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Social Determinants of Health and Primary Care Engagement: A Conceptual Mind Genomics Framework

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ABSTRACT

Social Determinants of Health (SDOH) encompass interconnected economic, educational, healthcare, environmental, and social conditions that may shape engagement with primary care. Although individual SDOH factors have been widely examined in relation to healthcare access, utilization, prevention, adherence, and health outcomes, less attention has been given to how multiple social and contextual conditions may be perceived when they occur together. This conceptual paper proposes a literature-informed Mind Genomics framework for examining the perceived relevance of multiple SDOH factors to primary-care engagement. The framework organizes relevant conditions into four complementary silos and translates them into a structured, literature-informed set of sixteen elements, providing a basis for examining SDOH factors as multidimensional combinations rather than isolated determinants. Future empirical implementation using BimiLeap, a web-based platform for designing and implementing Mind Genomics studies, could present experimentally designed combinations of these elements as vignettes for respondent evaluation and examine the relative salience of individual elements and patterns of response across individuals and population groups. The proposed framework does not directly measure healthcare utilization, treatment adherence, or causal effects; rather, it provides a structured and testable foundation for investigating how combinations of social and contextual conditions may be perceived in relation to primary-care engagement and for generating hypotheses for future epidemiological and health-services research.

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Introduction

Social Determinants of Health (SDOH) are increasingly recognized as important contributors to health and health inequities. The World Health Organization (WHO) defines SDOH as the conditions in which people are born, grow, live, work, and age, together with their access to power, money, and resources. These conditions influence health across the social gradient, with people in lower socioeconomic positions generally experiencing poorer health and greater risks of illness and death. SDOH therefore extend beyond individual health behaviors and clinical care to include the broader social, economic, environmental, and structural conditions that shape people's opportunities to achieve and maintain health [1]. The Centers for Disease Control and Prevention (CDC) similarly describes SDOH as nonmedical factors that influence health outcomes [2].

According to Healthy People 2030, an initiative of the U.S. Department of Health and Human Services, SDOH can be grouped into five broad domains: economic stability, education access and quality, health care access and quality, neighborhood and built environment, and social and community context. These domains encompass factors such as income, employment, education, language and literacy, healthcare access, transportation, housing, neighborhood conditions, discrimination, and environmental conditions, highlighting the broad range of circumstances through which social conditions can influence health and health inequities [3].

These determinants are particularly relevant to primary health care, where access, prevention, and engagement are shaped not only by the availability of health services but also by the social and material circumstances in which individuals live. Primary health care and SDOH share a strong emphasis on health equity, health promotion and prevention, community participation, and access to resources needed to maintain health [4]. SDOH can influence

the healthcare journey from initial care-seeking through treatment and follow-up, with economic circumstances, transportation, housing, healthcare access, and community support contributing to differences in people's ability to obtain and engage with care [5]. Thus, understanding primary-care engagement requires consideration of multiple and interconnected dimensions of social context rather than healthcare access as an isolated clinical or system-level issue.

Evidence across several SDOH domains illustrates this multidimensional relationship. Economic circumstances can influence whether individuals seek needed care and maintain contact with healthcare services. Financial barriers, including out-of-pocket costs and other costs associated with obtaining care, have been associated with reduced healthcare utilization, whereas interventions that reduce or eliminate such costs have been associated with increased healthcare utilization [6]. Employment instability may affect health and healthcare utilization through changes in health insurance coverage and medical care use following involuntary job displacement [7]. Together, these findings suggest that financial security, employment, insurance coverage, and healthcare costs may interact in shaping opportunities for primary-care engagement.

Education and health literacy represent another important pathway. Limited health literacy may create difficulties in understanding and using health information and following recommended treatment, with evidence suggesting relationships between health literacy, disease-state control, and medication adherence [8]. Health literacy has also been positively associated with adherence, while health-literacy interventions have demonstrated improvements in both health literacy and treatment adherence [9]. In preventive care, adequate health literacy has been associated with greater participation in breast, cervical, and colorectal cancer screening [10]. These findings indicate that the ability to understand and use health information may be relevant to both preventive care and continued engagement with recommended healthcare.

