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Digital health engagement amplifies the pathway from financial hardship to health care utilization

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The proliferation of digital health technologies has reshaped how people engage with the health care system, yet the psychological pathways through which economic adversity translates into care-seeking remain poorly understood. Whether psychological distress drives people toward health care or away from it remains unsettled, and financial hardship supplies distress in abundance. In a nationally representative sample of 5,551 U.S. adults (HINTS 7), we modeled depression/anxiety and loneliness as parallel routes from financial hardship to the frequency of provider visits, with health app and wearable use moderating the second stage. Hardship predicted higher distress and greater loneliness, and both, in turn, predicted more frequent visits. While financial hardship showed no significant total association with visit frequency, this nonsignificant total effect concealed a positive indirect pathway through perceived need that was counterbalanced by a negative direct path, illustrating competitive mediation. Digital engagement altered the second stage, though not uniformly. For distress, the association with visits was absent among non-users, present among those with one tool, and stronger among those with both. For loneliness, the same gradient appeared but the moderation was nonsignificant. These findings suggest that self-tracking technologies translate symptom-focused need into clinical contact, whereas the social motivation behind loneliness-driven visits is not something a wearable addresses.

Keywords: *financial hardship, psychological distress, loneliness, health care utilization*

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Financial hardship is among the most pervasive stressors shaping population health, and its psychological toll is now well known. Previous studies indicate that financial strain and worry are strong predictors of psychological distress (Ryu & Fan, 2023; Tsuchiya et al., 2020), and that financial debt and worry about debt predict depression and even suicidal ideation (Stickley et al., 2023). Much research reaches similar conclusions about the corrosive relationship between financial difficulty and mental health (Frankham et al., 2020; Richardson et al., 2013). Because economic difficulty is rarely a discrete event but rather a chronic and compounding condition, its consequences are best understood not as a single insult but as a cascade in which an initial loss of material resources propagates into the depletion of psychological social resources over time (Ambaw et al., 2025). How this cascade ultimately reshapes the way people engage with the health care system, however, remains poorly understood. Before examining how financial hardship reshapes care-seeking, it is worth clarifying theoretical expectations regarding the total effect of hardship on utilization, as existing theoretical frameworks offer competing predictions. By depleting enabling resources such as financial means, transportation, and the temporal flexibility needed to arrange healthcare, hardship tends to suppress utilization. Conversely, by generating heightened psychological distress and perceived need, hardship tends to increase it. Consequently, we do not anticipate a substantial total effect. Rather, these opposing forces likely offset each other, producing a modest total association that conceals a positive, need-based indirect pathway. This underlying process represents what MacKinnon et al. (2000) term competitive or inconsistent mediation, and our theoretical focus centers on this positive psychological route, which evaluating the total effect in isolation would mask.

Two psychosocial channels are especially plausible but have rarely been examined together. The first is depression and anxiety like economic strain, understood as a loss of valued resources, is repeatedly linked to subsequent

distress (Ambaw et al., 2025; Farkash et al., 2022). The second is loneliness, which has received comparatively little attention in this context yet is theoretically dominant. Resource loss has been shown to relate not only to distress but also to loneliness (Farkash et al., 2022), and social disconnectedness is itself a robust antecedent of depressive and anxious symptoms (Santini et al., 2020). Whether financial hardship reaches health care behavior primarily through emotional distress, through social isolation, or through both in parallel, is an open question. One cannot be answered when psychological need is treated as a single, undifferentiated construct. Distinguishing these two channels is a first aim of the current study.

A more fundamental ambiguity concerns the direction of the relationship between psychological need and health care use. Intuition suggests that distressed or isolated individuals disengage from care, and there is indeed reason to expect that such states can raise barriers to help-seeking. Yet many previous studies point the other way. Depression and anxiety are commonly accompanied by heightened attention to and worry about bodily sensations, prompting more frequent contact with providers. Loneliness, in turn, can make the clinical encounter itself a valued source of social interaction, so that socially isolated individuals may seek physician visits not solely for medical reasons but also to meet a need for human contact. Framing depression and loneliness as elevating a person's perceived need for care implies that these states may stimulate, not suppress, utilization. Adjudicating this directional question within a formal mediation framework, instead of assuming avoidance, is a second aim of this study.

