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Association between chronic pain and attrition: a prospective analysis of a national sample of midlife adults in the USA, 2004–2014

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ABSTRACT

Background Health conditions of participants can significantly affect longitudinal drop-out in population-based epidemiological surveys, yet few studies have examined the association between chronic pain (CP) and follow-up attrition.

Methods The Midlife in the United States study (MIDUS) was used to explore the longitudinal association between CP and survey attrition. CP was assessed by three measures: the presence of CP, CP interference and the number of pain sites at MIDUS 2. The types of sample attrition at MIDUS 3 encompassed several categories: complete, refusal to participate, inability to participate due to physical or mental constraints, deceased, non-working numbers, participants consistently unavailable for interviews, global refusal or withdrew from the study and not fielded. Multinomial logistic regression was employed to examine these relationships and to explore the moderation effects of sociodemographic variables and multiple chronic conditions on these associations.

Results High-interference pain was associated with a 162% increased risk (RR 2.62, 95% CI 1.12 to 6.16, p=0.026) of being physically and mentally unable to participate in MIDUS 3. Individuals reporting the presence of CP (RR 0.65, 95% CI 0.45 to 0.95, p=0.028) and those with three or more CP sites (RR 0.48, 95% CI 0.27 to 0.87, p=0.016) were less likely to refuse participation in MIDUS 3. However, no further significant associations or moderating effects were identified.

Conclusion Population-based epidemiological surveys may be susceptible to attrition bias from participants with CP, necessitating the adoption of adaptive survey methodologies.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Epidemiological research using population-based surveys is gaining traction in the field of chronic pain (CP). Previous research has indicated a significant association between CP and follow-up attrition.

⇒ However, the results are inconclusive due to ambiguities related to the measurement of CP duration, inadequate control of confounding variables and a failure to explore various dimensions of CP measurement and different types of attrition.

WHAT THIS STUDY ADDS

⇒ This is the first study that explores the relationship between different dimensions of CP and various types of survey attrition. The measures of CP were defined by pain conditions persisting beyond the expected time for normal healing, lasting from several months to many years. This description helps to mitigate measurement error concerning the duration of pain.

⇒ The moderating effects of sociodemographic variables and chronic conditions were examined.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The study's findings emphasise the risk of attrition bias in epidemiological population-based surveys caused by CP, underscoring the important role of CP in enhancing sample retention strategies and in the development of adaptive interviewing methodologies.

INTRODUCTION

Epidemiological research using population-based surveys is gaining momentum in the field of chronic pain (CP).[1–3] This trend emerges possibly due to the far-reaching impact of CP extending beyond clinical settings, such as increased burdens on public healthcare systems, harm to individual well-being and the abuse of opioids.[4 5] Meanwhile, population-based longitudinal studies play a vital role in providing evidence for a wider prevention and management of CP.[6] Consequently, against the backdrop of an increasingly severe CP epidemic and an urgent need for preventions and therapeutic interventions to CP, there arises a heightened demand for accurate statistical inferences of CP research from general population samples. However, sample attrition presents challenges for estimation and inference in population-based longitudinal health studies,[7 8] especially when

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attrition is associated with both CP and follow-up variables.

The majority of literature in survey attrition studies, which use population-based samples, has primarily focused on the effects of sociodemographic characteristics. First, age is correlated with follow-up attrition. The response rates for longitudinal surveys are higher among older age groups.[9] In the Netherlands, Mental Health Survey and Incidence Study, older age groups exhibited lower risks of failure to locate or refusal compared with respondents aged 18–24.[10] Nonetheless, older cohorts typically present an increased risk of attrition due to mortality.[10 11] In addition, general population-based studies consistently demonstrate higher longitudinal retention rates among Caucasian, females, those with advanced levels of education, and individuals who have a stable partner.[9 10 12 13]