The neighborhood and built environment may similarly influence access to primary care. Transportation difficulties have been associated with delayed care, missed or rescheduled appointments, and other barriers to healthcare access, particularly among lower-income and uninsured or underinsured populations [11]. Neighborhood-level healthcare resources and social characteristics may also contribute to variation in primary-care access and use [12,13]. Among low-income Medicaid enrollees, lower neighborhood walkability was associated with lower odds of having a usual source of primary care, although transit availability itself was not significantly associated with this outcome [14]. Poor housing conditions have additionally been associated with poorer health status, greater medical utilization, and higher likelihood of hospitalization [15]. These findings indicate that access to primary care may depend not only on the existence of healthcare services but also on the accessibility and quality of the physical environment in which individuals live.

Social and community context constitutes another relevant dimension of primary-care engagement. Social support has been associated with adherence to medical treatment across a large body of evidence, with practical support showing particularly strong relationships with adherence [16]. However, the relationship between social connectedness and primary-care use may not be uniformly directional. Lower social group connectedness has been associated with more frequent primary-care attendance, while increased social group connectedness following participation

in a social-group intervention was associated with reduced attendance [17]. This suggests that social context may shape patterns of primary-care engagement in different ways depending on individuals' needs and circumstances. The interpersonal and cultural context of care may also be relevant, although evidence concerning cultural competence and its effects on patient outcomes remains heterogeneous [18]. The latter review also identified limited empirical evidence regarding the efficacy of cultural competence in healthcare, supporting a cautious interpretation of this relationship.

Community-based approaches provide an additional mechanism through which several SDOH-related barriers may be addressed simultaneously. Community health worker interventions may incorporate health education, identification and addressing of barriers to care, navigation, appointment scheduling, reminders, transportation assistance, and patient follow-up, and evidence from community health worker navigation interventions suggests improvements in cancer screening adherence and use of primary care for chronic disease management, although evidence regarding broader clinical outcomes, patient experience, and cost-effectiveness remains insufficient [19]. Such interventions illustrate how primary-care engagement may be influenced by several interconnected social and practical conditions rather than by a single determinant.

Despite substantial evidence linking individual SDOH factors with healthcare access, utilization, prevention, adherence, and health outcomes, the literature remains distributed across different determinants, populations, settings, and outcomes. Evidence on social determinants of primary-care needs has also been heterogeneous across studies, with individual determinants examined in relation to different populations and healthcare contexts [20]. This body of evidence establishes the relevance of individual determinants but provides less insight into how multiple SDOH factors may be perceived when they coexist within the same primary-care context.

This gap is important because individuals rarely experience social determinants in isolation. Financial hardship may coexist with employment instability, limited health literacy, transportation difficulties, inadequate housing, or limited social support. Conversely, access to affordable healthcare may coexist with barriers related to transportation, communication, neighborhood infrastructure, or social circumstances. The combined presence of these conditions may therefore shape perceptions of primary-care engagement in ways that are not readily captured when determinants are examined independently. Although conventional observational approaches are essential for estimating associations between determinants and predefined outcomes, they provide less direct insight into how individuals evaluate combinations of social circumstances when multiple barriers and facilitators are present simultaneously.

Mind Genomics provides a complementary approach for examining how individuals respond to combinations of conceptually relevant messages or conditions. Rather than considering determinants only as isolated factors, the approach can examine how combinations of factors are evaluated within a multidimensional decision context. In the context of SDOH and primary care, this approach may help identify the relative salience of different economic, educational, neighborhood, and social factors in relation to primary-care engagement. It is not intended to replace established epidemiological methods or to infer causal effects from respondent evaluations; rather, it can complement existing evidence by

examining perceived relevance and relative salience when multiple SDOH-related circumstances are considered together.

Accordingly, this conceptual paper proposes a literature-informed Mind Genomics framework for examining the perceived relevance of multiple social determinants in relation to primary-care engagement. The framework is intended to provide a structured foundation for future empirical research examining how different SDOH factors may be evaluated individually and in combination, and how such perceptions may vary across individuals and population groups.

