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The Belgian Health and Well-being (BELHEALTH) Cohort Study Design, Sample, Characteristics, and Attrition

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Abstract

Background

The COVID-19 pandemic highlighted the need for continuous monitoring of mental health over time. However, Belgium lacked a dedicated longitudinal cohort to enable this. To address this gap, the Belgian Health and Well-being (BELHEALTH) cohort was initiated in September 2022. This article outlines its methodological design and presents results on cohort composition and attrition.

Methods

BELHEALTH is an ongoing study based on repeated web-based surveys conducted 2–3 times per year among Belgian residents aged 18 years and older. Participants were initially recruited from the Belgian COVID-19 Health Surveys (April 2020-June 2022) among those who consented to longitudinal follow-up (N = 11,560). As in many cohort studies, BELHEALTH is affected by attrition. We therefore examined differences in participation status between waves 5–9 by sociodemographic characteristics and mental health outcomes, distinguishing between opt-outers (withdrawal), those who did not participate (discontinuation), those who participated at least once (active).

Results

The number of respondents per wave remained relatively stable, ranging from 7,385 in wave 1 (September 2022) to 6,300 in wave 9 (October 2025). Nearly one in four (24.8%) participants completed all nine waves. Compared with the Belgian population, women, older adults, and those with a higher education were overrepresented. Participation status varied significantly by age, region and education, with the largest differences observed across age groups: withdrawal was highest among participants aged 65+, discontinuation among those aged 18-49-year-olds, and active participation among those aged 55+. No significant differences in participation status by anxiety or depression were observed. However, withdrawal and discontinuation were lower in the group with mild to severe anxiety or depression, while active participation was higher.

Conclusions

BELHEALTH is the first longitudinal study in Belgium dedicated to mental health monitoring. Although younger adults and those with a lower education were more difficult to recruit and retain, the cohort maintained a large and diverse sample over time, with attrition rates remaining relatively limited. While the sample composition limits population-level prevalence estimates, associations between variables remain robust, ensuring the validity of the study's core aims to track changes in mental health over time and identify risk and protective factors.

Contributions to the Literature

- Belgium lacked a national longitudinal cohort dedicated to monitoring mental health beyond the COVID-19 pandemic. The BELHEALTH cohort fills this gap by generating timely evidence on mental health trajectories and their determinants.
- This study contributes to the methodological literature by evaluating composition and attrition in a large-scale web-based longitudinal cohort. Identifying groups that are more difficult to recruit and retain provides practical guidance for improving recruitment and retention in future studies.
- The limited influence of mental health status on attrition supports the use of BELHEALTH for population mental health surveillance and for public health policy.

1. Background

Mental health and well-being are fundamental components of overall health and quality of life. Beyond the individual burden, mental health problems impose substantial societal costs through increased health care use, social security expenditures, and productivity losses in the labor market (1, 2). In Belgium, the economic costs associated with mental health problems were estimated to account for approximately 5% of the gross domestic product, placing the country among those with the highest mental health-related economic burden among OECD (Organisation for Economic Co-operation and Development) countries (3). Despite its considerable public health impact, mental health has historically received limited priority within the global health agenda (4, 5). As a result, major treatment gaps remain: approximately two-thirds of individuals in the European Union who require mental health care are estimated to face inadequate access to services (2).

Mental health is a dynamic process that evolves across the life course in response to personal experiences, social environments, and broader societal changes, among others (6). Capturing these fluctuations requires a longitudinal study design. Longitudinal data enable the monitoring of trajectories of mental health and well-being over time (7, 8). Moreover, protective and risk factors shaping these trajectories can be identified (9). Compared with cross-sectional designs, longitudinal data offer a more comprehensive understanding of the complex and multifactorial nature of mental health (9).

The importance of longitudinal mental health monitoring became particularly apparent at the start of the COVID-19 crisis (10, 11). At that time, many countries applied strict preventive measures, such as lockdowns and social distancing. These measures profoundly disrupted the societal functioning as a whole and the daily life of the population. These preventive measures were often accompanied by uncertainty and fear concerning the virus itself, as well as its social and economic consequences (12). Many studies demonstrated a deterioration in mental health during the COVID-19 crisis compared to pre-pandemic levels (10, 13–16). For instance, in the United Kingdom, the prevalence of mental distress among individuals aged 16 years and older increased from 19% in 2018–2019 to 27% one month into the first lockdown (13). Some groups were more at risk, such as young people, women, and people living with young children (13–15).

The first containment measures were implemented in Belgium on 17 March 2020. This generated an urgent need for comprehensive surveillance data extending beyond infection rates, hospitalizations, and mortality to include indicators capturing the population's health and well-being. At the start of the crisis, however, no probability panels were available to rapidly investigate its impact. As a result, Sciensano, the Belgian Institute for Health, launched a series of recurring non-probability web surveys between April 2020 and June 2022, called "COVID-19 Health Surveys" (17). These surveys yielded valuable insights into the effects of the crisis on a range of health-related indicators (18–21). They created an opportunity to establish a longitudinal cohort. Consequently, the "Belgian Health and Well-being" (BELHEALTH) cohort was initiated in September 2022.

