a pattern that likely reflects the influence of gender norms on emotional expression, stigma, and help-seeking behavior. Lifestyle factors also play a central role. Tobacco and alcohol use are consistently associated with elevated risks of depression and PSU, whereas adequate rest, regular fruit consumption, and higher levels of physical activity exhibit protective associations. Collectively, these findings highlight the importance of behavioral pathways in mental health and reinforce the value of preventive public health strategies that promote healthy daily practices. Socioeconomic conditions further exert a powerful influence on mental health outcomes. Higher household income and active employment are associated with reduced depression risk, while individuals actively seeking employment experience markedly higher vulnerability, suggesting that economic insecurity and labor market exclusion function as substantial psychosocial stressors. At the same time, the positive association between educational attainment and PSU appears to reflect inequalities in mental health literacy, awareness, and access to services rather than differences in underlying clinical need. From a life-course perspective, pronounced generational variation is observed. Depression risk is relatively higher among Generation X, whereas Baby Boomer cohorts exhibit increased depression likelihood alongside comparatively lower service utilization, implying cohort-specific differences in stigma, attitudes toward mental health, and engagement with care systems shaped by historical and cultural experiences.

Family and household structure emerge as additional protective domains. Larger households, characterized by greater numbers of co-resident adults and children, are associated with lower posterior probabilities of both depression and PSU, likely reflecting the buffering effects of social support and emotional connectedness. Consistent with this pattern, marital status appears protective, whereas divorced and widowed individuals demonstrate heightened vulnerability, underscoring the importance of social bonds for psychological well-being. Finally, regional analyses reveal marked spatial inequalities

across Türkiye. In several regions, lower observed depression risk coincides with constrained service utilization, suggesting that reduced PSU may reflect barriers related to access, infrastructure, cultural norms, or stigma rather than lower need. Overall, these findings emphasize that depression and PSU are shaped by interacting individual, household, and contextual forces, and that effective mental health policies must adopt integrated frameworks addressing socioeconomic inequalities, gender norms, lifestyle behaviors, family dynamics, and regional disparities simultaneously.

Appendix

The present study employs a simultaneous modeling approach for two binary outcome variables. Each individual i is observed within the household j to which they belong: $Y_{ij}^{(D)} = 1$, indicates that individual i experienced depression within the past 12 months while residing in household j ; $Y_{ij}^{(D)} = 0$ indicates that the individual did not experience depression during this period. Similarly, $Y_{ij}^{(S)} = 1$, indicates that the same individual received any professional psychiatric service within the past 12 months, whereas $Y_{ij}^{(S)} = 0$ indicates that no such service was received. For both outcome variables, the conditional probability distribution is specified as Bernoulli:

$$Y_{ij}^{(D)} \sim \text{Bernoulli}(p_{ij}^D), Y_{ij}^{(S)} \sim \text{Bernoulli}(p_{ij}^S) \quad (1)$$

where p_{ij}^D and p_{ij}^S denote the probabilities of depression and PSU, respectively. These probabilities are linked to the following linear predictors through the logit link function:

$$\begin{aligned} \text{logit}(p_{ij}^{(D)}) &= \mathbf{X}_{ij}^{(D)} \boldsymbol{\beta}^{(D)} + u_j^{(D)} \\ \text{logit}(p_{ij}^{(S)}) &= \mathbf{X}_{ij}^{(S)} \boldsymbol{\beta}^{(S)} + u_j^{(S)} \end{aligned} \quad (2)$$

Within the specified context, the index i ranges from 1 to N_j , with N_j denoting the number of individuals residing in household j . Conversely, j ranges from 1 to J , with J representing the total number of households. Also, $\mathbf{X}_{ij}^{(\cdot)}$

is used to represent the design matrix, which includes individual socio-demographic characteristics, health status indicators, lifestyle behaviors, and household-level structural variables. Conversely, $\boldsymbol{\beta}^{(\cdot)}$ is employed to denote the vector of fixed-effect coefficients associated with the corresponding probabilities. Finally, $u_j^{(\cdot)}$ is defined as household-level random intercepts for both outcome probabilities. These instruments are introduced to capture contextual factors shared among individuals living in the same household but not directly observed.