Conceptual Framework

Development of the Proposed Mind Genomics Framework

Mind Genomics provides a structured approach for examining how individuals respond to combinations of conceptually defined elements rather than considering factors exclusively in isolation [21,22]. The approach has subsequently been applied to health-related and social contexts, including healthcare communication, patient wellbeing, public health, and family or social experiences [23-26]. In a typical Mind Genomics implementation, a defined set of elements is combined through an experimental design into vignettes, which are presented to respondents for evaluation, allowing multidimensional situations to be examined and the contribution of individual elements to be estimated through quantitative modeling [21,22,25,26].

Building on the five-domain SDOH framework of Healthy People 2030, an initiative of the U.S. Department of Health and Human Services [3], the present framework organizes determinants relevant to primary-care engagement into four silos. Silo A — Economic Stability & Healthcare Access combines the Healthy People 2030 domains of Economic Stability and Health Care Access and Quality because both address financial and healthcare-service conditions relevant to access to and engagement with primary care. Silo B — Education & Health Literacy combines Education Access and Quality with health-literacy-related factors to capture the roles of education, language, literacy, and communication in patient understanding and engagement. Health literacy is not identified as a separate Healthy People 2030 domain; rather, literacy- and language-related factors are incorporated within this silo because of their relevance to education, communication, and engagement with care. Silo C — Neighborhood & Built

Environment corresponds to the Healthy People 2030 domain of Neighborhood and Built Environment and encompasses physical and environmental conditions relevant to primary-care access and continuity. Silo D — Social Support & Community Context corresponds to the Healthy People 2030 domain of Social and Community Context and encompasses social connectedness, cultural responsiveness, and community resources relevant to primary-care engagement [3].

The literature synthesized in the Introduction provided the evidence base for the SDOH factors represented in the four silos, including financial and healthcare-access conditions [6,7], education and health literacy [8-10], transportation, neighborhood characteristics, housing, and the built environment [11-15], and social support, cultural context, and community-based resources [16-19].

For each silo, one story question was developed to define the conceptual focus of its four elements and to ensure that the elements collectively represented the relevant SDOH context for primary-care engagement. To facilitate story-question development, the Idea Coach, an AI-based tool within the BimiLeap platform (BimiLeap; www.bimileap.com), was used to generate candidate story questions based on the four silos and the relevant concepts identified from the literature. BimiLeap is a web-based platform for designing, implementing, and analyzing Mind Genomics studies. The generated questions were subsequently reviewed and refined for conceptual relevance, consistency with the supporting literature, alignment with the study objective, and their ability to collectively tell a coherent story within each silo, consistent with the standard Mind Genomics workflow.

Following the selection of the story questions, the Idea Coach was again used to generate candidate elements for each question. Four elements were selected for each story question, resulting in the standard 4 × 4 Mind Genomics framework comprising 16 elements. The candidate elements were subsequently reviewed and refined for clarity, conceptual relevance, consistency with the supporting literature, and alignment with the study objective. The resulting 16 elements provide a literature-informed representation of the SDOH factors incorporated into the proposed framework for examining their perceived relevance to primary-care engagement. Table 1 presents the four silos, their corresponding guiding questions and behavioral rationales, and the final 16 elements.

Table 1: Proposed Four-Silo Mind Genomics Framework

Silo	Story Question	Elements	Behavioral Rationale
Silo A — Economic Stability & Healthcare Access	A. How does financial security influence engagement with primary care services?	A1. Financial hardship may lead individuals to delay or avoid needed primary care. A2. Affordable primary care can facilitate care-seeking and support greater engagement with primary care. A3. Employment instability and lack of insurance coverage may reduce regular primary care engagement. A4. Reducing out-of-pocket costs can support more consistent healthcare engagement.	Addresses how income, employment, insurance coverage, and affordability shape primary care utilization and health outcomes across socioeconomic groups.