Even if distress and loneliness do elevate perceived need, the translation of that need into an actual visit is unlikely to be uniform across individuals. Perceived need must still be acted upon, and the cues and resources that change intention into behavior vary widely. Here we draw attention to rapidly diffusing but largely overlooked conditioning factor. Engagement with digital

health technologies such as health apps and wearable devices. These tools continuously monitor physiological data and deliver actionable insights, empowering users to take proactive steps toward their health, and a large share of users are willing to share these data with their providers. For an individual whose motivation to independently initiate care is dulled by distress or isolation, such devices may supply the external prompts and lowered thresholds needed to change perceived need into a realized visit. The idea that a third factor can strengthen, rather than merely weaken, a stress–related relationship is not only estimation. Recent study found that certain conditioning factors produce stress–amplifying, not only stress–buffering, effects on the pathway from stress to depressive symptoms (Lee et al., 2024). This prior research provides a clear precedent for expecting that digital health engagement amplifies the pathway for psychological need to health care use. To our knowledge, not many prior studies have examined digital health technology engagement as a factor that conditions the indirect pathway linking financial hardship, psychological states, and health care utilization.

The process linking each state to healthcare utilization can be further articulated. For depression and anxiety, the pathway operates through symptom perception. Anxious and depressive states heighten interoceptive attention and health–anxiety. Consequently, individuals notice subtle bodily sensations more readily, interpret them as signs of illness, and deem them severe enough to warrant care (Barsky et al., 2001). Conversely, the pathway for loneliness is motivational. Because clinical interactions offer interpersonal connection and reassurance, socially isolated individuals often seek provider contact to address unmet social needs (Gerst–Emerson & Jayawardhana, 2015). While both states heighten perceived need in Behavioral Model of Health Service Use (BMHSU; Andersen, 1995). They operate through fundamentally different channels, a distinction that becomes critical when explaining why

somatic–focused technologies selectively amplify one route.

Based on this discussion, the present study integrates these strands into a single model tested with a large, nationally representative sample of U.S. adults from the Health Information National Trends Survey (HINTS 7). We investigate 1) whether financial hardship is indirectly associated with the frequency of health care visits through depression/anxiety and, in parallel, through loneliness; and 2) whether digital health technology engagement conditions the second stage of each pathway, such that the indirect association is stronger among individuals more engaged with these technologies.

1. Conservation of Resources Theory

The point of departure for this study is Conservation of Resources (COR) Theory (Hobfoll, 1989). COR conceptualizes psychological stress as a reaction to the actual loss of resources, the threat of such loss, or the failure to gain resources following resource investment (Hobfoll, 1989). Resources are defined as the objects, conditions, personal characteristics, and energies (e.g., time, money, and knowledge) that individuals value. Within this classification, financial resources constitute a core "energy" resource that is instrumental in acquiring and protecting other resources.

One of the theory's central tenets is the primacy of loss and the loss spiral. As Sonnentag and Meier (2024) note in their study of COR's core assumptions, the theory holds that those who lack resources are more vulnerable to resource loss, and this initial loss begets further loss. Financial hardship does not remain confined to the material domain. Rather, an initial loss of economic resources spreads into the cascading depletion of psychological and social resources.

This theoretical prediction has received consistent empirical support in recent studies. Drawing on longitudinal panel data from Australia (HILDA, 2001–2022), Ambaw et al. (2025) showed that financial stress is consistent with COR theory in that it represents a loss of resources and is therefore associated with subsequent psychological distress. Similarly, using COR as their theoretical framework, Farkash et al. (2022) found that resource loss was positively associated with both psychological distress and loneliness. Taken together, COR can provide a coherent account of how financial hardship diffuses into both depression/anxiety and loneliness.

Crucially, COR does not treat resources as a single, undifferentiated pool. Instead, it distinguishes among personal characteristics, energies, conditions, and objects, a typology that directly motivates our focus on these two specific mediators. Depression and anxiety index the depletion of personal and energy resources, reflecting the erosion of emotional and motivational reserves that accompanies sustained loss. In contrast, loneliness reflects the depletion of social or condition resources, representing the fraying of valued relational ties that COR classifies as a distinct resource class. Although financial hardship likely propagates into both fields, the two remain conceptually and functionally distinct, with no a priori reason to assume they translate need into healthcare utilization in an identical manner. Positioning depression/anxiety and loneliness as parallel pathways thus follows directly from COR's resource taxonomy, allowing the affective and social fields to exhibit distinct downstream links with utilization. Consistent with this view, Farkash et al. (2022) demonstrated that resource loss is associated with psychological distress and loneliness as separable outcomes.

H1: Greater financial hardship will be associated with higher level of depression/anxiety.

H2: Greater financial hardship will be associated with higher level of loneliness.

