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Comments

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Social determinants of health among family caregiver centered outcomes in lung cancer: a systematic review

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Background: Lung cancer is the leading cause of cancer death globally. Both lung cancer patients and family caregivers (FCGs) have unmet quality of life (QOL) needs. An understudied topic in lung cancer research is the role of social determinants of health (SDOH) on QOL outcomes for this population. The purpose of this review was to explore the state of research on SDOH FCGs centered outcomes in lung cancer.

Methods: The databases PubMed/MEDLINE, Cochrane Library, Cumulative Index to Nursing and Allied Health Literature, and American Psychological Association (APA) PsycInfo were searched for peer-reviewed manuscripts evaluating defined SDOH domains on FCGs published within the last ten years. The information extracted using Covidence included patients, FCGs and study characteristics. Level of evidence and quality of articles were assessed using the Johns Hopkins Nursing Evidence-Based Practice Rating Scale.

Results: Of the 344 full-text articles assessed, 19 were included in this review. The social and community context domain focused on caregiving stressors and interventions to reduce its effects. The health care access and quality domain showed barriers and underuse of psychosocial resources. The economic stability domain indicated marked economic burdens for FCGs. Four interconnected themes emerged among articles on the influence of SDOH on FCG-centered outcomes in lung cancer: (I) psychological well-being, (II) overall quality of life, (III) relationship quality, and (IV) economic hardship. Notably, most participants in the studies were White females. The tools used to measure SDOH factors included primarily demographic variables.

Conclusions: Current studies provide evidence on the role of SDOH factors on lung cancer FCGs' QOL. Expanded utilization of validated SDOH measures in future studies would provide greater consistency in data, that could in turn inform interventions to improve QOL. Further research focusing on the domains of education quality and access and neighborhood and built environment should be carried out to bridge gaps in knowledge.

Keywords: Social determinants of health (SDOH); family caregivers (FCGs); lung cancer; quality of life (QOL)

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Introduction

Cancer continues to be a growing health concern throughout the world. Historically, lung cancer has been one of the most disparate malignancies in the United States (1), with high levels of symptom burden and quality of life (QOL) needs that are challenging for both the patients and their family caregivers (FCGs) (2). FCGs are relatives or friends who assume care responsibilities for a patient (3). How a patient and their FCGs adapt to a lung cancer diagnosis and their ability to access quality and timely lung cancer care are influenced by an array of non-disease and non-clinical factors. These factors are referred to as social determinants of health (SDOH). The US Department of Health Human Services defines SDOH as the social and physical environmental conditions in which people live, work, age, play, and pray (4). The SDOH framework (*Figure 1*) includes five broad domains: economic stability, education access and quality, neighborhood and built environment, healthcare access and quality, and social and community context (5,6). The effects of SDOH on health outcomes can be disadvantageous (7,8). Compared to individuals living in higher socioeconomic status (SES) neighborhoods, individuals residing in lower SES neighborhoods have higher rates of morbidity and mortality from many diseases (9-11), including lung cancer (12-14). Similarly, studies have shown associations between low education, living

in racially segregated neighborhoods, low social support and mortality for myocardial infarction, cerebrovascular disease, and lung cancer (15,16). Patients with cancer and FCGs often experience significant out of pocket costs and employment disruptions, resulting in financial toxicity (17). Other social conditions such as SES, behavioral needs, and environmental circumstances may impact QOL outcomes among patients with lung cancer (18).

Research on SDOH for FCGs has mainly focused on pediatric populations (19-21) and chronic conditions (22,23). Furthermore, studies have largely focused on three out of the five SDOH domains, with economic stability, social and community context, and healthcare access [including health literacy (24)] and quality dominating the literature (19). Other important domains, including education access and quality and neighborhood and built environment, are often not prioritized, or assessed. Another important yet understudied sub-factor within the social and community context domain is spirituality, which is defined as the belief in something greater than oneself, and guidance of that belief in understanding connections to self, others, nature, and the sacred (25-27). Spirituality has been found to encourage social cohesion, defined as the cooperative achievement of goals among individuals in a community that contributes to progressive health and economic outcomes (28,29).

While lung cancer incidence has been found to be associated with SDOH factors such as education, occupation, and income (30), our understanding of other SDOH domains on lung cancer FCG outcomes is limited. Although SDOH accounts for nearly 80% of an individual's health status (31), the literature is sparse regarding SDOH in relation to cancer caregiving, specifically in the context of lung cancer. Questions remain in understanding the relationships between SDOH and lung cancer outcomes for FCGs. Within this framework, a systematic review was conducted to determine the current state of the literature on SDOH for FCG-centered outcomes in lung cancer. We present the following article in accordance with the PRISMA reporting checklist (available at <https://jtd.amegroups.com/article/view/10.21037/jtd-22-1613/rc>) (32).

Methods

Search strategy

The authors (DT, VS, JK) developed search strategy criteria with the assistance of a librarian using the following

Highlight box

Key findings

- Current studies provide evidence of the critical role of social determinants of health (SDOH) factors on lung cancer family caregivers' (FCGs) quality of life.
- The studies included in this review largely focused on three out of the five SDOH domains: social and community context, healthcare access and quality and economic stability.
- Tools used to measure SDOH factors lacked standardization and primarily focused on demographic variables.

What is known and what is new?

- SDOH is an understudied topic in lung cancer research for FCGs.
- SDOH factors influence the overall quality of life of FCGs including their psychological well-being, relationship quality, and increased economic hardship.

What is the implication, and what should change now?

- SDOH factors significantly influence QOL of FCGs, and utilization of validated measures across all five domains would provide greater data consistency that could inform interventions to improve their health outcomes.

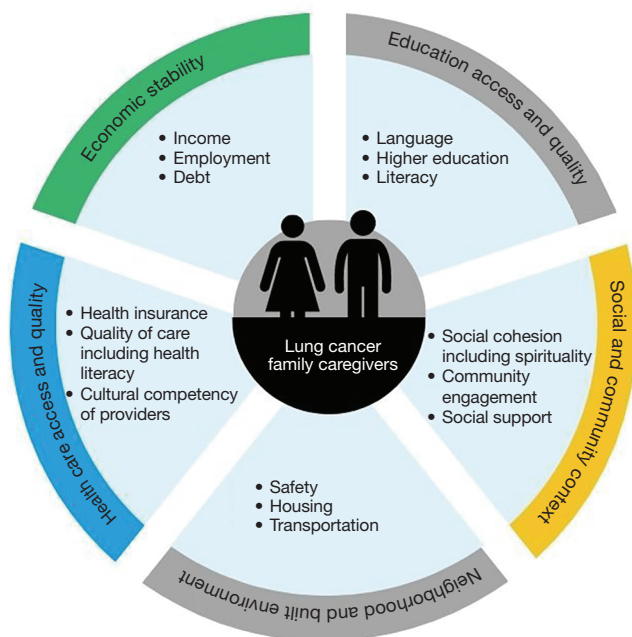


Figure 1 Social determinants of health framework for lung cancer family caregivers.