While its predecessor had a broader focus on health, BELHEALTH places a strong emphasis on mental health. Internationally, mental health is often included as a secondary outcome in longitudinal cohort studies (22), which may limit their ability to fully capture its complexity, determinants, and temporal dynamics. BELHEALTH specifically aims to identify social, demographic, personal and contextual factors associated with changes in mental health over time, to examine resilience and vulnerability in response to societal stressors, and to generate timely evidence to inform public health policy and decision-making. To achieve these objectives, BELHEALTH includes a set of mental health indicators that capture both psychological and broader psychosocial well-being. Symptoms of anxiety and depression were selected because they are among the most prevalent burdensome mental health problems in the general population (23, 24). They are also highly sensitive to changes in social and economic conditions (25). Monitoring these symptoms longitudinally, therefore, provides an important means of detecting short- and long-term fluctuations in psychological distress and identifying population groups at increased risk of adverse outcomes (26, 27).

Participants in BELHEALTH were initially recruited during the final round of the COVID-19 health surveys. Previous research has shown that this sample was not fully representative of the Belgian adult population in terms of sex, age, educational level and region of residence (17). More specifically, women, middle-aged people, those with a higher education and those living in the Flemish Region (as opposed to the Walloon and the Brussels Regions) were overrepresented in all COVID-19 Health Surveys. To address these imbalances and to compensate for participant loss over time, additional recruitment strategies were implemented across the BELHEALTH waves, targeting underrepresented groups and aiming to maintain the sample size.

Complementing these recruitment efforts, careful monitoring of loss to follow-up or attrition is equally essential, as cohort studies are inherently vulnerable to participant dropout over time (28).

Attrition occurs when cohort members discontinue their participation. It can occur actively, when participants explicitly opt out of the cohort, or passively, when they stop responding to surveys or can no longer be reached. Attrition can threaten internal and external validity of the study and reduce statistical power, especially when it is systematically related to participant characteristics or outcomes of interest (29). Studying patterns of attrition is important to identify potential sources of bias in longitudinal analyses.

In this article, we describe the design and methodology of BELHEALTH and present results on cohort composition and attrition.

2. Methods

2.1. Study design

BELHEALTH is a longitudinal study in the adult population (18 years and over) of Belgium. The cohort members receive an email invitation every four to seven months to complete an online questionnaire.

The first questionnaire was sent out on September 28, 2022. A total of nine survey waves have been organized since the start of the cohort. Table 1 gives an overview of the timing of each wave. To ensure ongoing participation, members who had not completed the questionnaire within one week received a reminder.

[Table 1 here]

2.2. Study population and recruitment strategy

The BELHEALTH cohort members were initially recruited among participants of the eleventh and final COVID-19 Health Surveys. An overview of the recruitment strategy of the COVID-19 Health Surveys is provided by Braekman et al. (2023) (17). The eligibility criteria for the BELHEALTH cohort were identical to those used in the COVID-19 Health Surveys: residing in Belgium, being aged 18 or older and explicitly consenting to participate in the study. Of the 18,706 participants in the final round of the COVID-19 Health Surveys, 11,560 agreed to join the cohort and provided their email address to be contacted for the first wave of BELHEALTH. A unique identifier, hereafter referred to as a token, was generated for each cohort member. The invitation email for each wave included a personalized link to the web survey, enabling responses to be linked across waves using the participant's token.

At each survey wave, people could choose to leave the cohort through an opt-out button in the invitation/reminder email. Participants who requested a withdrawal in the first four waves were not removed from subsequent invitations due to an administrative oversight. From wave 5, all individuals who requested to withdraw from the cohort were systematically removed from the invitation list, resulting in the exclusion of between 52 (wave 7) and 76 participants (wave 5) per wave. Between waves, some email addresses became invalid, ranging from 26 (wave 7) to 56 participants (wave 6) per wave; these participants were therefore removed from the invitation list for the subsequent wave.

Moreover, individuals who had registered but did not participate in any of the first four waves were removed from the invitation list (N = 1,621).

To compensate for participant loss and to increase the participation of underrepresented sociodemographic groups, particularly individuals aged 18–44 years, men, people with a lower educational level and residents of Brussels and Wallonia, additional recruitment rounds were conducted during survey waves 2, 6 and 9.

For wave 2 (February 2023), Statbel (the Belgian Statistical Office) drew a sample of 21,046 individuals living in private households from the Belgian National Register, who were invited by postal mail to join the cohort. The sampling design deliberately oversampled men aged 18–44 years residing in Brussels and Wallonia. A total of 1,162 individuals from this sample participated in wave 2 (response rate = 5.5%), with 785 providing valid email addresses for follow-up.