2. From psychological distress and loneliness to health care utilization

The pathway through which financial-hardship-induced distress and loneliness translate into actual health care use is explicated by BMHSU (Andersen, 1995). This model organizes the determinants of health care utilization into three categories like predisposing factors, enabling factors, and need factors, with need typically treated as the most immediate determinant of use.

Critically, Andersen (1995) did not restrict "need" to biological pathology but explicitly incorporated perceived need. That is, how people view their own general health, how they experience symptoms of illness and pain, and their worries about their health, and whether they judge these problems to be of sufficient importance to seek professional help. Depression/anxiety and loneliness are prototypical psychological states that elevate this perceived need. Psychological distress can amplify attention to and concern about bodily sensations, while loneliness renders the clinical encounter itself a channel for social interaction. Both states therefore can work to increase health care utilization.

This distress-increase-use logic is supported by contemporary applications of the Andersen model. Jia et al. (2025) found that need factors exerted a significant direct effect on the decision to utilize health services, and that individuals with lower income and greater instability exhibited distinctive utilization patterns - underscoring the joint operation of enabling and need factors that is central to the present model. Song et al. (2025) likewise confirmed that predisposing, enabling, and need factors shape utilization. Positioning depression/anxiety and loneliness as perceived-need factors within BMHSU thus may yield a prediction that both mediators increase the

frequency of provider visits.

H3: Higher levels of depression/anxiety will be associated with more frequent health care visits.

H4: Higher levels of loneliness will be associated with more frequent health care visits.

3. Digital health technology engagement as a second-stage moderator

Although the need-based logic above can predict that distress and loneliness increase utilization, this translation is unlikely to be uniform across individuals. A person who is depressed or lonely may perceive an elevated need for care, yet whether that perceived need is changed into an actual visit may depend on the resources and prompts available to act on it. We propose that engagement with digital health technologies, including the use of health/wellness apps and wearable devices, conditions the strength of the need-to-utilization link.

Our theoretical anchor for this moderation is the buffering mechanism (Cohen & Wills, 1985). The buffering hypothesis holds that a moderating resource alters the relationship between a stressor and its outcome, either by weakening it in the classic buffering case or, as subsequent work has shown, potentially strengthening it as well. Importantly, recent study found that moderators of stress-distress relationships can work in an amplifying, not only a buffering, direction. Lee et al. (2024) showed both stress-buffering and stress-amplifying effects of different social-support measures on the stress-depression association, establishing that a third variable can intensify a focal relationship. This provides direct precedent for hypothesizing an amplifying moderation in the present model.

The substantive process by which digital health engagement amplifies the need–to–utilization pathway is grounded in the affordances of these technologies. By continuously monitoring physiological data and providing actionable insights, wearable devices and health apps empower users to take proactive measures toward their health while facilitating more timely contact with providers. Consequently, as documented using HINTS 7 data suggest that a substantial share of users is willing to, and do, share these data with healthcare providers. For a distressed or lonely individual, whose motivation to independently initiate care may be diminished, these devices supply external prompts, salient data, and lowered thresholds that change perceived need into an actual visit for health. Furthermore, according to COR, digital health engagement functions as a supplementary resource that offsets the motivational depletion accompanying distress and loneliness. In conclusion, the positive effect of each mediator on visit frequency should be stronger among individuals more engaged with digital health technologies.

H5: Digital health technology engagement will moderate the effect of depression/anxiety on health care visit frequency, with the positive relationships being stronger at higher levels of engagement.

H6: Digital health technology engagement will moderate the effect of loneliness on health care visit frequency, with the positive relationships being stronger at higher levels of engagement.

4. Method

1) Data and sample

This current study utilizes data from the seventh cycle of the Health Information National Trends Survey (HINTS 7), nationally representative

survey of U.S. non-institutionalized adults aged 18 and older administered by the National Cancer Institute. Fielded between March and September 2024 via a mailed questionnaire with a push-to-web option, HINTS 7 produced 7,278 completed surveys drawn through a two-stage stratified probability design. Listwise deletion across all modeled variables produced a final analytic sample of N =5,551 (76% of respondents).

2) Measures

Financial hardship. Financial hardship was measured with five items assessing how often, in the past 12 months, the respondent's household experienced difficulty meeting basic needs. For example, these items evaluated specific challenges, including cutting or skipping meals because of insufficient money for food, being unable to afford balanced meals, worrying about being forced to move, and lacking reliable transportation for essential activities. Each item was rated on a 5-point scale, reverse-coded so that higher scores indicate greater hardship, and averaged. The scale demonstrated good internal consistency (Cronbach's alpha = 0.88, M = 1.48, SD = 0.82).