databases: PubMed/MEDLINE (Legacy version); Cochrane Library; Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus with Full Text; and American Psychological Association (APA) PsycInfo. The following search terms were used: lung cancer, family caregivers, patients, and social determinants of health. The keywords were combined with synonyms, alternate spellings/word endings, and controlled vocabulary, such as Medical Subject Headings (MeSH), to retrieve relevant results. Social determinants of health factors were broken down into individual keywords such as education, economic status, healthcare disparities, etcetera. The complete list of search strategies, including MeSH terms, can be found in [Appendix 1](#). The librarian performed all searches, with inputs from three authors (DT, VS, JK). This search strategy yielded 2,396 articles. The search results were further filtered limiting inclusion to studies published in the last ten years (January 2010-December 2020), human participants, and English language studies. For PubMed/MEDLINE, we also filtered the articles by (I) age: all Adults; and (II) publication types (refer to [Appendix 1](#) for specifics). CINAHL results were limited to the Age Group “All Adult” and peer reviewed publications. After applying these criteria, the search strategy yielded 1991 sources after

removing duplicate records (n=7).

Eligibility criteria

We included peer-reviewed original manuscripts published between 2010–2020, if at least 25% of participants were adult family caregivers of lung cancer patients. Exclusion criteria eliminated studies that were published prior to 2010, non-English studies, not conducted in the United States, dissertations, and other non-peer reviewed manuscripts. Due to the complexity of SDOH and lung cancer outcomes among FCGs, we chose to limit the scope of this review to the United States. We also excluded studies with the following designs and/or topics: interventions, systematic literature reviews/meta-analyses, case studies, drug efficacy trials, lung cancer screening, and basic science studies.

Data abstraction

We performed title/abstract screening, full-text screening, and data abstraction using the Covidence systematic review software tool (33). DT, ML, ME, MC, VS, JK and BF participated in the title/abstract screening, full-text screening, and data abstraction. Disputes over inclusion were resolved via virtual face to face discussions between DT, VS, and JK until consensus was reached. Of the 1,991 titles/abstracts screened, we excluded 1,647. Three-hundred forty-four articles remained for full-text evaluation. *Figure 2* illustrates the review process for final studies included in our qualitative synthesis. We then used the inclusion criteria to evaluate full-text articles and excluded an additional 338 studies. Using Covidence Extraction 2.0 template developed by DT in consultation with VS and JK, we abstracted the following information from each article selected for this review: (I) first author’s last name; (II) publication year; (III) study design; (IV) stage of disease; (V) treatment type; (VI) family caregiver demographic information (age, race/ethnicity, income, education level, setting); (VII) primary SDOH domain assignment; (VIII) secondary SDOH domain assignment; (IX) if SDOH domain selected was Social & Community context, was spirituality included; (X) if SDOH variables were connected to the outcome of the study or QOL of FCGs; (XI) type of validated SDOH tool used in data collection. DT, VS, and JK discussed assignments until consensus on domains was reached. For articles with a primary and secondary domain assignment, the primary domain assignments were included in the

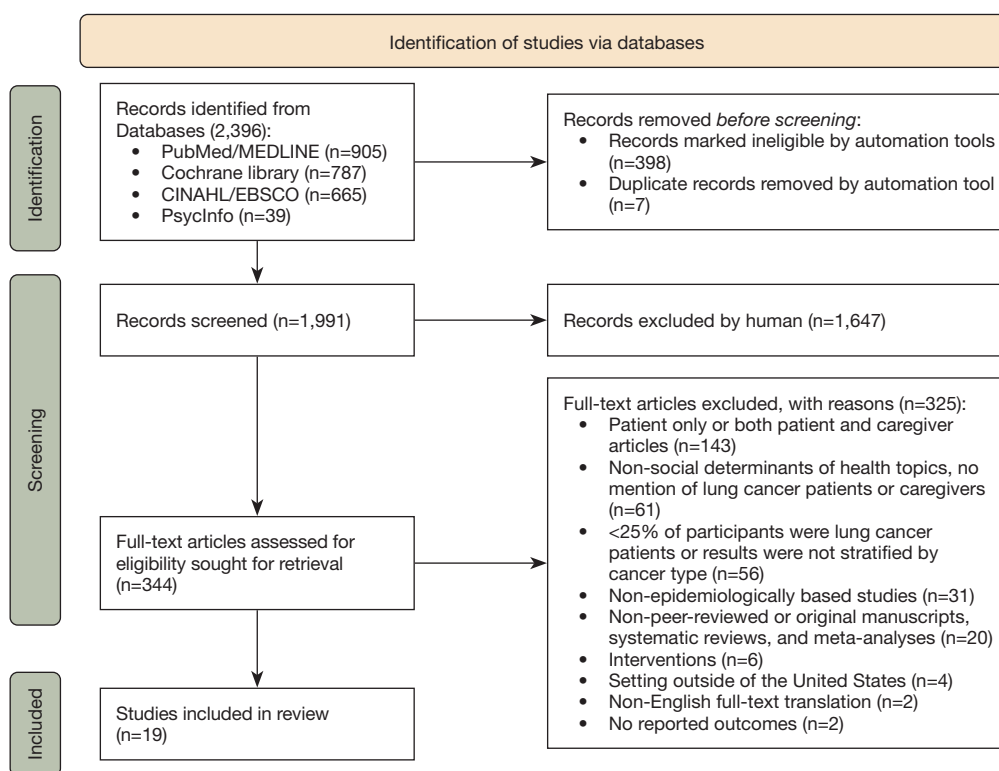


Figure 2 PRISMA flow diagram includes the number of records at various steps including identification of studies, screening, and final list of records for data extraction and analysis.

analysis and secondary domains were noted in result tables.

Level of Evidence and Quality Assessment

The Johns Hopkins Nursing Evidence-Based Practice Rating Scale (34) was used to determine the level of evidence and quality, where each article was assigned a level of evidence rating between I-III and quality evidence score from A-C. Level I articles are experimental studies, and randomized controlled trials (RCT). Level II articles are quasi-experimental studies, systematic review of a combination of RCTs and quasi-experimental studies with or without meta-analysis, and level III articles are qualitative studies or non-experimental study designs. High quality articles received an A rating and low-quality articles received a C rating. DT, ML, VS, JK, and BF rated the manuscripts independently and DT made the final decision on the evidence and quality ratings for all articles.