Additional cohort members were recruited at wave 6 (June 2024) and wave 9 (October 2025) using non-probability sampling methods. Because existing cohort members received personalized survey invitations through a closed survey linked to individual tokens, separate open surveys for both waves 6 and 9 were created for the recruitment of new participants. Additionally, for wave 9, a registration link was made available on the project website, enabling individuals to enroll in the cohort at any time.

For both waves, river sampling was applied which involved publishing advertisements on Facebook® to complete the open survey targeting the difficult to reach groups, publishing the survey link on the LinkedIn®, Facebook® and X® (wave 6) / Bluesky® (wave 9) profiles of Sciensano, and contacting federal and regional institutes, local community organizations, universities and higher education institutes, students councils, sports federations, young adult organizations and insurance funds to advertise and share the survey link. The registration link was also shared on social media.

In addition, snowball sampling was applied during wave 9. Cohort members were invited to share the open survey link with friends, family members, etc. Furthermore, the registration link was shared internally with colleagues through a message on the organization's internal website, inviting them to share it with others.

2.3. Post-stratification weights

For cross-sectional analyses, post-stratification weights were calculated separately for each survey wave to improve the alignment with the Belgian population. The participants' data were adjusted to the Belgian distribution in terms of sex, age group, education and province. The reference population was the Belgian population aged 15 years and older on 1 January 2019, the last updated and available dataset at the start of the COVID-19 Health Surveys. Population data for education were obtained from the Labour Force Survey 2018. All population statistics were provided by Statbel.

Based on the sociodemographic variables sex, age group (18–24, 25–34, 35–44, 45–54, 55–64, 65+), education (at most secondary education and higher education), and province (10 provinces and Brussels), 264 strata were created. Within each stratum, weights were calculated as the ratio of the population size to the number of survey participants. To limit the impact of extreme weights, an upper limit was set, defined as 100 times the minimum value. Weights exceeding this threshold were truncated to the upper limit.

2.4. Retention strategy

Participant retention and engagement were supported through a multifaceted strategy involving communications from the research team and the dissemination of survey findings.

An online dashboard[1] was developed to provide participants, researchers, stakeholders and the general population with regularly updated key indicators regarding anxiety, depression, life satisfaction and social unsatisfaction. Throughout the year, emails from cohort members were answered, and a New Year's greeting email was sent annually to thank the cohort for their engagement (29). In addition, the cohort members were invited to an online seminar in which the survey team presented the main study findings, explained the research procedures and confidentiality safeguards, discussed access to mental health care in Belgium, and fostered dialogue between cohort members and researchers.

Furthermore, factsheets and bulletins summarizing the main results after each wave were produced in three languages (English, Dutch and French) and distributed to cohort members and stakeholders.

Study findings were also shared during annual steering committee meetings and presented at national and international conferences and seminars (30–32), thereby reinforcing the visibility of the cohort.

2.5. Web questionnaire

2.5.1. Design

All surveys were created on the online platform LimeSurvey®. For the recruitment of participants in waves 6 and 9, two different surveys were developed: one for the cohort members and one for the new members. The latter was open to anyone who met

the eligibility criteria, and tokens were created after the survey for the new members who provided a valid email address. The total time to fill in the questionnaire ranged between 9 minutes (wave 8) and 16 minutes (wave 1). All questionnaires were available in the official national languages (Dutch, French, German), as well as in English.

2.5.2. Content

The data collected through the BELHEALTH cohort encompassed a broad range of health, well-being and sociodemographic characteristics. Table 1 provides an overview of the topics covered in each survey wave. A core set of measures was included in each survey wave, covering subjective (mental) health, anxiety (GAD-7) (33, 34), depression (PHQ-9) (35), life satisfaction (36), satisfaction with social contacts in the past 2 weeks, and the use of antidepressants and sedatives in the past 2 weeks, including tranquilizers, anxiolytics or sleeping tablets. In addition, socio-demographic information was collected, including birth year, sex at birth, education, occupation, household composition and residence postal code. Other sociodemographic characteristics, such as gender, subjective income, and country of birth, were assessed in selected survey waves.

Besides these recurrent measures, each survey wave also included additional or rotating modules covering topics such as lifestyle factors, medical history, social support, quality of life, sleep, and specific health conditions.

A detailed overview of the baseline questionnaire variables and response options can be found in the Additional file 1.

2.6. Analysis

A description of the data cleaning strategy by wave can be found in Additional file 2.