Silo B — Education & Health Literacy	B. How does health literacy shape patient engagement with primary care?	B1. Low health literacy can make it difficult for patients to understand and use health information and follow recommended treatment. B2. Stronger health literacy is associated with greater participation in preventive screening and adherence to recommended care. B3. Clear and accessible health communication may support patient understanding and adherence to health recommendations. B4. Community-based health education and navigation programs can strengthen awareness of preventive care and support primary care engagement.	Highlights how educational attainment, health literacy, and provider communication quality influence patient engagement, preventive care utilization, and primary care outcomes.
Silo C — Neighborhood & Built Environment	C. How do neighborhood conditions shape access to and continuity of primary care?	C1. Limited access to public transportation can create barriers to reaching primary care facilities regularly. C2. Living in areas with limited healthcare facilities may reduce access to routine and preventive primary care. C3. Walkable neighborhoods with accessible healthcare resources may support more consistent access to primary care. C4. Poor housing conditions and adverse environmental conditions can contribute to poorer health and greater healthcare needs.	Examines how transportation access, healthcare facility availability, housing quality, and neighborhood safety influence primary care access, continuity, and health outcomes.
Silo D — Social Support & Community Context	D. How do social connectedness and community resources influence primary care outcomes?	D1. Strong social support networks can support adherence to primary care recommendations and engagement with care. D2. Social isolation can complicate chronic disease management and shape patterns of primary care engagement. D3. Culturally responsive care may strengthen communication and patient experience across diverse communities. D4. Community health worker programs can help address barriers to care and support consistent primary care engagement among underserved populations.	Explores how social connectedness, cultural responsiveness, community resources, and health worker engagement shape patient behavior and primary care outcomes across diverse populations.

Proposed Future Empirical Implementation of the SDOH Mind Genomics Framework

The proposed conceptual framework is intended for future implementation using BimiLeap, a web-based platform developed for the design, administration, and analysis of Mind Genomics studies. The overall proposed implementation workflow is illustrated in Figure 1. In a future empirical investigation, the four-story questions and sixteen SDOH elements presented in Table 1 would be incorporated into the platform to examine how individuals evaluate combinations of social and contextual conditions in relation to their engagement with primary care services.

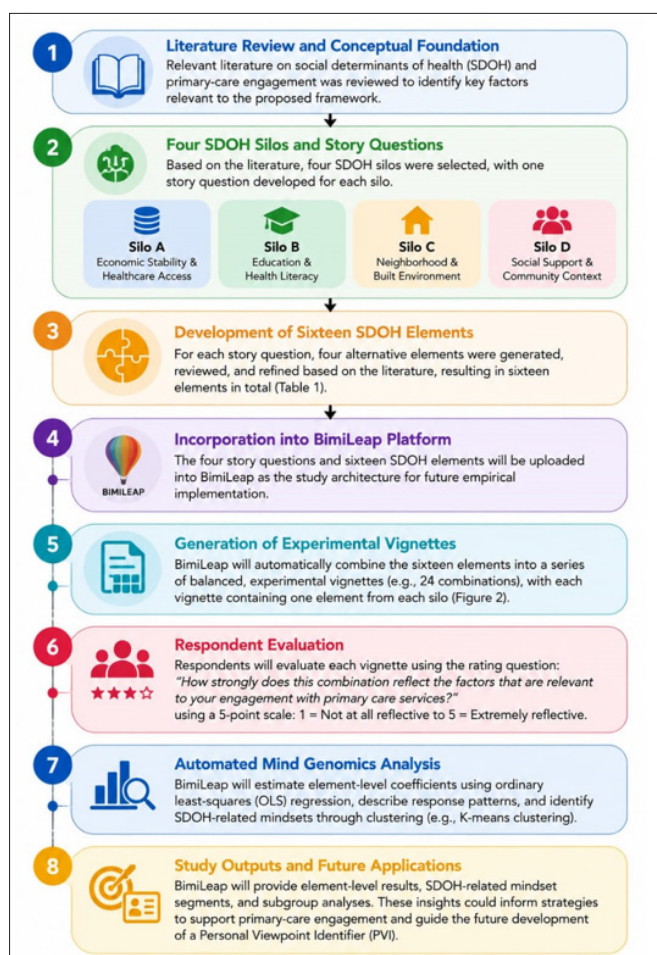


Figure 1: Proposed Conceptual Workflow for Future Empirical Implementation of the SDOH Mind Genomics Framework using the BimiLeap Platform

Using the standard Mind Genomics experimental design, BimiLeap would automatically recombine the sixteen SDOH elements into a series of experimentally designed multi-element vignettes. Each vignette would contain multiple elements drawn from different silos, allowing combinations of economic and healthcare-access conditions, education and health-literacy factors, neighborhood and built-environment conditions, and social or community context to be evaluated within the same primary-care context (Figure 2).