Depression/anxiety. Symptoms of depression and anxiety were measured with the four-item Patient Health Qeustionnnaire-4 (PHQ-4), which asks how often over the prior two weeks the respondent was bothered by little interest or pleasure in doing things, feeling down or hopeless, feeling nervous or anxious, and being unable to stop or control worrying. Items were rated on a 4-point scale, reverse-coded with higher scores indicating greater distress, and averaged (Cronbach's alpha = 0.89, M = 1.56, SD = 0.75).

Loneliness. Loneliness was measured with four items adapted from the PROMIS social-isolation item bank, asking how often the respondent feels left out, feels that people barely know them, feels isolated from others, and feels

that people are around them but not with them. Item responses were scored on the PROMIS Social Isolation metric and analyzed as the standardized T-score provided in the dataset, with higher scores indicating greater loneliness (Cronbach's alpha = 0.93, M = 45.39, SD = 9.96). As an ultra-brief measure of general psychological distress, the PHQ-4 integrates its depression (PHQ-2) and anxiety (GAD-2) subscales, which share a strong correlation and reflect a single underlying distress factor (Kroenke et al., 2009).

Health care visit frequency. The dependent variable was a single item asking how many times in the past 12 months, not counting emergency-room visits, the respondent saw a doctor, nurse, or other health professional to obtain care for themselves. Responses ranged from 0 (none) to 6 (10 or more times) on an ordered scale (M = 3.14, SD = 1.88).

Digital health technology engagement. Engagement with digital health technologies was operationalized as a summed index of two binary indicators. First, whether the respondent had used a health or wellness app on a tablet or smartphone in the past 12 months, and, secondly, whether the respondent had used a wearable device to monitor or track their health or activity in the past 12 months. The resulting index ranged from 0 to 2 (M = 0.97, SD = 0.84), with 36.5% of respondents using neither technology, 29.9% using one, and 33.6% using both.

Covariates. Following Andersen's Behavioral Model of Health Services Use, we controlled for three sets of covariates. Predisposing factors included age (in years), gender (1 = female, 0 = male), education (a 7-level ordinal variable), race/ethnicity (dummy-coded with non-Hispanic White as the reference category), and marital status (dummy-coded with married as the reference category). Enabling factors included household income (a 9-level ordinal variable), health insurance coverage (1 = insured, 0 = uninsured), and

digital health literacy (a single reverse-coded item indexing perceived ability to find needed health information online). Need factors included self-rated general health (reverse-coded with higher scores indicating better health) and a count of physical chronic conditions (0–4), summing physician-diagnosed diabetes, hypertension, heart condition, and chronic lung disease.

〈Table 1〉 Descriptive statistics of study variables (N = 5,551)

Variable	Mean/n	SD/%	Range
Financial hardship	1.48	0.82	1–5
Depression/anxiety	1.56	0.75	1–4
Loneliness	45.39	9.96	34.8–74.2
Health care visit frequency	3.14	1.88	0–6
Digital health tech engagement	0.97	0.84	0–2
Age (years)	53.78	17.67	18–100
Female	3,318	59.8%	–
Education	5.16	1.54	1–7
Household income	5.86	2.26	1–9
Insured	5,063	91.2%	–
Digital health literacy	3.36	0.84	1–4
General health	3.34	0.95	1–5
Chronic conditions (count)	0.84	0.98	0–4

Note: General health and digital health literacy (reverse-scored) with higher = better. Race/ethnicity and martial status (categorical) not shown.

3) Analytic strategy

This study tested two second stage moderated mediation models following the PROCESS Model 14 (Hayes, 2017) with financial hardship as the predictor, visit frequency as the dependent variable, and digital health engagement moderating the mediator-to-dependent variable path. Models were estimated separately because the two mediators, though conceptually distinct, were strongly correlated (r = .64). Including them in a model would introduce multicollinearity and obscure their respective pathways. Each mediator was

therefore modeled individually to preserve its specific indirect effect, rather than to imply that loneliness is conceptually more distinct than depression and anxiety. Given their mutual association and potential reciprocal relationship, we modeled these constructs as parallel pathways instead of imposing a serial ordering that cross-sectional data cannot empirically resolve.

All covariates were included in both equations, and continuous predictors involved in interactions were mean-centered. Variance inflation factors were all well below 10, indicating no problematic multicollinearity. By controlling for self-rated health and chronic conditions counts in both mediator and outcome equations, the psychological indirect effects reported below account for physical health rather than conflating it with financial strain. To test this competing-pathway account more directly, we estimated a parallel-mediator model in which physical health served as a mediator alongside each psychological factor (see [Appendix 1]).