2.6.1. Cohort composition by wave

The cohort composition was compared by survey wave in terms of age, sex at birth (1. Male or 2. Female, hereafter referred to as men or women), education (1. Lower level including no degree, primary education and secondary education and 2. Higher level including bachelor, master, doctorate: PhD), region of residence, occupation (1. In paid job, 2. Not working including people unemployed, those with invalidity/incapacity and 3. Out of the labor market including student, retired and housewife/man), household composition (1. Living alone with(out) children, 2. Cohabiting (as a couple with(out) children, or with my parent(s), family, friends or acquaintances) and making ends meet (1. With great difficulty or difficulty 2. With some difficulty to very easily). For each wave, four age groups were created based on the age of the participants at baseline (in 2022, corresponding to wave 1). Regarding the education level and region of residence, the first available value reported across survey waves was retained. Lastly, for occupation, household composition, and subjective income, the cross-sectional information provided in each wave was used. The distributions in terms of sex, age, educational level, region of residence were then compared to the Belgian population composition in 2019 (20). For the comparison of our cohort with the Belgian population, we used the most recent available indicators for household composition (2026) and ability to make ends meet (2025).

2.6.2. Attrition

To assess selective attrition, we identified three groups of participants based on their actions between waves 5 and 9 (March 2024 to November 2025): (1) participants who explicitly opted out of the cohort during this period (**withdrawal**), (2) participants who remained enrolled but did not actively participate in any of the five survey waves (**discontinuation**), and (3) those who actively participated in at least one survey between waves 5 and 9 (**active participation**). Participants were grouped across these five waves (waves 5 to 9) to ensure sufficient statistical power for profiling participant characteristics.

Group differences were examined with respect to sociodemographic characteristics (sex at birth, age group, highest educational level and region of residence) and baseline mental health (anxiety and depression in waves 1 to 4). All participants with available mental health data from at least one of the first four waves were included (i.e. an available-case analysis). For each participant, we determined whether they experienced anxiety[2] or depression[3] at least once across the first four waves, and whether they experienced mild to severe anxiety (score on GAD-7 ≥ 5) or depression (score on PHQ-9 ≥ 5) at least once across the first four waves.

All comparisons were conducted using chi-squared tests.

3. Results

3.1. Cohort composition by wave

A total of 10,833 cohort members participated in at least one of the nine survey waves. Figure 1 illustrates the distribution of participants according to the number of survey waves in which they participated. Overall, 87.7% of the cohort members participated in at least two survey waves. A total of 2,692 participated in all nine waves, representing 24.8% of all participants over time.

Table 2 presents, for each wave, the sociodemographic distribution of participants who completed the questionnaire, alongside the Belgian population composition in 2019. Across survey waves, the proportion of men was about 40%, while the proportion of women was about 60%. This distribution differed from that of the Belgian population (49% men and 51% women). The distribution improved slightly in wave 2, after recruitment through the National Register.

Compared with the general population, adults aged 18–44 years were underrepresented in our cohort (Table 2). A modest increase in the proportion of younger participants was observed between waves 1 and 2, corresponding to recruitment via the Belgian National Register, and between waves 5 and 6, coinciding with targeted recruitment of younger adults through social media. However, by wave 9, the proportion of participants aged 18–44 years remained unchanged. In contrast, individuals aged 55 years and older were constantly overrepresented in the cohort relative to the Belgian population.

The distribution by education level remained relatively stable across all survey waves and showed a strong overrepresentation of highly educated participants, with an average of 75% holding a higher education degree. In comparison, only 33% of the Belgian population attained higher education.

Participants from the Flemish Region were also overrepresented in the cohort (66% on average versus 58% nationally). The proportion of participants from the Walloon Region increased in wave 2 following an oversampling through the National Register, before declining in wave 5. Nevertheless, this proportion remained below that observed in the general population. In the Brussels Region, the proportion of participants slightly increased in wave 2, then decreased in wave 3 and remained stable through wave 9. This proportion was comparable to that of the Belgian population.

In terms of occupation, nearly half of the participants were in paid employment in the first two survey waves and this decreased over time. Approximately 5.5% of the participants were not working due to invalidity or unemployment. The remaining participants were outside the labour market (students, retirees, and homemakers) and this group increased over time.

About 30% of participants lived alone, either as single adults or as single parents, and this proportion increased slightly over time. The proportion of those cohabiting, on the other hand, was about 70% and declined over the same period. Compared to the Belgian population (01/01/2026), the proportion of people living alone was underrepresented in our cohort, while the proportion of those cohabiting was overrepresented.

Finally, regarding subjective financial situation, approximately 8% of participants reported experiencing financial difficulties which was lower than the national estimate of 15.5% reported in the 2025 European Statistics on Income and Living Conditions (EU-SILC) survey conducted by Statbel.

[Table 2 here]

3.2. Attrition

Table 3 presents the participation status of the cohort members across survey waves 5 to 9 by sociodemographic characteristics. Active participation was the most common pattern, while discontinuation (those who did not participate) was less frequent, and withdrawal (those who opted-out) occurred in only a small minority of participants. Furthermore, the results of the chi-squared tests showed that participation status was associated with age, education level, and region of residence.

The largest differences in participation status were found by age group. Withdrawal was highest among participants aged 65 + and lowest among those aged 18–29 years. Discontinuation decreased with age, with a difference of nearly 25 percentage points between the youngest and oldest age groups. Conversely, active participation increased with age, differing by more than 20 percentage points between the youngest and oldest age groups.