Results

Three hundred and forty-four articles met the criteria for

full text review, and 19 were included in the synthesis. The studies focused on three out of the five SDOH domains including social and community context, healthcare access and quality, and economic stability. *Tables 1,2* present patient, family caregiver, and study characteristics including level of quality for each article. Fifty-eight percent of articles in this review were assigned to the social and community context domain. The Social and Community Context domain is described as the psychosocial context of a community including social cohesion, community engagement, and social support that can determine an individual's well-being (5,6). The health care access and quality domain involves the availability of health coverage and specialist healthcare providers, quality of care, and the cultural competency of healthcare providers (5). Thirty-two percent of articles in this review were assigned to the health care access and quality domain. The economic stability domain relates to factors such as income, employment, debt, and expenses, all of which can affect an individual's health (5). Eleven percent of articles in this review were assigned to the economic stability domain. Most caregivers were White females but one article highlighted the experiences

Table 1 Social and community context domain studies on lung cancer family caregivers

Primary author & year	Patient characteristics		Family caregiver characteristics			Study characteristics			
	Stage of disease	Treatment type	Age, years (range or mean)	Sex or gender (majority)	Race/ethnicity	Study design	Sample size	Location	Evidence level & quality
Williams 2013 (48)	I, II, III	C	18–84	Female	AA/B, AA, W, O	Cohort	84	New Haven, CT	IIA
Grant 2013 (39)	I, II, III, IV	Other ^c	57	Female	AA/B, AA, NA, H/L, PI, W	Cohort	163	Duarte, CA	IIIB
Litzelman 2016 (37)	I, II, III, IV	C, R, S	20–71	Male	W, O	Cross Sectional	1,500	Multiple	IIIA
Mosher 2013 (41)	Other ^a	C, R, S	26–83	Female	AA/B, W	Cross Sectional	91	Indianapolis, IN	IIB
Dionne-Odom 2018 [†] (46)	IV	Other ^c	65.5	Female	AA/B, W, O	Cross Sectional	294	Multiple	IIIB
Kramer 2010 [†] (43)	I, II, III, IV	Other ^c	63	Female	AA/B, W	Cross Sectional	152	WI (Statewide)	IIIB
Kramer 2010 [†] (44)	Other ^b	Other ^c	63	Female	AA/B, W	Cross Sectional	155	WI (Statewide)	IIB
van Ryn 2011 [†] (38)	I, II, III, IV	C, R, S	21–80	Female	AA/B, AA, H, NA, W	Cross Sectional	335	Multiple	IIA
Mazanec 2011 (51)	Other ^a	Other ^c	39	Female	AA/B, W	Qualitative	14	Multiple	IIIC
Stone 2012 [¶] (45)	Other ^a	Other ^c	36–72	Female	AA/B, AA, W, O	Qualitative	35	Chicago, IL	IIIB
McDonnell 2019 (35)	I, II, III	Other ^c	54	Female	AA/B	Qualitative	26	Multiple	IIIA

[†], Health care access and quality; [¶], Neighborhood & built environment; [§], Education access and quality. ^aOther, Stage of disease information not provided; ^bOther, Deceased. ^cOther, Treatment type information not provided; ^dOther, Standard care including curative or palliative treatment. C, chemotherapy; R, radiation; S, surgery; W, White; AA/B, African American or Black; AA, Asian American; H/L, Hispanic/Latino; NA, Native American; PI, Pacific Islander including Hawaiian; O, Other groups.

of African American/Black females (35) and two articles focused primarily on White male caregivers (36,37).

Evidence level and quality assessment

Overall, studies included in this review revealed variations in evidence levels and the quality of the assessments (see *Tables 1,2*). Most of the studies were rated as either “high quality” or “good quality” with 42% of the studies classified with an A-rating (“high quality”) and 53% of the studies classified with a B-rating (“good quality”). Only one study (5%) was assigned a C-rating, indicating a “low quality or major flaws” distinction. In terms of evidence levels, 63% of studies demonstrated level III evidence and 37% level II evidence.

Four general themes were observed across articles on the

influence of SDOH on FCG-centered outcomes in lung cancer: (I) overall quality of life, (II) relationship quality including spirituality, (III) psychological well-being, and (IV) financial toxicity.

Theme 1: overall QOL of FCGs

Four papers focused on the overall QOL of FCGs, with two papers exploring the relationship of race with caregiving. It is well documented that FCGs provide significant clinical care including treatment related side effects management for newly diagnosed lung cancer patients without training (38). McDonnell and colleagues reported family members need basic education, skills training, and support related to the lung cancer diagnosis and other cancers (35). Current methods to provide these services are limited in their accessibility, availability, and effectiveness. FCGs

Table 2 Health care access and quality domain & economic stability studies on lung cancer family caregivers

Primary author & year	Patient characteristics		Family caregiver characteristics			Study characteristics			
	Stage of disease	Treatment type	Age, years (range or mean)	Sex or gender (majority)	Race/ethnicity	Study design	Sample size	Location	Evidence level & quality
Health care access and quality domain									
Litzelman 2016 [‡] (36)	I, II, III, IV	C, R, S	20–71	Male	W, O	Cross Sectional	689	Multiple	IIIB
Martin 2012 (40)	I, II, III, IV	Other ^b	Other ^c	Female	AA/B, W	Cohort	607	Multiple	IIIA
Mosher 2013 [‡] (49)	I, II, III, IV	C, R, S	29–80	Female	AA/B, W, O	Cross Sectional	83	Multiple	IIIB
Mosher 2015 [‡] (50)	I, II, III, IV	C, R, S	53	Female	AA/B, W, O	Qualitative	21	New York, NY	IIIA
Williams 2012 [‡] (42)	Other ^a	C	52.3	Female	AA/B, AA, W, O	Qualitative	135	New Haven, CT	IIIB
Zhang 2012 (47)	II, III, IV	C, R, S	49–57	Female	AA/B, W	Cross Sectional	199	Cleveland, OH	IIA
Economic stability domain									
Van Houtven 2010 [‡] (52)	I, II, III, IV	C, R, S	Other ^c	Female	AA/B, H/L, W, O	Cross Sectional	865	Multiple	IIA
Mosher 2013 [‡] (53)	I, II, III, IV	C, R, S	29–80	Female	AA/B, W, O	Cross Sectional	83	Multiple	IIB

[‡], Social and community context. ^aOther, Stage of disease information not provided. ^bOther, Treatment type information not provided. ^cOther, age range/mean information not provided. C, chemotherapy; R, radiation; S, surgery; W, White; AA/B, African American or Black; AA, Asian American; H/L, Hispanic/Latino; NA, Native American; O, Other groups.

contributions to improving the patients' overall QOL are also often at the detriment of their own health, decreased economic mobility, and increased caregiving burden as they are also caring for other family members (38,39). In addition, racial disparities in the caregiving experience exist and despite greater preparedness for the caregiving role African American caregivers reported more weekly hours caregiving than whites (35,40). African American FCGs experience several stressors compounded with lack of access to resources (e.g., education, skills training) to support their caregiving roles (35). As discussed by Grant *et al.* (39) interventions to improve caregiver outcomes should include a holistic model of care that incorporates QOL domains (physical, psychological, social, spiritual well-being), addresses caregiver burden, provides skills training, and a self-care plan.