Conditional indirect effects were computed ±1 *SD*) at of the moderator, and the index of moderated mediation (the a-path x interaction coefficient product) tested whether indirect-effect strength varied across levels of engagement. Inference relied on bias-corrected bootstrap confidence intervals (5,000 resamples). Effects were significant when the 95% CI excluded zero. Significant interactions were probed using the Johnson-Neyman technique (Hayes & Matthes, 2009) instead of arbitrary group splits. Unlike the conventional pick-a-point approach, which evaluates the conditional effect only at arbitrarily chosen values of the moderator (e.g., ±1 *SD),* the Johnson-Neyman technique identifies the exact range of the moderator across which the conditional effect is statistically significant (Hayes & Matthes, 2009).

〈Table 2〉 Zero-order correlation among variables (N = 5,551)

Variable	1	2	3	4	5	6	7	8	9
1. Financial hardship	–								
2. Depression/anxiety	.44***	–							
3. Loneliness	.36***	.64***	–						
4. Visit frequency	−.06***	.03*	.05***	–					
5. Health tech	−.03*	.01	.01	.08***	–				
6. Income	−.37***	.22***	−.14***	.06***	.28***	–			
7. Health literacy	−.02	−.03*	−.01	−.04**	.26***	.20***	–		
8. General health	−.24***	−.30***	−.24***	−.21***	.12***	.28***	.18***	–	
9. Chronic(count)	.07***	.06***	.04**	.27***	−.11***	−.19***	−.19***	−.37***	–

Note: Visit frequency: Health visit frequency, Health tech: Digital health tech engagement, Income: Household income, Health literacy: Digital health literacy, Chronic: Chronic conditions, * p 〈. 05, ** p 〈. 01, *** p 〈. 001

5. Results

1) Preliminary analysis

The analytic sample comprised 5,551 respondents with complete data on all modeled variables. The multi-item showed good reliability (see Measures section). Loneliness was measured with the standardized PROMIS Social Isolation T-score (M = 45.39, SD = 9.96). The two mediators were themselves correlated (r = .64, p 〈. 001). Although substantial, this association is consistent with the established co-occurrence of emotional distress and social disconnection, leading the two to be retained as distinct constructs, with one indexing affective symptoms and the other capturing perceived social isolation. Thus, they were modeled in separate equations to preserve their distinct indirect pathways. This current study conducted PROCESS Model 14 (Hayes, 2015), with mean-centered predictors and bias-corrected bootstrap CIs (5,000).

2) The mediating role of depression/anxiety

This study through H1 and H3 predicted that financial hardship would increase depression/anxiety and that heightened depression/anxiety would, in turn, increase health care visit frequency. Consistent with H1, financial hardship had a significant positive effect on depression/anxiety (b = 0.295, 95% CI [.271, .318]), and depression/anxiety in turn predicted more frequent visits (b = 0.105, 95% CI [.036, .174]), enabling and need covariates. The total effect of financial hardship on visit frequency was negligible and nonsignificant (c = −0.015, 95% CI [−0.078, 0.048]). Controlling for the mediator yielded a negative, nonsignificant direct effect (c' = −.054, 95% CI [−.120, .011]) alongside a positive indirect effect through psychological distress (see Table 3).

3) The mediating role of loneliness

In formulation H2 and H4, financial hardship again showed a parallel pathway through loneliness. It significantly predicted loneliness (b = 3.531, 95% CI [3.203, 3.859]). Loneliness, in turn, predicted frequent visits (b = 0.008, 95% CI [.003, .013]), controlling for the full covariate set. Once the mediator was included, the direct effect of financial hardship was not distinguishable from zero (c' = −.054, 95% CI [−.118, .011]). This pattern is consistent with mediation through greater social isolation, making the distress pathway (see Table 3).

4) The moderation role of digital health technology engagement

This study proposed that the second stage of each indirect pathway in H5 and H6, representing the mediator−to−utilization link, would be amplified

among respondents with higher digital health technology engagement.