Individuals with a lower education showed lower active participation rates and higher attrition rates compared with people with a higher education.

Withdrawal was higher among people residing in the Flemish Region and lower among people residing in the Brussels or Walloon Region. In contrast, discontinuation was highest among people residing in the Walloon Region and lowest among those living in the Brussels Region. Finally, participants living in the Brussels Region showed a higher rate of active participation than those living in the Walloon Region.

There were no differences in participation status according to anxiety and depression. However, significant differences emerged when considering mild to severe anxiety and depression (Table 3). More specifically, participants experiencing mild to severe anxiety or depression showed lower levels of attrition and higher active participation rates compared with participants without mild to severe anxiety and depression.

[Table 3 here]

4. Discussion

This manuscript describes the design and methodology of the BELHEALTH cohort, an ongoing longitudinal study of the adult population in Belgium. Building on the infrastructure of the COVID-19 Health Surveys, BELHEALTH was established to monitor changes in mental health and well-being in the post-pandemic period and to identify the social, demographic, personal, and contextual factors associated with an increased risk of mental health problems and unmet care needs. To serve these aims, the cohort requires a sufficiently large and diverse sample, sustained over time. Substantial efforts were therefore made to annually recruit participants and retain them by fostering trust as regard to the research team and sustaining interest in the study topic.

Compared with the Belgian general population, participants in the BELHEALTH cohort were more likely to be women, older adults and higher educated. This is consistent with the sociodemographic profile of participants in the COVID-19 Health Surveys, a series of non-probability web surveys from which the initial sample was drawn (17). This pattern of selective participation is in line with findings from previous population-based health surveys, in which men, younger individuals and those with lower levels of education are typically less likely to participate, even when probability sampling methods are used (17, 38–40). The higher proportion of women in BELHEALTH further aligns with well-known sex differences in (health) survey participation and willingness to self-disclose (41, 42).

Targeted recruitment strategies were implemented to address these imbalances. Recruitment through the National Register improved the distribution of participants in terms of sex, age, and region of residence. However, the response rate was very low (5.5%), making this approach a costly method for recruiting additional participants. Additional efforts through social media further improved the age distribution of participants in wave 6. However, similar efforts repeated in wave 9 did not produce the same effect. This might be due to changes in Facebook's advertising regulations that restricted targeting young people (43). Importantly, the recruitment strategies were effective in maintaining an overall sample size of more than 6000 participants per wave.

Although the BELHEALTH sample is not fully representative of the Belgian general population, this does not compromise its primary scientific aims. Associations between variables are generally less sensitive to selection bias than are prevalence estimates, meaning that risk and protective factors can be validly estimated within this cohort (44). Since the main objective of BELHEALTH is not to report population-level prevalence, but to track changes in mental health over time and identify their determinants, this limitation is of secondary concern. Complementary data sources such as the Belgian Health Interview Survey can be used for general population prevalence estimates (45). Nevertheless, efforts to improve the representativeness of the

BELHEALTH cohort remain a priority for future waves. Targeted recruitment strategies are planned to increase participation among currently underrepresented groups, including residents of Wallonia, men and young adults. These may include reinforced collaboration with regional partners and local associations in Wallonia to improve outreach, the use of tailored communication channels and simplified or incentive strategies to encourage participation among socioeconomically vulnerable groups. These strategies would strengthen the cohort's capacity to detect determinants of mental health that are unevenly distributed across these subgroups, and would improve the precision of subgroup-specific analyses in future waves.

To assess and quantify the potential attrition bias in our study, we calculated attrition rates over a period of 1.5 years and compared participation status according to the sociodemographic characteristics and mental health profiles of the cohort members. Overall, 15.6% of the cohort did not participate in any of the five follow-up waves organized in this period (discontinuation), while 3.2% actively opted out (withdrawal). These rates are broadly consistent with the attrition literature, where reported rates range from 5 to 70%, and attrition-related bias is generally considered a concern when rates exceed 20% (Polit and Hungler, 1995; cited by Marcellus, 2004 (29)). In our study, attrition patterns varied by age, education level, and region of residence. Age emerged as the strongest determinant of attrition, with younger participants more likely to discontinue participation than older ones. Lower education was also associated with both active withdrawal and survey discontinuation. These results are consistent with previous longitudinal studies reporting higher retention among the older age and higher education groups (26, 46–48). Although women showed slightly lower attrition rates than men, this association was not statistically significant, in contrast with studies reporting higher retention among women (40, 49).