Theme 2: relationship quality

The role of a caregiver can impact an individual's quality of relationships on multiple levels, including relationships

with family, friends, healthcare providers, and a higher power expressed through their spiritual journeys. Nine papers discussed the role of relationship quality in the lives of family caregivers of lung cancer patients, with two papers further exploring relationships with spirituality. While many caregivers of patients with lung cancer experience negative physical and mental health effects, relations with family members improved for a substantial minority of caregivers (41,42). Williams *et al.* reported that some caregivers found positive outcomes from the overall cancer experience, such as the opportunity to prioritize and develop new relationships, collaborate as a family, and practice better communication (42). Conversely, Kramer *et al.* reported that family conflict was found to be higher in family dynamics with a history of prior conflict (43,44). In addition, Kramer *et al.* also reported caregivers of patients with greater physiological and clinical care needs, and shared decision-making challenges were more likely to have greater family conflict (44). Further, older age was associated with less social stress, and better family functioning, but worse relationship

quality while caring for a female patient was associated with less social stress and better relationship quality, but worse family functioning (37). For some, understanding the child-parent relationship in the context of the illness balanced with the consideration of other family members' perspectives and coping with the caregiving role posed additional relationship challenges (45). In addition to fostering relationships with family and friends, many caregivers turned to faith for comfort. Most caregivers found solace in religious practices, especially prayer (42). The strongest associations with low confidence in surrogate decision-making were low spiritual growth self-care and high use of avoidant coping (46). Moreover, Zhang *et al.* reported avoidant behavior demonstrated racial differences around end-of-life decision making, care and communication (47).

Theme 3: psychological well-being

Five articles describe the psychological well-being of caregiving with an emphasis on the negative health impact for FCGs due to various sociodemographic factors. As an important member of the treatment team, caregivers' health and psychological well-being are often correlated with how patients with cancer perceive their care (36). For example, when caregivers reported fair or poor self-related health, patients were more than three times more likely to report fair or poor perceived quality of care. Distinct from the patient's well-being, FCGs experience significant psychological stressors resulting in negative health outcomes related to several sociodemographic factors including ethnicity (48), education (48,49), stigma associated with mental health service use (50) and distance (51). Caregivers of patients receiving curative treatment (chemotherapy) have lower rates of depressive symptoms, but greater negative health impact related to the length of time in their caregiving role (median, 6.5 months) (48). Latino caregivers had significantly higher depressive symptoms than non-Latino caregivers, but additional research is warranted to understand the clinical significance of these findings with a larger sample. Caregivers with less than a college degree were more likely to have increased depressive symptoms indicating a mediating effect between lower socioeconomic status and negative psychological health outcomes. Greater levels of education (mean of 15 years) were also associated with the use of mental health services and complementary and alternative medicine methods to reduce caregiver burden (49). Additionally, Mosher and colleagues concluded caregivers perceived a conflict between mental health services use and the caregiving role

(prioritizing the patients' needs) (50). Although caregivers denied stigma associated with service use, their anticipated negative self-perceptions if they were to use services suggest that stigma may have influenced their decision to not seek services. Furthermore, Mazanec *et al.*, denoted distance caregivers (individuals who reside 100 miles from patient) of lung cancer patients diagnosed with advance lung cancer experience similar stressors as local caregivers in addition to unique psychosocial stressors due to geographic distance (51).

Theme 4: financial toxicity

Two articles described the significant economic burden experienced by caregivers of lung cancer patients. Most FCGs of lung cancer patients experienced one or more adverse economic or social changes since the patient's illness (52,53). Caregiving can be costly to family members in terms of both time and money (52). Caregivers often sacrifice both leisure time and time that could be spent working for pay. A substantial minority of caregivers lose their main source of family income or make a major change (e.g., delaying medical care for another family member) in family plans due to the cost of the illness (53). Other caregivers reported family members made major life changes (e.g., quit work) to care for the patient or their family lost most or all their savings since the patient's illness (53). Van Houtven *et al.*, concluded the loss of major source of family income was also associated with the patient's receipt of surgery (52). Additionally, the economic burden was higher for caregivers of patients diagnosed at stage 4 versus stage 1; and spouses faced higher economic burden than other relatives or friends.

Discussion

This systematic literature review provides a broad overview of the relationship between SDOH and lung cancer outcomes for FCGs. While SDOH factors account for nearly 80% of an individual's health status (31), researchers continue to focus largely on social and community context, health care access and quality, and economic stability domains (19). FCGs remain an understudied group in oncology research, although they often experience the burden of SDOH related health outcomes which in turn often leads to poor health and decreased QOL (54). While most studies on FCGs focused on social and community context, there were no studies on the effect of the neighborhood and built environment and minimal context on the role of educational access. The lack of attention on FCGs' experiences within

the health care system was disconcerting, considering the significant role of caregiving on QOL for this population (40,42,49,50). Future studies should explore the unmet needs of FCGs in navigating the health care system in relation to time spent caregiving, shared decision-making processes with providers, and the potential health implications for themselves.

The social and community context domain focused on QOL experiences of FCGs from a single time point, which minimizes generalizability. Moreover, we found increased psychosocial stressors due to several sociodemographic factors that are critical to understanding the social and environmental determinants of QOL outcomes for FCGs that are also understudied (36,48-51). While some patients are living longer because of screening and treatment advancements for lung cancer, the negative long-term effects of caregiving have not been studied extensively (55,56). For instance, FCGs who reported negative caregiving experiences reported worse physical and mental health effects 10 years after the patient's initial diagnosis (55). Importantly, conclusions based on the current evidence are applicable to predominantly non-Hispanic White female FCGs. It's critical to include underrepresented minorities and historically excluded groups in future research efforts as the patients and FCGs in these groups have the greatest cancer burden and lower QOL.

Spirituality has been shown to improve QOL for cancer patients and FCGs (57-59). Two studies included the observational (cohort and qualitative study designs) impact of spirituality on psychological well-being across multiple stages of the disease (42,46). FCGs used spirituality as a primary source of support to cope with treatment, survivorship, and end of life experiences. African American/Black female FCGs used faith as a primary source of social support (35). Spirituality has been shown to encourage social cohesion (28,29); and understanding its usage in intervention planning and development may improve QOL outcomes for FCGs.