For the depression/anxiety pathway, the findings supported H5 (see Table 3). Technology engagement itself predicted more frequent visits (b = 0.234, 95% CI [.176, .292]), and critically, the interaction between depression/anxiety and technology engagement was positive and its confidence interval excluded zero (b = 0.089, 95% CI [.018, .161]). The index of moderated mediation (Hayes, 2015) indicated that the strength of the indirect effect varied across levels of engagement (index = 0.026, 95% CI [.003, .050]). Decomposing this pattern, the conditional indirect effect of financial hardship on visits through distress was indistinguishable from zero at low engagement (−1 *SD*: b = 0.009, 95% CI [−.020, .038]) but positive and reliable at high engagement (+1 *SD*: b = 0.054, 95% CI [.023, .084]). The conditional b−path slopes showed the same context. Among respondents using no digital tools, distress was unrelated to visit frequency (b = 0.018, 95% CI [−.078, .115]). Those using one tool, however, the effect became reliable (b = 0.108, 95% CI [.038, .177]). It was strongest among those using both a health app and a wearable (b = 0.197, 95% CI [.094, .300]).

For loneliness, the picture was less clear−cut. As before, technology engagement predicted visit frequency (b = 0.233, 95% CI [.175, .291]). The interaction between loneliness and engagement leaned positive, in line with what we expected. But its confidence interval grazed zero (b = 0.005, 95% CI [−.0004, .010], and so did the index of moderated mediation (index = 0.018, 95% CI [−.002, .037]). By the formal test, then, the moderation did not hold.

Yet, the underlying effects traced the same pattern as the distress pathway. At low engagement, the indirect effect stayed close to zero (−1 *SD*: b = 0.015, 95% CI [−.010, .040]). In contrast, at high engagement, it turned significantly positive (+1 *SD*: b = 0.044, 95% CI [.019, .070]). The conditional slopes showed step by step with each added tool. They were negligible for respondents with no tools (b = 0.004, 95% CI [−.004, .011]), reliable for those

with one (b = 0.008, 95% CI [.004, .014]), and largest for those with both (b = 0.013, 95% CI [.006, .021]). So while loneliness did not clear the significance, the effect took nearly the same shape as it did for distress. We therefore read H6 directionally suggestive instead of confirmed.

〈Table 3〉 Moderated mediation results (N = 5,551)

	Model 1 Depression/ Anxiety		Model 2 Loneliness (PROMIS T)	
Path	**b**	**CI**	**b**	**CI**
a : Financial hardship → mediator	.295***	[0.271, 0.318]	3.531	[3.203, 3.859]
b : Mediator → Visit frequency	0.105**	[0.036, 0.174]	0.008***	[0.003, 0.013]
Tech engagement → Visit frequency	0.234***	[0.176, 0.292]	0.233***	[0.175, 0.291]
Mediator x Tech engagement	0.089*	[0.018, 0.161]	0.005	[−.0004, 0.010]
c' : Financial hardship → Visit frequency	−.054	[−0.120, 0.011]	−0.054	[−0.118, 0.011]
Model R^2	.206		.206	
Note: CIs for individual path coefficients are based on the t-distribution; CIs for indirect, conditional indirect, and moderated-mediation-index effects are bias-corrected bootstrap intervals based on 5,000 resamples.				
Conditional indirect effect	**b**	**CI**	**b**	**CI**
At low tech engagement (−1 SD)	0.009	[−.020, .038]	0.015	[−.010, .040]
At high tech engagement (+1 SD)	0.054	[.023, .084]	0.044	[.019, .070]
Index of moderated mediation	0.026	[.003, .050]	0.018	[−.002, .037]
Conditional b-path slope	b	CI	b	CI
Tech=0 (no tools)	0.018	[−.078, .115]	0.004	[−.004, .011]
Tech=1 (one tool)	0.108**	[.038, .177]	0.008***	[.004, .014]
Tech=2 (both tools)	0.197***	[.094, .300]	0.013***	[.006, .021]

Note: Conditional indirect effects and the index of moderated mediation are reported with bias-corrected bootstrap 95% CIs (5,000) and no p values, as their sampling distributions are asymmetric. Conditional b-path slopes are single linear coefficients and are reported with t-based 95% CIs and p values.

(1) Supplementary analysis

A competing physical–health pathway

A plausible alternative account is that financial hardship may increase utilization primarily by eroding physical health – a need–based pathway that could subsume the psychological route. To test this, we re–estimated each model with self–rated health included as a parallel mediator alongside the psychological mediator, allowing digital engagement to moderate both second–stage paths (see [Appendix 1]). A physical–health pathway was indeed evident. Financial hardship predicted poorer health (a = 0.174), which in turn predicted more frequent visits (b = 0.350, p 〈 .001), yielding a statistically significant indirect effect (0.061, 95% CI [0.046, 0.077]). However, the depression/anxiety pathway remained largely unchanged after accounting for physical health. The coefficient of moderated mediation remained significant (0.027, 95% CI [0.001, 0.053]), and the conditional second–stage slope strengthened across engagement levels (b = 0.032, 0.113, and 0.195 at zero, one, and two tools, respectively). The same pattern held for loneliness. Notably, digital engagement did not moderate the physical–health pathway (index = −.0003, 95% CI [−0.011, 0.010]), indicating that the amplifying moderation was specific to the psychological route. These findings confirm that the psychological mediation is distinct from physical illness.