Attrition patterns did not vary according to baseline mental health status using conventional clinical cut-offs. However, when applying a lower threshold for the definition of anxiety and depression (GAD-7 and PHQ-9 ≥ 5), members with mild to severe symptoms were less likely to discontinue participation compared with those who had no symptoms. This suggests that some selection occurred according to symptoms level. Some studies have found that mental health problems may be underestimated in longitudinal research due to attrition (49, 50). A first explanation of why attrition can bias prevalence estimates is that the same factors that predicted retention also predicted the disorder itself, making the missingness non-ignorable rather than a simple random loss of observations (50). However, other evidence suggests that attrition and non-response do not necessarily translate into meaningful bias in prevalence estimates of mental disorders (48). Authors argue that the impact of attrition on prevalence estimates is not a fixed or universal phenomenon, but depends heavily on why people drop out in a cohort study, and that representativeness on key sociodemographic indicators can be reassuring evidence against attrition bias (48). In our study, the pattern points toward a potential overrepresentation of participants with poorer mental health among those retained over time. While prevalence estimates may be overestimated, associations between mental health estimates and potential risk and protective factors tend to remain robust, as demonstrated elsewhere (47, 50, 51).

Given that attrition may introduce bias, strategies to mitigate attrition are critical. Adaptive study strategies, including targeted incentives or SMS reminders, have been shown to improve retention and could be cost-effectively implemented among groups at higher risk of disengagement, such as younger cohort members (40, 52). For the BELHEALTH cohort, this would require collecting cohort members' telephone numbers and/or allocating additional resources to fund incentive schemes. From an analytical perspective, approaches such as multiple imputation may help address missing data under plausible assumptions (53, 54). While some degree of attrition is inevitable in longitudinal studies, rigorous study design combined with appropriate analytical strategies remains essential to limit bias and preserve the validity of the longitudinal findings (55).

The longitudinal design of BELHEALTH provides important opportunities for mental health research in Belgium. Repeated measurements over time enable the monitoring of changes in mental health and the investigation of temporal relationships between mental health outcomes and their determinants. This design also reduces recall bias compared with retrospective approaches and allows the study of a wide range of risk and protective factors. Although maintaining participant engagement remains a major challenge in longitudinal research (52), BELHEALTH places strong emphasis on retention strategies to support sustained participation over time.

4.1. Limitations

As with all observational research, our findings may be affected by bias, defined as systematic distortion in the estimated association between an exposure and an outcome that can lead to erroneous inferences regarding observed relationships (55, 56). The use of a non-probability sample can introduce selection bias, as seen in the composition of our cohort. Individuals experiencing mental health problems may also have been more motivated to participate due to heightened interest in the study topic. Nevertheless, substantial efforts were made to minimize and manage the potential sources of bias through careful study design and diversified recruitment strategies. While these measures cannot fully eliminate bias, they help reduce its impact and strengthen the reliability and validity of the study findings (55).

5. Conclusions

The BELHEALTH cohort is the first longitudinal study in Belgium dedicated to monitoring mental health in the adult population over time. The cohort composition reflects that of the COVID-19 Health Surveys on which it was built, with an overrepresentation of women, older adults and people with a high education compared to the Belgian population. Recruitment efforts targeting underrepresented groups modestly improved this distribution and helped maintain a large sample across survey waves. Attrition remained relatively limited over time and, although socially patterned, was only weakly associated with baseline mental health status. The findings show that recruitment and retention strategies should mainly be targeted to younger people and those with a lower education. Despite these challenges, BELHEALTH continues to provide large-scale, socio-demographically diverse longitudinal data well suited to its core aims: tracking mental health trajectories and their determinants over time, generating timely and policy-relevant evidence for public health policy and decision-making. Sustaining the BELHEALTH cohort will ensure that Belgium retains the monitoring capacity needed to better anticipate population mental health needs, respond to emerging societal stressors, and support evidence-based public health research and decision-making (55).

Abbreviations

BELHEALH: Belgian Health and Well-being cohort

EU-SILC: European Statistics on Income and Living Conditions

OECD: Organisation for Economic Co-operation and Development

Statbel: the Belgian Statistical Office

Declarations

Ethics approval and consent to participate

“This study was approved by the ethics committee of the Ghent university hospital (Commissie voor Medische Ethiek) with approval number B.U.N.: B6702022000431. All methods were carried out in accordance with the General Data Protection Regulation (GDPR) and the Declaration of Helsinki. All participants were informed about the purpose of the study, assured of confidentiality, and provided written consent prior to participation. Participation was voluntary, and respondents could withdraw at any time without consequence.

Consent for publication

Not applicable.

Availability of data and materials

Access to the data reported in this manuscript is possible upon reasonable request by sending an e-mail to_belhealth@sciensano.be.

Competing interests

The authors declare no competing interests.

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The BELHEALTH project, funded under the 2024-2026 Surveillance Note, is managed by Sciensano. It operates under the mandate of federal and regional commissioners and is followed up by a scientific steering committee. The commissioners and steering committee members contribute to the content of the survey by submitting topics of relevance for the field and policymakers and offer guidance on the methodologies to analyse the data.

Authors' contributions

LH and CD conducted the literature searches, undertook the statistical analyses, interpreted the results and wrote the initial version of the manuscript. L.H. and C.D. contributed equally to this manuscript. LH, CD, LG, SDe and RC developed the BELHEALTH surveys. SDr developed web surveys for the BELHEALTH surveys. SDe was responsible for the supervision. All the authors revised and approved the final manuscript.