A growing body of population-based research has consistently identified that specific chronic conditions were associated with heightened risks of attrition attributable to morbidity and mortality, difficulties in maintaining contact and relocation. A longitudinal mental health study conducted in the Netherlands revealed that sample non-response resulting from morbidity and mortality was correlated with dysthymia, agoraphobia, simple phobia, obsessive–compulsive disorder and the broader category of anxiety disorders.[10] Furthermore, individuals who could not be located were more likely to experience agoraphobia, alcohol abuse and the categories of mood, substance use and eating disorders.[10] Similarly, another population-based study from the UK found that impairment in daily activities and poor self-rated health were associated with higher mortality-related non-response. Refusal was linked to poorer cognitive abilities, while the inability to maintain contact and relocating was associated with smoking behaviour, dementia and depression.[11]

However, the connection between health and general attrition is intricate, for example, a particular health condition may predict a contrasting non-response correlation. A study using the German Aging Survey suggested that a greater number of chronic conditions was associated with a reduced drop-out rate in the subsequent follow-up survey.[14] Similarly, research comparing nationally representative cohorts of older adults in the UK and the USA revealed that participants aged 55–64 who reported having arthritis were associated with lower risks of non-mortality drop-out despite the lack of associations between non-mortality drop-out and other chronic conditions.[15] However, some other health indicators demonstrate a contrary association. For example, depressive symptoms and poorer health conditions were found to be associated with lower general response rates among women from Finland,[16] and general attrition was positively linked to one or more psychiatric disorders in a sample from the Netherlands.[10] In addition, subjective health and functional health showed a positive correlation with longitudinal retention after 9–10 years, accompanied by significant interactions between subjective health and age or sex, as well as between race and functional health.[13]

CP is frequently regarded as an interfering force in daily life and work. It has been linked to an increased risk of disability, cognitive impairment and mortality.[17] Despite the potential consequences of CP leading to attrition in the follow-up of the epidemiological survey, only a limited number of studies have examined the association between CP and follow-up attrition using population-based data. In a longitudinal analysis conducted with data from the Health and Retirement Study (HRS)—a nationally representative survey of US adults aged 50 and above—moderate severity of CP was associated with 72% of the odds of survival to the next survey wave, while severe pain was linked to only 50% of the odds of surviving compared with those without pain.[18] Also, the study only examined the association between deceased attrition and general attrition and the severity of CP, without considering other attrition circumstances like refusal or the inability to complete surveys due to physical and mental conditions. Using data from the German National Back Pain Survey, which included 9263 participants aged between 18 and 75 years, one study revealed that individuals experiencing low pain disability were less likely to drop out in the follow-up survey compared with those reporting no pain disability.[19] However, the study did not find associations between pain intensity and higher levels of pain disability and follow-up attrition. These studies CP either by inquiring, 'Are you often troubled with pain?'in the HRS or by evaluating pain experienced during the past 3 months. The phrasing employed may not sufficiently align with the criteria for defining CP, specifically regarding the duration of pain,[20 21] and may encompass both trivial and recent instances of pain.[22]

Therefore, the association between different pain measures and different types of follow-up attrition remains unclear. This study sought to discern the extent to which CP contributes to differential types of follow-up attrition using the Midlife in the United States (MIDUS) study. Specifically, it evaluated the influence of the presence of CP, the degree of interference caused by CP, and the extent of CP widespreadness on participant attrition in the follow-up survey. In addition, the study explored the moderating effects of CP and sociodemographic variables, as well as the presence of multiple chronic diseases.

METHOD

Data

The MIDUS is a national longitudinal study on individual social status, psychological profiles and biological processes of ageing, begun between 1995 and 1996 and successfully interviewed 7108 non-institutionalised Americans aged 25–74 in the contiguous USA.

The national random digit dialling method employed US working telephone banks as its sampling framework, incorporating oversampling in five cities to address

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specific geographical objectives, resulting in the participation of 4244 individuals. From this group, 529 individuals who had siblings were randomly chosen, leading to 950 siblings sharing the same biological parents. The twin sample was established through a two-tiered process: initially screening approximately 50 000 households for twins via national surveys, followed by contacting these households to enlist twins aged between 25 and 74. This effort yielded 957 twin pairs (totalling 1914 individuals), with participating twins providing their co-twins' contact details.[23]

Of the 7108 respondents who participated in the MIDUS 1 telephone interview, a total of 4963 were successfully reached for the MIDUS 2 telephone interview, which lasted around 30 min. After successfully completing a 30 min telephone interview, participants received two self-administered questionnaires by mail. The average follow-up interval was roughly 9 years, with a range spanning from 7.8 to 10.4 years.