Financial toxicity is also common among patients and FCGs during and after treatment; this in turn may impact access to care, clinical outcomes and QOL. FCGs experience considerable economic burdens related to their caregiving role (52,53); however, this area of study is underdeveloped and warrants additional research. Importantly, none of the studies in this review included research on neighborhood and built environment. The increased risk of environmental toxicants from residential (60-62) and occupational (63,64) settings and lung cancer diagnosis

for patients are discussed in the literature. While evidence suggests that educational attainment equates to a healthier and longer life (4), and low attainment is associated with treatment delays, functional impairment and poor QOL in lung cancer patients (65-67), no articles focused on this domain for FCGs. Extensive variations in the measure of education in the field of social science exists, in that education can be measured by years of completion, highest education qualification, or highest degree achieved (68). Future research should consider selection of commonly used measures individually and combined when analyzing the impact of educational attainment on health outcomes for lung cancer patients and FCGs.

Validated instruments are critical to our understanding of education, spirituality and other SDOH factors on FCG centered outcomes. They also ensure researchers are measuring intended study variables, minimizing researcher bias and subjectivity (69). Demographic variables such as age, sex or gender, race/ethnicity, education level, marital status, employment status, income, and health insurance status were primarily used across the studies in this review to provide some context of the populations' social position. This was expected, as efforts to standardize SDOH data collection tools and integration of these tools into primary care settings are recent (70). The field should move toward data collection strategies that include standardized tools such as the Protocol for Responding to and Assessing Patients' Assets, Risks, and Experiences (PRAPARE), Health Begins' Upstream Risks Screening Tool, the Accountable Health Communities Health-related Social Needs Screening Tool or include tools from the Patient-Reported Outcomes Measurement Information System (PROMIS) to provide critically needed information regarding social needs for lung cancer patients and their FCGs ([Appendix 2](#)). Further exploration of the unmet needs of FCGs across all SDOH domains using both qualitative (e.g., focus groups and key informant interviews) and quantitative approaches is clearly warranted.

Limitations and strengths

There are several limitations that should be considered in the interpretation of the results from this systematic literature review. Since we added a quality assessment component, the Johns Hopkins Nursing Evidence-Based Practice Rating Scale (34), we were able to report the quality of studies and the level of evidence varied widely. As the research on SDOH continues to evolve, the field

should also consider testing interventions that address SDOH needs of the most vulnerable populations. We also acknowledge that the process of assigning studies to their respective domains may not have been devoid of selection bias despite the considerable actions taken by the authors to reach consensus in appropriately assigning studies (4,71) including the engagement of subject matter experts. While not within the scope of this review, we acknowledge that racial/ethnic minorities especially African American/Black and Hispanic populations are disproportionately affected by this disease but are underrepresented in this already sparse SDOH FCG literature thus warranting additional research (72,73). Lastly, we also recognize research conducted outside the U.S. is important, but due to country-level differences in social and cancer care delivery structures, we chose to only focus on studies conducted in the U.S. as SDOH factors may differ across societal infrastructures.

Despite these limitations, there are also several strengths to note. To our knowledge this is the first review to classify studies by SDOH domains for lung cancer FCGs. Secondly, the authors included a deliberate discussion on the impact of spirituality on QOL—an understudied topic in SDOH research. Thirdly, we provide context on the dearth of research on lung cancer FCGs, and the critical need to better understand QOL outcomes in future SDOH studies. Fourthly, we excluded patients only and both patients and FCG articles across several locations (see [Appendix 3](#)) to provide specificity and useful information on the current state of the literature on the impact of SDOH domains on FCG-centered outcomes in lung cancer. Finally, we bring attention to the lack of validated SDOH instruments used and provide examples of tools and resources that researchers could consider adopting to promote better measurement uniformity in SDOH research ([Appendix 2](#)).

Conclusions

There is a lack of knowledge on SDOH domains such as education quality and access, and neighborhood and built environment for FCGs. Spirituality, while important in improving QOL of FCGs, remains an underdeveloped field of study. The increased integration of validated SDOH tools in research is critical to further our understanding of QOL outcomes for lung cancer patients and their FCGs.

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Appendix 1 List of search strategies

Database: PubMed/MEDLINE (Legacy version)

- ❖ Ran on: 5/28/2020
- ❖ Number of results: 905
- ❖ Limits/Filters used:
 - ◆ Humans, English, Last 10 years
 - ◆ Publication types: Clinical Study, Clinical Trial, Clinical Trial Protocol, Comparative Study, Consensus Development Conference, Controlled Clinical Trial, Evaluation Study, Guideline, Introductory Journal Article, Meta-Analysis, Multicenter Study, Observational Study, Practice Guideline, Pragmatic Clinical Trial, Randomized Controlled Trial, Review, Scientific Integrity Review, Systematic Reviews, Technical Report, Twin Study, Validation Study
- ❖ Search strategy used:
 - ◆ ("Lung Neoplasms"[Mesh]) OR ((bronchi OR Pulmonary OR "pulmonary Alveoli" OR Lung) AND ("Carcinoma"[Mesh] OR "Sarcoma"[Mesh] OR "adenocarcinoma"[MeSH] OR adenocarcinoma OR cancer OR tumor OR tumour OR oncology OR Oncologic OR Oncological OR Malignancies OR Malignancy OR Neoplasm OR Neoplasms OR carcinoma OR sarcoma OR chemotherapy OR chemotherapeutic OR cancer[sb]))
 - ◆ AND
 - ◆ (families OR family OR parent* OR partner* OR spouse* OR family OR carer* OR caregiver* OR "Sexual Partners"[Mesh] OR "Parents"[Mesh] OR "Spouses"[Mesh] OR "Family"[Mesh] OR "Caregivers"[Mesh])
 - ◆ AND
 - ◆ (age OR gender OR education OR educat* OR ethnic OR ethnic* OR race OR race* OR culture OR language OR language* OR occupation OR social class OR socioeconomic OR health social determinants OR social determinant* OR social capital OR residence OR geograph* OR equity OR disparit* OR sociology OR social OR network OR prejudice OR insurance OR health gradient OR health gap OR vulnerable OR urban OR rural OR poverty OR wealth OR rich OR poor OR discriminat* OR demograph* OR spirituality OR faith OR religion OR stress OR economic stability OR housing OR neighborhood OR built environment OR social context OR community context OR income OR "Social Determinants of Health"[Mesh] OR "Socioeconomic Factors"[Mesh] OR "Stress, Psychological"[Mesh] OR "Gender Identity"[Mesh] OR "Sex"[Mesh] OR "Education"[Mesh] OR "Educational Status"[Mesh] OR "Economic Status"[Mesh] OR "Ethnic Groups"[Mesh] OR "Race Factors"[Mesh] OR "Continental Population Groups"[Mesh] OR "Culture"[Mesh] OR "Language"[Mesh] OR "Occupations"[Mesh] OR "Religion"[Mesh] OR "Social Class"[Mesh] OR "Social Capital"[Mesh] OR "Residence Characteristics"[Mesh] OR "Geography"[Mesh] OR "Health Equity"[Mesh] OR "Healthcare Disparities"[Mesh] OR "Sociology"[Mesh] OR "Prejudice"[Mesh] OR "Insurance"[Mesh] OR "Vulnerable Populations"[Mesh] OR "Urban Population"[Mesh] OR "Rural Population"[Mesh] OR "Poverty"[Mesh] OR "Poverty Areas"[Mesh] OR "Social Discrimination"[Mesh] OR "Demography"[Mesh] OR "Spirituality"[Mesh] OR "Housing"[Mesh] OR "Income"[Mesh])
 - ◆ NOT child