How strongly does this combination reflect the factors that are relevant to your engagement with primary care services?
Please indicate your rating using the scale below.

1 = Not at all reflective
2 = Slightly reflective
3 = Moderately reflective
4 = Very reflective
5 = Extremely reflective

Consider the following combination of factors:

- Financial hardship may lead individuals to delay or avoid needed primary care services.
- Clear and accessible health communication may support patient understanding and adherence to health recommendations.
- Limited access to public transportation can create barriers to reaching primary care facilities regularly.
- Strong social support networks can support adherence to primary care recommendations and engagement with care.

Please select your rating:

1 Not at all reflective 2 Slightly reflective 3 Moderately reflective 4 Very reflective 5 Extremely reflective

Figure 2: Illustrative Example of a Mind Genomics Experimental Vignette for SDOH and Primary-Care Engagement

Respondents would evaluate each vignette using the following rating question:

How strongly does this combination reflect the factors that are relevant to your engagement with primary care services?

Responses would be recorded using the proposed five-point response scale:

- 1 — Not at all reflective
- 2 — Slightly reflective
- 3 — Moderately reflective
- 4 — Very reflective
- 5 — Extremely reflective

The rating would reflect the respondent's perceived relevance of the overall SDOH combination to primary-care engagement. It would not directly measure healthcare utilization, treatment adherence, or causal effects.

Following completion of data collection, BimiLeap would automatically analyze the accumulated vignette ratings using its integrated Mind Genomics analytical workflow. The platform would estimate element-level utilities using ordinary least-squares (OLS) regression and group respondents with similar response patterns into SDOH-related mindsets using clustering approaches, including K-means clustering [21,23,25,26]. These analyses would provide an empirical basis for examining the relative salience of individual SDOH elements and differences in response patterns across respondents.

Within the context of the present conceptual framework, several potential SDOH-related mindsets could emerge. For example, one group may respond most strongly to combinations emphasizing financial affordability, insurance coverage, and reduced out-of-pocket costs, reflecting a greater salience of economic and healthcare-access conditions in relation to primary-care engagement. A second group may respond more strongly to combinations involving health literacy, clear communication, transportation access, and availability of healthcare services, indicating greater salience of information and practical access-related factors. A third group may place greater relative importance on combinations involving social support, cultural responsiveness, community resources, and neighborhood conditions, highlighting the relevance of social and community context to primary-care engagement. These potential mindset descriptions are presented solely as illustrative examples of response patterns that could emerge following future empirical implementation. The actual number, characteristics, and interpretation of SDOH-related mindsets would ultimately depend on the response patterns observed in the future empirical study.

The final BimiLeap report could provide total-panel analyses, element-level coefficients, SDOH-related mindset segmentation, and classification data for subsequent subgroup analyses. Such findings could help identify the relative salience of individual SDOH elements and combinations in relation to perceived primary-care engagement and could provide an empirical basis for examining heterogeneity across population groups. The resulting insights could complement conventional epidemiological evidence by showing how individuals evaluate multiple social and contextual conditions when considered simultaneously and could inform future research on more context-sensitive approaches to primary-care engagement.

In addition, empirically identified SDOH-related mindsets could potentially support the future development of a Personal Viewpoint Identifier (PVI) for identifying individual patterns of response to different social and contextual conditions. Such an application would represent a future extension of the proposed framework and would require empirical validation of the identified response patterns.

Discussion

The present paper proposes a literature-informed Mind Genomics framework for examining how multiple social determinants of health (SDOH) may be perceived in relation to primary-care engagement. The framework brings together multiple economic, educational, neighborhood, and social or community conditions within a common conceptual and experimental structure, providing a basis for examining multiple SDOH factors simultaneously rather than as isolated determinants.