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Footnotes

1. https://healthinformation.sciensano.be/shiny/belhealth/
2. The anxiety indicator is calculated by summing the scores of each item on the scale, after recoding them to [0–3], where the value 0 represents "not at all" and the value 3 represents "nearly every day". The total score, ranging between 0 and 21, is then dichotomized, with the value 10 + being used to identify individuals with generalized anxiety disorder.
3. The depression indicator is calculated by summing the scores of each item on the PHQ-9, after recoding them to [0–3] with 0 = not at all and 3 = nearly every day. To identify people with a depressive disorder, at least 2 out of the 9 items must be scored as 2 or 3, and at least one of the first two items (little interest or pleasure and feeling down, depressed or hopeless) must be included. Item 16 (thoughts of death) is counted as a symptom if present at all (score of 1 or more).

Tables

Table 1. BELHEALTH surveys by timing, recruitment strategy, themes and participant numbers, Belgium 2022-2025

Timing	Recruitment strategy	Themes included	Number of participants invited	Number of participants before cleaning	Number of participants after cleaning	Number of participants who opted out
Wave 1						
28 September 2022 – 12 October 2022	Email to participants of the COVID-19 Health Surveys who agreed to be recontacted	Core questions Climate crisis COVID-19 Energy crisis Opinion questionnaire Resilience Sleep and vitality Social support Subjective income Trust in authorities Worries	11,560	7750	7353	106 between waves 1 to 4
Wave 2						
6 February 2023 – 27 February 2023	Email to cohort members, invitation letter sent to a sample drawn from the National Register	Core questions Mental health care use and access Mental health stigma Social support Subjective income Substance use Suicide Worries	11,560 from cohort 21,046 from National Register	7891 from cohort 1175 from National Register	8324	106 between waves 1 to 4
Wave 3						
21 June 2023 – 6 July 2023	Email to cohort members	Core questions Antimicrobial resistance Loneliness Mental health care use and access Sleep and vitality Social support Subjective health extended Subjective income Work and well-being ...	12,125	7541	7189	106 between waves 1 to 4
Wave 4						
21 November 2023 – 15 December 2023	Email to cohort members	Core questions COVID-19 & flu vaccination Frequenct social support Mental health care use and	12,112	7407	7010	106 between waves 1 to 4

		access Motivation participation Opinion questionnaire Psychotrops extended Sleep Subjective income Worries				
Wave 5						
18 March 2024 – 3 April 2024	Email to cohort members	Core questions Chronic diseases Discrimination Height and weight Mental health care use Social support Substance use Trust in authorities	10,398	6891	6405	76
Wave 6						
20 June 2024 – 12 July 2024	Email to cohort members, River sampling through Sciensano, local community organizations, sports federations, young adult organizations, health insurance funds, higher education institutes	Core questions Resilience (new participants) Loneliness Mental health care use Mental health stigma Optimism Social support Subjective income	10,319	6622 from cohort 216 new participants	6624	71
Wave 7						
28 October 2024 – 13 November 2024	Email to cohort members	Core questions Coping Positive mental health Resilience (cohort members recruited through National Register) Screen time Suicide Worries	10,306	6479	6324	52
Wave 8						
17 March 2025 – 7 April 2025	Email to cohort members	Core questions Absence of work Loneliness Mental health care use and access extended Nationality Subjective economic status Subjective income	10,229	6347	6226	75

		Substance use Telework Worries				
Wave 9						
27 October 2025 – 17 November 2025	Email to cohort River sampling through Sciensano, local community organizations, sports federations, young adult organizations, health insurance funds, higher education institutes Snowball sampling via participants and Sciensano employees	Core questions Discrimination Height and weight Motivation participation Nationality Opinion questionnaire Physical activity Resilience (new participants) Sleep and vitality Social inclusion Social support Subjective income	10,331	6459 from cohort 177 new participants	6300	73

Table 2. Unweighted cohort distribution of the BELHEALTH waves versus population distribution, Belgium 2022-2025