In the MIDUS 3 study, the University of Wisconsin Survey Center aimed to conduct follow-up interviews with the living participants of the MIDUS longitudinal sample, who had previously completed the telephone interview for MIDUS 2. From 2013 to 2014, participants enrolled in MIDUS 3 participated in an initial 45 min telephone interview, subsequently receiving an invitation to complete an extensive 100-page questionnaire distributed through mail. The mean follow-up duration for participants between the MIDUS 2 and MIDUS 3 waves was 9 years, with a variability range of 7.9–10.3 years.

Among the 4963 participants in MIDUS 2, 286 were not included (designated as 'not fielded') due to deceased status (confirmed through previous National Death Index submissions), withdrawal from the study, or being assessed as cognitively incapable of participating in future endeavours. Fieldwork initiated in May 2013 encountered various forms of non-participation: 364 individuals refused to participate, 96 were physically or mentally unable to participate, 367 were consistently unavailable, 248 could not be located due to non-working numbers, 23 withdrew from the study or resided outside the USA, and 286 were identified as deceased. In total, 3293 respondents were successfully reached. For those not responding, specific protocols were implemented as necessary to determine the reasons for non-response.[24] The MIDUS is publicly accessible secondary data. More details of the study are available on the MIDUS website (available at: http://midus.wisc.edu/).

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Dependent variable: follow-up attrition at MIDUS 3

In alignment with the disposition codes of the MIDUS study, the types of sample attrition encompassed following categories: complete, refusal to participate, inability to participate due to physical or mental constraints, deceased, non-working numbers (resulting in the inability to locate participants), participants consistently unavailable for interviews, global refusal or withdrew from the study (participants residing outside of the USA or choosing to withdraw from the study) and not fielded (including individuals previously identified as deceased, those who had withdrawn from the study or were assessed as cognitively incapable of engaging in future research activities prior to being fielded).

Predictor: CP at MIDUS 2

The presence of CP, the extent of its interference and the number of CP sites as reported in the MIDUS 2 study were used, given that CP-related data were not collected during the MIDUS 1. CP has traditionally been identified as pain that persists beyond the normal healing time. Recent modifications to its definition now characterise CP as pain that either persists or reoccurs for more than 3 months.[25] The updated definition diminishes the focus on the requirement for pain to be associated with tissue damage.[21] Despite the MIDUS measure of CP adhering to the earlier definition, it effectively captures the chronic nature of pain by inquiring of the respondents whether they experience CP, specifically asking 'Do you have CP, that is, do you have pain that persists beyond the time of normal healing and has lasted from anywhere from a few months to many years?'. Affirmative responses to this question were identified as having CP, and the respondents were subsequently inquired about the extent of CP's interference. A Pain Interference Index was generated by calculating a mean score of how much pain interfered with respondents' activity, mood, relations, sleep and enjoyment, ranging from 0 to 10.[1 26] Then, the Pain Interference Index was further categorised into no pain, low-interference pain (0–4) and high-interference pain (>4) as categorical variable.[26] In addition, if respondents reported having CP, they were asked about the location of the pain, including head, neck, back, arms, legs, shoulders, hips, knees and other sites. We summed up the pain sites into an index and then categorised it into no pain, 0–2 sites or 3 or more sites as a categorical variable.[1 2]

Confounders

In addition to the sociodemographic variables adjusted for in previous studies on health and follow-up attrition, including age, gender, race, education, income and marital status, as well as health behaviours such as smoking, drinking and physical activity, this study also controlled for multiple chronic diseases,[14] whether a participant had health insurance,[27 28] adverse childhood experiences (ACEs)[29] and social supports[14] to decrease confounding effects.

The Chronic Condition Index summed up a count of 'yes' responses to the chronic conditions-related questions.[30] The chronic conditions included heart disease, high blood pressure, circulation problems, blood clots, heart murmur, transient ischaemic attack or stroke,

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other blood disease, cholesterol problems, diabetes, asthma, emphysema or chronic obstructive pulmonary disease, tuberculosis (TB) (including positive TB skin test), thyroid disease, peptic ulcer disease, cancer, colon polyp, arthritis, glaucoma, cirrhosis or liver disease, alcoholism, depression, blood transfusion before 1993, and other chronic conditions. Then, the index was coded as a binary variable (ref: <2) and the index more than 2 was regarded as multimorbidity.