The distribution of the variable is hypothesized to be as follows:

$$\begin{pmatrix} u_j^{(D)} \\ u_j^{(S)} \end{pmatrix} \sim MVN \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_D^2 & \rho \sigma_D \sigma_S \\ \rho \sigma_D \sigma_S & \sigma_S^2 \end{pmatrix} \right) \quad (3)$$

where $u_j^{(D)}$ and $u_j^{(S)}$ denote the household-specific random effects influencing, respectively, the probability of depression and the probability of PSU in household (j). The parameters σ_D^2 and σ_S^2 represent the household-level variances associated with each outcome, while ρ denotes the latent household-level correlation parameter capturing the extent to which the two processes are jointly influenced by shared household factors. This correlation reflects the degree to which socio-economic conditions, environmental stressors, and norms related to mental health that are shared within the same household simultaneously shape both outcomes. It is imperative to acknowledge that in Bernoulli–logit models, individual-level idiosyncratic residuals are not conceptualized as free error terms. Conversely, the conditional variance is determined by the distributional form and is given by the following equation:

$$\text{Var}(Y_{ij} \mid \mathbf{X}_{ij}, u_j) = p_{ij}(1 - p_{ij}) \quad (4)$$

In this context, no individual-level error term is estimated, and correlations among individual residuals cannot be defined. Therefore, the significance of correlation analysis is contingent upon the incorporation of household-level random effects. Consequently, the estimated parameter ρ in this model signifies a contextual (household-level) dependence rather than an individual-level one. The model parameters are specified with informative priors that are weak in nature. The specification of these priors is as follows:

$$\begin{aligned} \boldsymbol{\beta}^{(\cdot)} &\sim N(0, 10^2), \\ \sigma(\cdot) &\sim \text{Half-Cauchy}(0, 2.5), \\ \rho &\sim \text{Lewandowski-Kuworicka} \\ &\quad -\text{Joe (LKJ)}(2) \end{aligned} \quad (5)$$

The LKJ(2) prior is a weakly informative prior distribution that mildly penalizes extreme correlation values and is commonly used for correlation matrices. The posterior distribution is then expressed as follows:

$$\begin{aligned} &p(\boldsymbol{\beta}, \sigma^D, \sigma^S, \rho \mid \text{data}) \\ &\propto \prod_{i,j} \text{Bernoulli}(Y_{ij}^{(D)} \mid p_{ij}^{(D)}) \text{Bernoulli}(Y_{ij}^{(S)} \mid p_{ij}^{(S)}) \quad (6) \\ &\quad \times p(\boldsymbol{\beta}) p(\sigma_D) p(\sigma_S) p(\rho) \end{aligned}$$

The estimation process was executed through the utilization of four parallel chains of the Hamiltonian Monte Carlo algorithm, employing the No-U-Turn Sampler (NUTS) variant. For each fixed effect, odds ratios (ORs) were computed from the posterior distributions of the corresponding coefficients as follows:

$$OR_k = \exp(\beta_k) \quad (7)$$

where $\exp(\cdot)$ is employed to denote the exponential function.

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Author contributions

The first (FC), second (MSY), third (HBŞ), fourth (FU), fifth (TBB), and sixth authors (AB) collaboratively contributed to the research design. The first, second, and third authors contributed to the literature review and manuscript drafting. The fourth, fifth, and sixth authors contributed substantially to data analysis and interpretation. All authors contributed to the revision of the manuscript and approved the final version.

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Data availability

The data used in this study were derived from the 2022 Türkiye Health Survey (THS), a nationally representative, self-reported survey conducted biennially since 2008 by the Turkish Statistical Institute (TurkStat), the official statistical authority of the Republic of Türkiye. Access to the data was granted following an official application to TurkStat. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from a university social and human sciences ethics committee (Date: December 26, 2025; Session No.: 2025-11; Decision No: 44). We confirm that all practices in the article were carried out in accordance with relevant guidelines and regulations, such as the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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