Separating depression and anxiety

To evaluate whether our findings were driven by a specific field of distress, we re–estimated Model 1 separately for the depression (PHQ–2) and anxiety (GAD–2) subscales (see [Appendix 2]). Both subscales demonstrated consistent directional patterns. The anxiety subscale displayed significant moderated mediation (index = 0.025, 95% CI [0.003, 0.046]), with conditional second

−state slopes increasing across engagement levels (b = 0.039, 0.119, and 0.199). The depression subscale exhibited an identical directional pattern, although the overall index did not achieve statistical significance (index = 0.016, 95% CI [−0.005, 0.036]) and was significant only at high engagement levels. Because the effect is not exclusive to a single subscale, using the composite PHQ−4 score, which offers superior reliability, remains the most robust operationalization.

6. Discussion

This study examined how financial hardship shapes health care utilization through two psychological pathways and whether engagement with digital health technologies conditions the second stage of each pathway.

First, the findings support a resource−loss account of how economic adversity reaches psychological well−being. Financial hardship was robustly associated with both greater depression/anxiety and greater loneliness. This is consistent with the premise that an initial loss of material resources propagates into the depletion of psychological and social resources. More importantly, these effects held after controlling objective household income, suggesting that it is the lived experience of hardship rather than income level alone that carries the psychological burden. This distinction reinforces the value of measuring subjective financial strain separately from income in health research.

Second, and most crucial for the health−communication literature, the findings speak to a contested question about the direction of the distress−to−utilization relationship. Contrary to the notion of care withdrawal, individuals with higher levels of depression/anxiety and loneliness visited providers more frequently. This pattern aligns with conceptualizing

psychological states as perceived-need factors that heighten, rather than suppress, care-seeking. However, because perceived need was not directly measured, this interpretation is inferred from the observed associations instead of empirically tested. Distress can amplify attention to and worry about bodily symptoms, while loneliness may render the clinical encounter itself a valued source of human contact. The result cautions against the intuitive but often unexamined assumption that psychological suffering uniformly suppresses health care engagement, and it aligns with the contemporary application of the behavioral model in which need factors exert direct positive effects on utilization (Jia et al., 2025; Song et al., 2025). For study, this underscores the importance of specifying the direction in which mental-health states influence service use.

Third, and least anticipated, digital engagement did not amplify both pathways equally. It sharpened how distress translated into care but left the loneliness route largely untouched. This split is generative, because it raises a question the resource-loss and need-based accounts do not settle. Why would the same technology move one form of psychological need but not the other, then? One reading concerns what these tools actually do. Health apps and wearables are built around bodily signals and the nudges tied to them. For someone whose distress already sharpens attention to physical sensation, a flagged reading or a prompt becomes the occasion for a visit that might otherwise be deferred. Loneliness may carry no such somatic marker. A wearable does not register social disconnection, and its prompts do not answer the wish for contact that may draw a lonely person to the clinic. The technology amplifies the pathway whose signal it can read and passes over the one it cannot. That these two routes diverged provides a clear rationale for evaluating them independently. Depression and anxiety function as an affective-somatic construct, whereas loneliness reflects a social domain. Accordingly, only the former aligns with the somatic signals monitored by

self-tracking tools, and combining the two would have masked this conceptual and empirical distinction.

These results address an alternative, need-based explanation, namely that hardship increases utilization primarily by impairing physical health. Although this pathway was indeed evident, with poorer self-rated health serving as a strong and independent predictor of visit frequency, it did not displace the psychological mechanism. When physical health was modeled as a competing mediator, the depression/anxiety pathway and its amplification by digital engagement remained virtually unchanged, with the moderation remaining specific to the psychological route. Financial hardship thus appears to influence care-seeking through partially independent physical and psychological channels, with self-tracking technology selectively amplifying the latter, the very channel whose internal signals such tools are designed to register.