Statistical analysis

Differences in sample characteristics across types of attrition were evaluated by comparing continuous variables using analysis of variance (ANOVA) tests, and categorical variables were assessed with the χ^2 test. Multinomial logistic regression was used to examine the association between CP indicators and attrition types. All regression models were adjusted for all confounders. In addition, the significant associations were further explored through the inclusion of two-way interaction terms between CP and sociodemographic characteristics, as well as CP and multiple chronic conditions, to examine the moderating effects. In addition, to reduce the estimation bias caused by item missingness[31], the 'MICE' package in the R Studio was used for multiple imputation[32] and 20 imputed datasets were generated. All analyses were performed in R Studio.

RESULTS

Descriptive statistics

Among the total cohort of 4963 participants in MIDUS 2, 3293 individuals were successfully enrolled for longitudinal follow-up in MIDUS 3 through the initial MIDUS telephone interview. In comparison to those who completed the MIDUS 3 survey, individuals who were lost to follow-up exhibited a higher proportion of CP presence, ranging from 42% to 52%, except for individuals who were never reachable and those who refused participation in the survey, who demonstrated a lower prevalence of CP. Moreover, MIDUS 3 participants reported a lower level of pain interference compared with those who discontinued their participation. Additionally, the participants presented a greater number of pain sites relative to individuals who declined to participate.

At baseline, the majority of the respondents have attained education up to high school or some college level (53%), with a substantial proportion possessing a bachelor's degree (25%) or an advanced degree (17%). The demographic composition of the sample is predominantly Caucasian (92%), with a significant majority being married (73%). Regarding economic status, 54% are categorised as affluent based on the income-to-needs ratio, while a mere 6% fall within the extremities of poverty. Women constitute 55% of the sample population. Regarding ACEs, 33% reported an absence of parental emotional abuse, and 40% indicated no experience of parental physical abuse. There is a noted higher prevalence of multiple chronic conditions, with 56% of respondents having two or more such conditions. Health behaviours indicate a 60% prevalence of former smokers, 38% abstaining from alcohol or consuming it rarely,and a notable segment engaging in moderate to heavy drinking (35%). A vast majority of the participants (94%) possess health insurance, and the scores for family and friend support suggest a moderate level of social support, with average scores of 3.3 and 3.5, respectively. Further details are provided in online supplemental table 1.

Regression results

Table 1 presents the multinomial logistic regression results of the adjusted associations between CP indicators and longitudinal sample attrition. High-interference pain was associated with a 162% increased risk (RR 2.62, 95% CI 1.12 to 6.16, p=0.026) of being physically and mentally unable to participate in MIDUS 3. The presence of CP and having three or more pain sites were associated with a 35% reduced risk (RR 0.65, 95% CI 0.45 to 0.95, p=0.028) and a 52% reduced risk (RR 0.48, 95% CI 0.27 to 0.87, p=0.016) of refusal to participate in MIDUS 3, respectively. These associations remained statistically significant in the analyses of the imputed dataset (see online supplemental table 2).

Table 1 additionally reveals significant associations among three CP indicators and global refusal to participate (participants not in the USA) or withdrawal from the survey. However, interpretations must be approached with caution owing to the limited sample size for the category (n=23). Moreover, the examination of the imputed dataset failed to reveal a consistently significant correlation, thereby undermining its robustness. No other significant associations were found.

Moderation analyses conducted on the significant associations within both complete case and imputed dataset analyses revealed no moderating effects (see online supplemental table 3).

DISCUSSION

This study investigated the relationship between three CP indicators—presence, interference and widespreadness—and various types of follow-up attrition in a nationally representative sample of community-dwelling adults in the USA The current study revealed that high levels of CP interference at baseline were linked to increased risks of attrition related to physical and mental incapacity in MIDUS 3. Conversely, participants reporting CP and those reporting pain in three or more locations at baseline were associated with a decreased risk of refusing to participate in follow-up surveys.