		Wave 1 N = 7,353 %	Wave 2 N = 8,324 %	Wave 3 N = 7,189 %	Wave 4 N = 7,010 %	Wave 5 N = 6,405 %	Wave 6 N = 6,624 %	Wave 7 N = 6,324 %	Wave 8 N = 6,226 %	Wave 9 N = 6,300 %	Belgian population[c]
Sex[a]	Men	38.3	40.9	40.2	40.2	41.0	39.8	40.5	40.3	39.5	49.1
	Women	61.7	59.1	59.8	59.8	59.0	60.2	59.5	59.7	60.5	50.9
Age group	18-24	0.8	2.9	1.6	1.5	1.2	1.9	1.4	1.4	1.3	10.2
	25-34	5.6	7.7	6.7	6.2	5.6	6.6	6.0	5.9	5.8	16.3
	35-44	11.0	11.8	10.8	10.8	10.2	10.6	10.8	10.4	10.5	16.4
	45-54	18.7	17.7	17.2	17.2	17.4	17.2	17.0	17.4	18.2	17.3
	55-64	26.4	24.8	26.3	26.6	27.3	26.0	26.8	26.5	26.6	16.7
	65+	37.0	34.4	37.1	37.5	38.2	37.6	38.0	38.7	37.5	23.1
Education level[b]	Lower	25.7	25.7	25.5	25.4	25.6	25.0	24.6	24.8	24.3	67.1
	Higher	74.3	74.3	74.5	74.6	74.4	75.0	75.4	75.2	75.7	32.9
Region of residence	Flemish	68.5	63.0	64.7	64.8	65.8	65.7	65.8	65.5	65.3	58.1
	Brussels	8.9	10.1	9.9	9.8	9.8	9.8	9.8	10.0	9.9	10.2
	Walloon	22.6	26.9	25.4	25.4	24.4	24.5	24.5	24.5	24.8	31.7
Occupation	In paid job	49.0	50.1	47.2	45.0	44.8	43.3	43.5	43.3	42.5	NA[d]
	Not working	5.8	5.4	5.7	5.3	6.0	5.5	5.6	5.7	6.5	
	Out of the labour market	44.7	43.6	46.5	46.8	48.6	48.0	49.4	51.0	50.7	
	Missing	0.5	0.8	0.7	2.9	0.6	3.3	1.4	0.0	0.3	
Household composition	Living alone (with(out) children)	28.4	27.6	28.5	28.5	29.1	28.9	29.1	29.5	31.2	51.3
	Cohabiting	71.1	71.9	71.0	70.0	70.4	67.9	69.6	69.2	68.6	2.3
	Missing/ Other	0.5	0.6	0.5	1.6	0.4	3.2	1.3	1.4	0.1	
Making ends meet	With great difficulty or difficulty	10.5	8.0	7.1	7.7	NA	6.8	NA	NA	NA	15.5
	With some difficulty to very easily	88.8	90.7	92.2	91.6	NA	91.7	NA	NA	NA	NA
	Missing	0.7	1.3	0.7	0.7	NA	1.5	NA	NA	NA	NA

a Although sex assigned at birth was collected with this variable, we present the data using gender terms: “men” and “women”.

b Educational level: Lower includes those who have at most a higher secondary school diploma.
c The sex, age and regional distribution is based on the distribution of the Belgian registered population aged 15 and older on 01/01/2019, source Statistics Belgium (37). ; The household composition was based on data of Statbel on 01/01/2026. ; The subjective financial situation was based on data from the SILC survey of Statbel 2025.
d NA = Not applicable because this question was not included in the wave/ or because this information was not available at the national level.

Table 3. Participation status of the cohort members, by sociodemographic and mental health profiles.

		Participation status between survey waves 5 to 9						Total	Statistical test
		Withdrawal (opted-out)		Discontinuation (did not participate)		Active participation (participated at least once)			
		N	**%**	**N**	**%**	**N**	**%**	**N (100%)**	**χ2, p-value**
N	Waves 5 to 9	347	3.2	1,674	15.6	8,697	81.2	10,718	
Sex	Men	147	3.5	669	16.0	3,368	80.5	4,184	3.14, .207
	Women	198	3.0	995	15.3	5,329	81.7	6,522	
Age group	18-29	16	2.4	224	34.1	417	63.5	657	**379,15, <.0001**
	30-49	70	2.5	596	21.6	2,091	75.8	2,757	
	50-64	108	2.9	519	13.7	3,160	83.4	3,787	
	65+	150	4.3	322	9.2	3,029	86.5	3,501	
Education	Lower	125	4.5	485	17.7	2,137	77.8	2,747	**35.93, <.0001**
	Higher	220	2.8	1,182	14.8	6,560	83.4	7,962	
Region of residence	Flemish	244	3.6	1,031	15.0	5,583	81.4	6,858	**19.84, .0005**
	Brussels	26	2.4	147	13.8	894	83.8	1,067	
	Walloon	75	2.7	492	17.6	2,220	79.7	2,787	
Anxiety	Yes	66	3.0	365	16.5	1,776	80.5	2,207	2.40, .300
	No	271	3.4	1,239	15.4	6.558	81.3	8,068	
Depression	Yes	52	2.9	266	14.7	1,494	82.4	1,812	2.79, .247
	No	283	3.4	1,339	15.8	6,843	80.8	8,465	
Mild to severe anxiety	Yes	31	2.8	88	7.9	989	89.3	1,108	
	No	307	3.3	1,524	16.6	7,360	80.1	9,191	**58.32, <.0001**
Mild to severe depression	Yes	30	2.6	87	7.7	1,020	89.7	1,137	**65.66, <.0001**
	No	308	3.4	1,525	16.6	7,329	80.0	9,162	

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