Database: Cochrane Library via <https://www.cochranelibrary.com/>

- ❖ Ran on: 5/29/2020
- ❖ Limits/Filters used: January 2010-December 2020
- ❖ Search strategy used: See attached PDF file with the search strategy details
- ❖ Number of results: 787

Database: Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus with Full Text via EBSCOhost

- ❖ Ran on: 5/29/2020
- ❖ Limits/Filters used:

- ◆ Date range: January 1, 2010-December 31, 2020
- ◆ Peer reviewed
- ◆ Human
- ◆ English language
- ◆ Subject: All adult
- ❖ Search strategy used: See attached PDF file with the search strategy details
- ❖ Number of results: 665

Database: APA PsycInfo via the Ovid platform

- ❖ Ran on: 5/29/2020
- ❖ Limits/Filters used:
 - ◆ Human
 - ◆ English language
 - ◆ Year range: 2010 -2021
- ❖ Search strategy used: See attached PDF file with the search strategy details
- ❖ Number of results: 39

Appendix 2

Social determinants of health screening tools and resources

Tool	Description	SDH Domain Assessment	Reference
Protocol for Responding to and Assessing Patients' Assets, Risks, and Experiences (PRAPARE)	21-item survey validated using the 8 "Gold Standard" stages of measure development. Available in English, Spanish, Chinese and 24 other languages	All SDH domains [†]	National Association of Community Health Centers. (2016). Retrieved from http://www.nachc.org/research-and-data/prapare
Epic version of PRAPARE Or PRAPARE-plus	13-item survey validated at three community health centers that includes adapted questions from PRAPARE, Institute of Medicine, and other validated SDH sources. Available in English and Spanish	All SDH domains [†]	Gold R, <i>et al.</i> (2017). Developing Electronic Health Record (EHR) Strategies Related to Health Center Patients' Social Determinants of Health. <i>J Am Board Fam Med.</i> 2017 Jul-Aug;30(4):428-447. doi: 10.3122/jabfm.2017.04.170046. PMID: 28720625
Health Begins Upstream Risks Screening Tool	15-item survey adapted from Institute of Medicine and the National Academies Press	All SDH domains [†]	Rishi & Gottlieb (2015). Upstream risks screening tool and guide. Retrieved from https://www.aamc.org/media/25736/download
Accountable Health Communities Health-related Social Needs Screening Tool	10-item survey used to identify unmet needs across five core domains developed using literature review and technical expert panel	All SDH domains [†]	Billioux, A., Verlander, K., Anthony, S., & Alley, D. (2017). Standardized screening for health-related social needs in clinical settings: the accountable health communities screening tool. <i>NAM Perspectives.</i>
WellRx	11-item survey validated in 3048 patients in 3 family medicine clinics in New Mexico	All SDH domains [†]	Page-Reeves J., <i>et al.</i> (2016). <i>Journal of the American Board of Family Medicine</i> , 29(3), 414–418. 10.3122/jabfm.2016.03.150272
Social Determinants of Health by US Census Tract	47-variables including race/ethnicity, education, socioeconomic status, racial residential segregation poverty level with 73,056 records using 2010 census tract and the American Community Survey data	All SDH domains [†] except Health Care Access and Quality	National Cancer Institute. (2021). Social determinants of health by US census tract. Retrieved from https://healthcaredelivery.cancer.gov/social-determinants/
Patient-Reported Outcomes Measurement Information System (PROMIS)	Over 300 measures of health outcomes including physical, mental, and social well-being for adult and pediatric populations. Available in multiple languages including English, Spanish, French, Xhosa, Bengali, Czech	Health Care Access and Quality, Social and Community Context	Ader DN. Developing the patient-reported outcomes measurement information system (PROMIS). <i>Medical care.</i> 2007 May 1;45(5):S1-2. doi: 10.1097/01.mlr.0000260537.45076.74

[†]SDH framework includes five broad domains: economic stability, education access and quality, neighborhood and built environment, healthcare access and quality, and social and community context.

Appendix 3

Economic Stability Domain Studies on Lung Cancer Patients and Family Caregivers (FCGs)

Primary author & year	Study design	Location	Population	Sample size	Evidence level & quality
Barbaree 2019 (1)	Cross sectional	Other: Europe & North America	Patients	74	IIIB
Adorno 2017 [†] (2)	Cross Sectional	North America	Patients	30	IIB
Dalton 2015 [§] (3)	Cohort	Europe	Patients	13045	IIIB
Hovanec 2018 [†] (4)	Other: Case Control	Other: Europe and North America	Patients	17021	IIA
Behrens 2016 [†] (5)	Cohort	Europe	Patients	25580	IIIB
Cai 2011 [†] (6)	Cross Sectional	Asia	Patients	108	IIIB
Nicolau 2019 (7)	Other: Case Control	North America	Patients	761	IIIA
Bensenor 2012 [†] (8)	Cross Sectional	South America	Patients	14566	IIA
Zhou 2017 [†] (9)	Other: Administrative Data	Asia	Patients	34678	IIIA
Shilling 2017 [†] (10)	Qualitative	Europe	Both	6 dyads	IIIA
Forrest 2015 [†] (11)	Cohort	Europe	Patients	22967	IIIA
Lee 2018 [†] (12)	Cross Sectional	Asia	Both	150 dyads	IIA

Secondary domain assignments: [†]Health care access and quality; ^{*}Social and community context; [§]Education access and quality.