The literature reviewed in the Introduction indicates that individual SDOH factors have been examined in relation to healthcare utilization, preventive care, treatment adherence, access to primary care, and other health-related outcomes. However, these factors have generally been studied across different populations, settings, determinants, and outcomes. The proposed framework addresses this dispersed evidence by providing a structured approach for examining how combinations of SDOH conditions may be perceived in relation to primary-care engagement.

Mind Genomics offers a complementary methodological perspective by allowing respondents to evaluate combinations of multiple conditions and by estimating the relative contribution of individual elements within those combinations [21,24,25,26]. The proposed approach focuses on perceived relevance rather than directly measuring healthcare utilization, treatment adherence, or causal effects. By presenting SDOH factors as multidimensional combinations, future empirical research could examine which conditions are more salient to respondents and whether different patterns of response emerge across individuals or population groups.

Such heterogeneity may be relevant because social and contextual conditions are experienced differently across individuals and population groups. Empirically identified response patterns could generate hypotheses for further epidemiological and health-services research and, following appropriate validation, could potentially inform more context-sensitive approaches to primary-care engagement.

Overall, the proposed framework serves as a bridge between existing SDOH evidence and future empirical investigation. It does not replace established SDOH classifications or conventional epidemiological approaches; rather, it provides an experimental structure for examining how multiple social and contextual conditions may be perceived simultaneously in relation to primary-care engagement. Future empirical implementation will be required to determine whether the proposed framework produces meaningful and reproducible response patterns.

Limitations and Future Research

Several limitations should be acknowledged. This paper presents a conceptual framework rather than an empirical Mind Genomics investigation; therefore, the proposed SDOH elements, vignette combinations, rating approach, and illustrative SDOH-related mindsets have not been experimentally validated. Similarly, the

four-silo structure and the proposed elements should be considered hypothesis-generating rather than definitive representations of the complex and interconnected nature of SDOH. The applicability of the framework across different populations, healthcare systems, and social or cultural contexts remains to be established through future empirical research.

These limitations also highlight important opportunities for future research. Future empirical studies could implement the proposed framework using the BimiLeap platform with appropriately defined and diverse participant populations to examine the relative salience of SDOH elements in relation to perceived primary-care engagement using standard Mind Genomics analytical approaches, including ordinary least-squares (OLS) regression and clustering techniques such as K-means [21,24,25,26]. Such studies may also examine whether response patterns differ across population groups and healthcare settings, assess the relationship between perceived relevance and independently measured indicators of primary-care engagement, and explore the potential development of a Personal Viewpoint Identifier (PVI) following appropriate empirical validation.

Conclusion

This conceptual paper proposes a literature-informed Mind Genomics framework for examining the perceived relevance of multiple social determinants of health (SDOH) in relation to primary-care engagement. By organizing relevant SDOH factors into four complementary silos and translating them into a structured set of sixteen elements, the framework provides a basis for examining social and contextual conditions as combinations rather than as isolated factors. The proposed approach extends existing SDOH evidence by introducing a Mind Genomics perspective focused on how such combinations may be perceived by individuals.

The framework is intended as a foundation for future empirical implementation using BimiLeap, where experimentally designed vignettes could be evaluated by respondents and analyzed to identify the relative salience of individual SDOH elements and patterns of response. Such empirical investigation may help clarify how different individuals perceive combinations of economic, educational, neighborhood, and social or community conditions in relation to primary-care engagement. As a conceptual framework, the present work does not establish empirical associations or causal effects; its value lies in providing a structured and testable foundation for future research on the multidimensional relationship between SDOH and primary-care engagement.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

AI Use Statement

Idea Coach, an AI-based tool within the BimiLeap platform, was used to assist with the development of the four-story questions and sixteen SDOH elements. ChatGPT (OpenAI) was used for language editing and preparation of Figures 1 and 2.

Ethical Considerations

This conceptual paper did not involve human participants, primary data collection, or identifiable participant information; therefore, ethics approval was not required.

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