Given the high prevalence of CP in the USA, national strategies have emphasised population-level monitoring and intervention for CP, with population-based surveys serving as crucial tools to achieve these objectives.[33] The MIDUS study decomposed general attrition into distinct categories of non-responses, thereby facilitating a detailed

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Table 1 Adjusted association between CP indicators at MIDUS 2 and attrition types at MIDUS 3

Attrition type (complete as reference) *	Decease		Global refusal/ withdrew		Non-working number		Not fielded		Physically/mentally unable		Refusal		Never available	
	RR (95% CI)	P value	RR (95% CI)	P value	RR (95% CI)	P value	RR (95% CI)	P value	RR (95% CI)	P value	RR (95% CI)	P value	RR (95% CI)	P value
CP presence														
No	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Yes	1.14 (0.79 to 1.64)	0.482	**4.94 (1.09 to 22.35)**	**0.038**	0.96 (0.59 to 1.56)	0.871	1.08 (0.75 to 1.56)	0.680	1.55 (0.82 to 2.96)	0.180	**0.65 (0.45 to 0.95)**	**0.028**	0.77 (0.52 to 1.16)	0.209
CP interference														
No pain	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
Low-interference pain	1.02 (0.67 to 1.53)	0.937	**5.82 (1.17 to 28.88**)	**0.031**	1.03 (0.6 to 1.77)	0.902	0.95 (0.63 to 1.45)	0.823	1.1 (0.51 2.38)	0.805	0.65 (0.42 to 1.01)	0.056	0.68 (0.42 to 1.1)	0.113
High-interference pain	1.54 (0.91 to 2.59)	0.105	3.56 (0.29 to 44.17)	0.323	0.86 (0.41 to 1.83)	0.698	1.26 (0.74 to 2.15)	0.404	**2.62 (1.12 to 6.16**)	**0.026**	0.67 (0.38 to 1.21)	0.184	0.81 (0.43 to 1.52)	0.509
CP widespreadness														
No pain	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
0–2 pain sites	1.08 (0.7 to 1.66)	0.734	**6.48 (1.33 to 31.49**)	**0.021**	0.98 (0.56 to 1.69)	0.931	1.02 (0.67 to 1.57)	0.921	1.17 (0.52 to 2.62)	0.711	0.76 (0.5 to 1.17)	0.216	0.65 (0.39 to 1.06)	0.086
3+ pain sites	1.34 (0.84 to 2.13)	0.224	2.4 (0.19 to 30.74)	0.500	1.01 (0.51 to 2.01)	0.980	1.29 (0.8 to 2.07)	0.296	1.94 (0.9 to 4.2)	0.091	**0.48 (0.27 to 0.87**)	**0.016**	1.07 (0.62 to 1.86)	0.799

The bold values denote statistically significant results.
*Adjusted for age, income-to-needs ratio, gender, education, age, ethnicity, marital status, parental physical/emotional abuse, smoking status, drinking status, physical activity score, multiple chronic conditions, support from friends/family and health insurance at MIDUS 2.
CP, chronic pain; MIDUS, Midlife in the United States; RR, relative risk.

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examination of the nuanced relationship between CP and follow-up non-responses. This research uncovered a notable association between high-interference pain and non-responses attributable to physical and mental incapacities, underscoring the important role of CP in enhancing sample retention strategies and in the development of adaptive interviewing methodologies.

Prior research has identified a paradoxical relationship between CP and general sample attrition; specifically, individuals reporting mild disabling CP and arthritis in earlier surveys demonstrated a higher likelihood of participation in follow-up studies compared with those free from pain and arthritis.[15 19] However, these investigations have predominantly focused on the association between CP and general attrition, without delving into the underlying drivers of such participation patterns. By categorising different forms of attrition, this study revealed that participants reporting CP, as well as those experiencing low-interference pain, exhibited a lower propensity to refuse participation in follow-up surveys compared with baseline respondents without CP. In other studies of chronic conditions and their associated response dynamics, the capacity and motivation of respondents to partake could shed light on the intricate nexus between health and attrition.[34 35] On one hand, physical and cognitive impairments may compromise an individual's ability to participate in surveys, thereby contributing to higher attrition rates. Conversely, the presence of mild chronic conditions might heighten the individual's inclination to discuss such issues, potentially increasing their willingness to participate in research addressing these matters.[14] Similarly, high-interference pain leading to functional limitations could deter survey participation; meanwhile, reporting low-interference pain suggests that while health concerns are present, they do not severely impede the individual's capability. These individuals are likely to participate more actively in research activities related to their health concerns.