Education Access and Quality & Neighborhood and Built Environment Domain Studies on Lung Cancer Patients

Primary author & year	Study design	Location	Population	Sample size	Evidence level & quality
Education Access and Quality Domain Studies					
Verma 2018 [§] (13)	Qualitative	Australia	Patients	252	IIIB
Billmeier 2013 (14)	Cohort	North America	Patients	1007	IIIA
Nipp 2018 [†] (15)	Cross Sectional	North America	Patients	234	IIA
Neighborhood and Built Environment Domain Studies					
Consonni 2015 (16)	Cohort	Europe	Patients	599	IIIB
Nakano 2019 (17)	Cross Sectional	Asia	Patients	4	IIIC
Brenner 2010 [†] (18)	Cross Sectional	North America	Patients	445	IIIB
Petitte 2014 (19)	Non-Randomized Control Trial	North America	Patients	10	IIIC
Torres-Durán 2014 (20)	Other: Case control	Europe	Patients	192	IIB
Rodríguez-Martínez 2017 (21)	Other: Case Control	Europe	Patients	113	IIIA
Torres-Durán 2016 [§] (22)	Other: Case Series	Europe	Patients	19	IIIB
Wang 2016 (23)	Cohort	North America	Patients	2148	IIA
Goodridge 2010 [#] (24)	Cohort	North America	Patients	483	IIIA
Torres-Durán 2015 [†] (25)	Other: Case Control	Europe	Patients	216	IIIB
Sawicki 2013 [†] (26)	Cross Sectional	Europe	Patients	300	IIA
Bracci 2012 [†] (27)	Other: Case-Control	North America	Patients	338	IIB

Secondary domain assignments: [†]Health care access and quality; ^{*}Social and community context; [#]Economic stability; [§]Neighborhood and built environment.

Health Care Access and Quality Domain Studies on Lung Cancer Patients and Family Caregivers (FCGs)

Primary author & year	Study design	Location	Population	Sample size	Evidence level & quality
Lee 2016 [†] (28)	Cohort	North America	Both	13 dyads	IIIB
Sun 2017 (29)	Other: Quasi-Experimental	North America	Both	38 Patients; 22 FCGs	IIB
Bakitas 2017 [†] (30)	Qualitative	North America	Both	24 Patients; 20 FCGs	IIIB
Gustafson 2013 (31)	Randomized Controlled Trial	North America	Both	285 dyads	IA
Brady 2018 (32)	Cross Sectional	North America	Patients	72	IIB
Husain 2013 (33)	Cross Sectional	North America	Patients	116	IIA
Lee 2018 (34)	Cross Sectional	Other: Europe, Australia, Asia, South America	Patients	1,140	IIIB
Lynch 2010 (35)	Other: Clinical Audit	Europe	Patients	34	IIIB
Roulston 2013 (36)	Qualitative	Europe	Patients	52	IIIB
Wright 2016 [†] (37)	Cross Sectional	North America	Both	886 dyads	IIA
Bailey 2016 (38)	Qualitative	Europe	Both	24 Patients; 20 FCGs	IIIB
Ermers 2019 (39)	Cohort	Europe	Patients	95	IIB
Jarosek 2016 [#] (40)	Cohort	North America	Patients	22,558	IIIA
Falchook 2017 (41)	Cross Sectional	North America	Patients	12,764	IIA
Hanratty 2012 [#] (42)	Qualitative	Europe	Patients	13	IIIB
Ellis 2012 (43)	Qualitative	Europe	Both	37 Patients; 23 FCGs	IIIB
Schook 2014 [†] (44)	Qualitative	Europe	Both	5 Patients; 20 FCGs	IIIB
Sikjær 2018 (45)	Cohort	Europe	Patients	20,787	IIA
Rose 2017 (46)	Cohort	Europe	Patients	20	IIB
Baumgardner 2018 (47)	Cohort	North America	Patients	14,380	IIA
Aubin 2011 [†] (48)	Cohort	North America	Patients	395	IIIB
Goulart 2013 (49)	Cohort	North America	Patients	28,977	IIIA
Lee 2019 (50)	Cross Sectional	Asia	Patients	118	IIIB
Eichler 2019 [†] (51)	Cross Sectional	Europe	Patients	604	IIIB
Shen 2016 [†] (52)	Cross Sectional	North America	Patients	231	IIIA
Bülbül 2017 [†] (53)	Cross Sectional	Other: Turkey	Patients	1,202	IIIB
Ellis 2017 (54)	Randomized Controlled Trial	North America	Both	70 dyads	IIIC
Billmeier 2011 (55)	Cohort	North America	Patients	679	IIB
Shi 2015 [†] (56)	Cross Sectional	Asia	Patients	104	IIA
Fukumoto 2015 (57)	Other: Case-Control	Asia	Patients	625	IIA
Nababan 2020 (58)	Qualitative	Australia	Patients	47	IIIA
Parsonage 2017 (59)	Qualitative	Europe	Patients	121	IIIB
Stegmann 2019 (60)	Qualitative	Europe	Patients	20	IIIB
Jacobsen 2011 [†] (61)	Randomized Controlled Trial	North America	Patients	67	IA
Pirl 2012 (62)	Randomized Controlled Trial	North America	Patients	151	IC
Temel 2017 [†] (63)	Randomized Controlled Trial	North America	Patients	191	IA

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Primary author & year	Study design	Location	Population	Sample size	Evidence level & quality
Walton 2013 (64)	Qualitative	Other: New Zealand	Patients	20	IIIB
Burt 2010 [*] (65)	Cross Sectional	Europe	Both	252 Patients; 135 FCGs	IIIB
Xiu 2020 (66)	Randomized Controlled Trial	Asia	FCGs	157	IC
Yennurajalingam 2018 (67)	Cross Sectional	North America	Patients	468	IIIB
Ellis 2017 (68)	Qualitative	Europe	Both	11 Patients; 3 FCGs	IIIC
Ledderer 2014 (69)	Qualitative	Europe	Both	5 dyads	IIIC
Owens 2020 (70)	Qualitative	North America	Both	6 dyads	IIIC
Bigay-Gamé 2018 (71)	Cohort	Europe	Patients	146	IIA
Banik 2017 (72)	Other: Longitudinal	Europe	Patients	102	IIB
Hanratty 2012 [*] (73)	Qualitative	Europe	Patients	14	IIIB
Patel 2016 ^{&} (74)	Cohort	North America	Patients	1,044	IIA
Park 2012 [*] (75)	Cohort	North America	Patients	2,456	IIIA
Wiljer 2012 (76)	Cross Sectional	North America	Patients	95	IIIB
George 2010 (77)	Qualitative	North America	Patients	10	IIIB

Secondary domain assignments: ^{*}Social and community context; [#]Economic stability; [&]Education access and quality.