These findings also have practical implications for health communication and service delivery. If digital health engagement channels psychological need into care specifically for the distress pathway, then embedding symptom-monitoring and prompting features into tools used by financially strained populations could help ensure that elevated need is met with actual contact rather than left unaddressed. At the same time, the weaker moderation for loneliness suggests that self-tracking technology alone is unlikely to resolve the isolation-driven component of care-seeking, pointing to the continued importance of relational and community-based interventions, addressing social connectedness directly.

With these implications, this study has several limitations. First, HINTS 7 is cross-sectional, so the temporal ordering implied by the mediation model cannot be established. Although our sequencing is theoretically grounded, reverse or reciprocal pathways are plausible and the results should be interpreted as associations. Thus, future research should conduct longitudinal

or panel designs, including the emerging HINTS Panel.

Second, our analysis did not incorporate the HINTS survey weights. We controlled extensively for demographic variables, enabling, and need covariates, which reduces but does not eliminate the influence of the complex sampling design. As a result, the point estimates reported here should not be read as precise population values, and readers should be cautious in generalizing their magnitude to the full U.S. adult population. Applying the HINTS replicate weights within a design-based framework, and confirming that the moderated mediation patterns hold under that approach, is an important step for future study.

Third, a further limitation concerns the underlying mechanism itself. Perceived need, the central construct through which our framework links distress and loneliness to utilization, was not directly measured. Although our data demonstrate that these psychological states predict more frequent visits and that digital engagement moderates the distress link, they do not empirically establish that these associations operate specifically through heightened perceived need. The perceived-need account therefore represents a theoretical interpretation consistent with our findings instead of a directly verified mechanism. In conclusion, alternative explanations, such as clinician-initiated follow-up of distressed patients, cannot be ruled out. Directly measuring perceived need, symptom appraisal, and help-seeking intention as intermediate steps remains a crucial direction for validating the proposed pathway.

Lastly, engagement was measured only as whether respondents used health apps and wearables, not how often, how long, or in what way. Two people coded identically on our index could differ sharply in practice, one glancing at a step count now and then, the other reviewing reading daily and sending them to a clinician. Because our measure cannot separate these cases, it likely understates the moderation for heavy users and overstates it for

nominal ones, and the true pattern may be sharper than what this study reports. Measures that include frequency of use, or whether data are shared with providers, would allow a more precise test.

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[Appendix 1]

〈Table A1〉 Parallel model with poor physical health as a competing mediator

	Model 1 Depression/Anxiety + poor physical health	Model 2 Loneliness + poor physical health
Path	b	b
A1 : Financial hardship mediator	.330	3.937
A2 : Financial hardship poor health	.174	.174
b1: Mediator Visit frequency	.111	0.009
b2: Poor health Visit frequency	.350***	.350***
Psychological indirect	0.037[.012, .062]	0.035[.013, .056]
Psychological index of moderated mediation	0.027[.001, .053]	0.017[−.005, .040]
Physical−health indirect	0.061[.046, .077]	0.061[.046, .077]
Physical−health index of moderated mediation	−0.000[−.011, .010]	.001[−.010, .011]
c' : Financial hardship Visit frequency	−.053	−0.052

Note: N = 5,486. X = financial hardship, W = digital health engagement, Y = visit frequency; second−stage moderated mediation (PROCESS Model 14). Bias−corrected bootstrap 95% CIs (5,000 resamples). Poor physical health = reverse−scored self−rated general health (higher = worse); chronic−condition count retained as a covariate. *** $p < .001$.

[Appendix 2]

〈Table A2〉 Separate models for depression (PHQ-2) and anxiety (GAD-2)

Path/index	PHQ-2 Depression	GAD-2 Anxiety	PHQ-4
a: Financial → hardship mediator	0.288	0.311	0.299
b1: Mediator → Visit frequency	0.061	0.117	0.111
Mediator x engagement	0.054	0.080	0.081
Conditional b, 0 tools	0.008 (ns)	0.039 (ns)	0.032 (ns)
Conditional b, 1 tools	0.062 (ns)	0.119***	0.113**
Conditional b, 2 tools	0.117*	0.199***	0.194***
Indirect at +1 SD engagement	0.031 [.005, .058]	.057 [.030, .085]	0.054[.025, .085]
Index of moderated mediation	0.016[−.005, .036]	0.025[.003, .046]	0.024 [.002, .047]

Note: N = 5,486. X = financial hardship, W = digital health engagement, Y = visit frequence; second-stage moderated mediation (PROCESS Model 14). Bias-corrected bootstrap 95% CIs (5,000 resamples). * p 〈 .05, ** p 〈 .01, *** p 〈. 001.

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