Inconsistent with previous research, this study did not find an association between CP and deceased attrition. A longitudinal study using the HRS in the USA indicated a significant association between moderate to severe CP and deceased attrition.[18] The following differences may contribute to the inconsistent findings. First, multiple chronic diseases can confound the association between CP[6] and follow-up attrition.[10 11] The lack of control for multiple chronic diseases in previous studies may have led to spurious associations.[18] The additional analysis (see online supplemental table 4) found that after adjusting for other covariates except for multiple chronic diseases, high-interference pain and the occurrence of pain in three or more sites were significantly associated with deceased attrition. However, the association no longer exhibited statistical significance when adjustments were made for the presence of multiple chronic conditions. Second, in addition to the potential inconsistency in defining the duration of the pain measure, measuring different dimensions of pain experience can lead to divergent results. The degree of CP interference, as used in this study, is associated with the severity of CP, however, individual catastrophising and beliefs regarding pain may play a significant moderating role in the correlation between pain severity and interference.[36] Therefore, there is a need for further research that uses rigorously defined severity of CP and adequately controls confounding factors to examine the relationship with follow-up attrition. Finally, the attrition category 'not fielded', as defined in the MIDUS 3 disposition codes codebook, includes participants from MIDUS 2 who had been recorded as deceased prior to the initiation of fieldwork, in addition to individuals who either withdrew from the study or were assessed as cognitively unable to participate in subsequent phases. Future iterations of the MIDUS study may benefit from further refinement of this category, specifically by analysing the reasons for not being fielded. Such an approach could yield more nuanced insights into the relationship between CP and participant drop-out due to mortality.

This study has the following strengths. In contrast to prior research that concentrated solely on general attrition, this study incorporated deceased attrition, non-response due to physical or mental conditions, inability to interview, refusal and being out of the field into the analysis, filling the current gap in understanding specific longitudinal non-responses of CP. Furthermore, by querying participants about their experience of pain that endures beyond the expected period of healing, extending from months to years, this measurement potentially mitigates the inclusion of recent, trivial pain episodes, which likely augments the validity of the measures in contrast to prior research. While an exhaustive discussion on the definition of CP falls outside the scope of this analysis, the future integration of CP indicators that adhere to the revised criteria could yield more nuanced insights. Additionally, this study considered possible influential confounders to reduce spurious associations. However, the limitations of this study include the self-report nature of the survey and the inability to control for unobserved confounders. Finally, the extended interval of 7.9–10.3 years between MIDUS 2 and MIDUS 3 could have allowed various factors, beyond CP or baseline chronic conditions, to influence participant attrition at wave 3. Future research may benefit from employing population-based samples with shorter survey intervals to enhance analysis.

In summary, the results revealed that CP might introduce attrition biases to population-based epidemiological follow-up surveys. Individuals reporting CP and experiencing pain at three or more sites at baseline were less likely to decline participation in the follow-up survey. Conversely, the presence of high-interference pain increased risks of being physically or mentally incapacitated to engage in the follow-up survey. Considering the escalating prevalence of CP within the population and the pivotal role of population-based epidemiological studies in mitigating the crisis of CP, forthcoming epidemiological surveys targeting individuals suffering from

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CP must implement adaptive survey methodologies to minimise attrition bias.

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Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants but ethical approval was not required for this study since the data used in this study are publicly available devoid of any personally identifiable information. The author was not privy to any data that could reveal personal identities or establish connections to specific individuals. Information in aggregate ensures that individual identification cannot be deduced from the data. Participants gave informed consent to participate in the study before taking part.

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Data availability statement Data are available in a public, open access repository. The data backing the conclusions of this study can be found openly at the Inter-university Consortium for Political and Social Research.

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