Social and Community Context Domain Studies on Lung Cancer Patients and Family Caregivers (FCGs)

Primary author & year	Study design	Location	Population	Sample size	Evidence level & quality
Manne 2012 (78)	Cohort	Australia	Both	77 dyads	IIIB
Milbury 2012 (79)	Cohort	North America	Both	169 patients; 167 FCGs	IIIB
Hobbs 2015 [†] (80)	Cohort	North America	Both	2932 dyads	IIIA
Milbury 2013 [#] (81)	Cohort	North America	Both	158 dyads	IIIB
Ersek 2017 (82)	Cohort	North America	Both	847 dyads	IIIB
Loh 2019 [†] (83)	Cohort	North America	Both	88 dyads	IIIB
Lee 2019 (84)	Cohort	North America	Both	113 dyads	IIIB
Litzelman 2016 (85)	Cohort	North America	Both	689 dyads	IIIA
Douglas 2013 (86)	Cohort	North America	Both	65 dyads	IIIB
Garlo 2010 (87)	Cohort	North America	Both	179 dyads	IIIB
DuBenske 2010 (88)	Cohort	North America	Both	72 dyads	IIIB
Buchanan 2010 (89)	Cohort	Europe	Patients	170	IIB
Lau 2018 (90)	Cohort	North America	Patients	1366	IIIB
Jacobs 2017 (91)	Cohort	North America	Both	191 dyads	IIIB
Lyons 2016 (92)	Cohort	North America	Patients	78	IIB
Oh 2019 (93)	Cross Sectional	Asia	Both	150 dyads	IIA
Cooley 2013 (94)	Cross Sectional	North America	Both	37 dyads	IIB

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Primary author & year	Study design	Location	Population	Sample size	Evidence level & quality
Zhang 2010 [†] (95)	Cross Sectional	North America	Both	184 Patients; 171 FCGs	IIA
Leydon 2012 (96)	Cross Sectional	Other: Africa, Europe, Asia	Both	113 Patients; 70 FCGs	IIIB
Madani 2018 (97)	Cross Sectional	Asia	Patients	25	IIIB
Hung 2018 [§] (98)	Cross Sectional	Asia	Patients	159	IIA
Dogan 2019 (99)	Cross Sectional	Europe	Patients	55	IIIB
Akin 2010 [†] (100)	Cross Sectional	Other: Asia and Europe	Patients	154	IIB
Nipp 2016 (101)	Cross Sectional	North America	Both	149 dyads	IIA
Kramer 2010 [†] (102)	Cross Sectional	North America	Both	155 dyads	IIB
Ostlund 2010 (103)	Cross Sectional	Europe	FCGs	84	IIIB
Malik 2013 (104)	Cross Sectional	Europe	FCGs	50	IIIB
Chen 2016 [†] (105)	Cross Sectional	Asia	Both	166 dyads	IIIB
Hu 2018 (106)	Cross Sectional	Asia	Both	116 dyads	IIIB
Lobchuk 2012 (107)	Cross Sectional	North America	Both	304 dyads	IIIA
Miller 2017 (108)	Cross Sectional	North America	Both	109 dyads	IIB
Porter 2012 (109)	Cross Sectional	North America	Both	127 dyads	IIIA
Wood 2019 (110)	Cross Sectional	Europe	FCGs	427	IIA
Lee 2013 [†] (111)	Cross Sectional	Asia	Both	106 dyads	IIA
Martin 2014 [#] (112)	Cross Sectional	North America	Patients	1773	IIIA
Chang 2015 [§] (113)	Cross Sectional	Asia	Patients	231	IIIB
Hechtner 2019 [†] (114)	Cross Sectional	Europe	Patients	555	IIIA
Skalla 2015 (115)	Cross Sectional	North America	Patients	15	IIIC
Cykert 2019 (116)	Other: Non-Randomized Control Trial	North America	Patients	3201	IIA
Borneman 2015 (117)	Other: Non-Randomized Control Trial	North America	Both	272 Patients; 203 FCs	IIA
Nguyen 2017 (118)	Other: Non-Randomized Control Trial	North America	Both	170 Patients; 156 FCGs	IIA
Li 2019 [†] (119)	Other: Non-Randomized Control Trial	Asia	Both	67 dyads	IIB
Milbury 2015 (120)	Other: Non-Randomized Control Trial	North America	Both	15 dyads	IIB
Milbury 2018 (121)	Other: Non-Randomized Control Trial	North America	Both	7 dyads	IIC
Sun 2016 (122)	Other: Quasi-Experimental	North America	Both	475 Patients; 354 FCGs	IIB
Lindau 2011 (123)	Qualitative	North America	Both	13 dyads	IIIA

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Primary author & year	Study design	Location	Population	Sample size	Evidence level & quality
Lowson 2013 [†] (124)	Qualitative	Europe	Patients	14	IIIC
Ngwenya 2016 (125)	Qualitative	Europe	Both	20 Patients; 17 FCGs	IIIB
Occhipinti 2018 (126)	Qualitative	Australia	Both	16 Patients; 12 FCGs	IIIB
Ewing 2016 (127)	Qualitative	Europe	Both	20 Patients; 17 FCGs	IIIB
Sihombing 2019 (128)	Qualitative	Asia	FCGs	9	IIIB
Steinval 2011 (129)	Qualitative	Europe	FCGs	11	IIIB
Bottorff 2015 (130)	Qualitative	North America	FCGs	30	IIIB
Pardon 2012 (131)	Qualitative	Europe	Patients	85	IIIB
Pardon 2010 (132)	Qualitative	Europe	Patients	126	IIIA
Feliciano 2018 (133)	Qualitative	North America	Patients	17	IIIB
Pusa 2012 (134)	Qualitative	Europe	FCGs	11	IIIA
Ólafsdóttir 2018 [†] (135)	Qualitative	Europe	Both	7 Patients; 5 FCGs	IIIB
Hendriksen 2015 (136)	Qualitative	North America	Both	10 Patients; 5 FCGs	IIIB
Sjolander 2012 (137)	Qualitative	Europe	FCGs	17	IIIC
Villalobos 2018 (138)	Qualitative	Europe	Both	9 dyads	IIIB
McDonnell 2020 (139)	Qualitative	North America	Both	26 dyads	IIIC
McDonnell 2019 (140)	Qualitative	North America	Both	26 dyads	IIIB
Granger 2019 [†] (141)	Qualitative	Australia	Patients	7	IIIA
Kyte 2019 [§] (142)	Qualitative	Europe	Patients	14	IIIB
Wittenberg 2018 (143)	Pilot	North American	FCGs	20	IIIB
Chih 2013 [†] (144)	RCT	North America	FCGs	118	IA
DuBenske 2014 (145)	RCT	North America	FCGs	285	IA
Shaffer 2017 ^{&} (146)	RCT	North America	FCGs	275	IA
Namkoong 2012 [†] (147)	RCT	North America	FCGs	246	IB
Bastian 2013 [†] (148)	RCT	North America	FCGs	496	IA
Mosher 2019 (149)	RCT	North America	Both	50 dyads	IC
Schellekens 2017 (150)	RCT	Europe	Both	63 Patients; 44 FCGs	IB
Northouse 2013 (151)	RCT	North America	Both	141 dyads	IA
Porter 2011 (152)	RCT	North America	Both	233 dyads	IA
Winger 2018 [†] (153)	RCT	North America	Both	51 dyads	IC
Chen 2017 (154)	RCT	Asia	Both	132 dyads	IA

Secondary domain assignments: [†]Health care access and quality; [#]Economic stability; [§]Neighborhood and built environment; [&]Education access and quality.

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