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Review article

Social isolation in people with type 2 diabetes: A concept analysis

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ABSTRACT

Objective: To identify the defining attributes, antecedents, consequences and empirical referents to form an operational definition of social isolation in people with type 2 diabetes.
Design: The Walker and Avant approach.
Data source: An electronic search of the literature using China National Knowledge Infrastructure (CNKI), Wanfang database, PubMed, Web of Science, CINAHL, and PsycINFO informed the analysis. The search included both quantitative and qualitative studies related to social isolation in people with type 2 diabetes published in Chinese and English.
Results: Of the 2918 articles identified, 21 ultimately met the inclusion criteria. The analysis identified the defining attributes of social isolation in people with type 2 diabetes as objective and subjective. Antecedents included five aspects: personal characteristics, disease-related physiological factors, and psychological, behavioral, and social factors. Consequences were identified as physiological, psychological, behavioral aspects and quality of life.
Conclusions: The operational definition of social isolation in people with type 2 diabetes is that due to personal characteristics, disease-related physiological factors, and psychological, behavioral, and social factors, people with type 2 diabetes will have limited social networks and social support, reduced social contact and social involvement, and/or negative feelings of disconnection from the outside world, which lead to adverse physiological, psychological, and behavioral outcomes and poor quality of life. Clinicians can further develop tools to measure social isolation in people with type 2 diabetes and analyze the path of the antecedents to social isolation to investigate the interplay between them in order to develop target interventions.

1. Introduction

Social isolation was first proposed in 1979 when researchers investigated the relationship between social relationships and mortality in older adults. It was initially considered as an objective state of reduced social networks and lack of social relationships [1]. With the deepening of research, the concept of social isolation is constantly refined. An increasing number of scholars have begun to pay attention to the social isolation of people with chronic diseases. People with diabetes mellitus, whether type 1 or type 2, need to use antidiabetic drugs and adhere to diet therapy, which will reduce their communication and interaction with others [2]. Compared to type 1 diabetes, type 2 diabetes often occurs in the middle-aged and elderly population. These patients usually have different social roles, and their social network members come from a wide range of sources, including family, relatives, friends and colleagues. Therefore, the size and connectivity of their social networks are more subject to change than those of people with type 1 diabetes. In

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addition, the possible poor self-management behaviors, suboptimal blood glucose control and vascular complications increase the likelihood for people with type 2 diabetes to keep a distance from others and have less contact with others [3]. Previous studies have found that people with type 2 diabetes in severe disease situations had less contact with social networks and were less likely to receive social support than those with type 1 diabetes [4]. Therefore, people with diabetes, especially type 2 diabetes, are at a high risk for social isolation. It has been reported that the prevalence of social isolation in people with type 2 diabetes is between 22.7 % and 41.3 % [5–8]. Social isolation increases the risk of cardiovascular diseases and stroke in people with diabetes, which is the main cause of death in those patients [9]. It will also cause negative emotions such as depression and loneliness, which in turn affect patients' treatment adherence and self-management behaviors, leading to suboptimal glycemic control. Therefore, the social isolation of people with type 2 diabetes deserves further investigation.

A comprehensive description of the concept is vital to gain an in-depth understanding of the phenomenon associated with the concept. The definition of social isolation is evolving since it was proposed. As mentioned earlier, social isolation was defined as an objective state of reduced social networks and lack of social relationships when it was first proposed [1]. Researchers continued to study social isolation by including subjective levels in different definitions [10]. According to Cornwell and Waite [11], social isolation encompassed different dimensions, namely, objective and subjective social isolation. Objective social isolation reflected the *quantitative* aspect of social relationships, which referred to the reduction of connections between individuals and others, manifested as limited social networks and support; subjective social isolation reflected the *quality* level of social relationships, which referred to the perceived lack of social support by individuals, manifested as loneliness, and can be reflected through their subjective experience of a shortage of social resources (such as companionship and support). As research expands, the concept of social isolation gradually presents a state of interweaving subjective and objective dimensions [12]. An increasing number of studies have supplemented subjective feelings such as loneliness on the basis of the initial concept [13,14]. However, there are still some studies that have only discussed social isolation at an objective level, completely separating loneliness and other related subjective concepts from social isolation [15,16]. To date, researchers have not yet formed a comprehensive description of social isolation when taking both objective and subjective attributes into account.

Concept analysis is an effective method to clarify concepts that involve multiple disciplines and are widely used but have vague meanings, and concepts are constantly integrated in a rigorous way in the process of concept analysis [17]. The classic concept analysis strategy of Walker and Avant has been widely used in the field of nursing research [17]. Using the structured method of Walker and Avant enables conceptual clarity to be obtained based on an inductive identification of the concept's attributes, antecedents and consequences. In 2009, Nicholson [18] analyzed the concept of social isolation in older adults and identified five related attributes: the number of contacts, sense of belonging, enriching the relationship, interaction with others and the quality of the network members. The author defined social isolation as a kind of individual lack of social belonging, and social interaction and social relations quality are not high. Although the analysis gave a clear definition of social isolation, it only included the objective dimension. Moreover, it described social isolation in older adults in general, and was not disease specific.

As mentioned previously, people with type 2 diabetes are a high-risk group for social isolation, not only because they are mostly older adults, but also because of the characteristics of diabetes itself. To date, researchers have not yet formed a comprehensive description of social isolation when using it among people with type 2 diabetes, especially when taking both objective and subjective attributes into account. Understanding the concept of social isolation in people with type 2 diabetes is an important step to develop a scale to measure the phenomenon and develop target interventions to alleviate social isolation. To this end, we undertook a concept analysis by using the framework of Walker and Avant [17] to identify the defining attributes, antecedents, consequences and empirical referents to develop an operational definition of social isolation in people with type 2 diabetes. Clinicians can further develop tools to measure social isolation in people with type 2 diabetes based on the operational definition developed by our concept analysis. Clinicians can also analyze the path of the antecedents to social isolation to investigate the interplay between them to develop target interventions.

2. Methods

In line with our research objective, Walker and Avant's approach [17] was adopted for the current concept analysis. This approach includes the following eight steps: 1) selecting a concept; 2) determining the aims or purposes of analysis; 3) identifying all uses of the concept; 4) determining the defining attributes of the concept; 5) constructing a model case; 6) constructing borderline, related, and contrary cases; 7) identifying antecedents and consequences; and 8) defining empirical references. We have justified the selection of social isolation in people with type 2 diabetes as the targeted concept as well as the aim of the analysis in the introduction section. Next, we will identify all uses of social isolation in people with type 2 diabetes through a comprehensive literature review, and further determine its defining attributes, antecedents, consequences and empirical referents. We will also construct a model case and additional cases to demonstrate what the concept is and what the concept is not.

2.1. Data sources

Electronic databases including the China National Knowledge Infrastructure (CNKI), Wanfang database, PubMed, Web of Science, CINAHL and PsycINFO were utilized to identify relevant studies about social isolation in people with type 2 diabetes from the introduction of the concept of social isolation in 1979 to April 1, 2023. The search was carried out with "diabetes", " social isolation", "social exclusion", "loneliness" and other keywords using the combination of subject words and free words. In addition, we also checked the references of the retrieved literature (especially the review article) and tracked the classic literature with high cited

frequency in the early years to maximize the search results. Take the PubMed search strategy as an example (Fig. 1).

2.2. Inclusion and exclusion criteria

The original study with the theme of "social isolation of type 2 diabetes" was included, including subjective or objective social isolation. Also, an eligible article should mention at least one of the relevant conceptual connotations, defining attributes, antecedents, consequences and empirical referents of social isolation in people with type 2 diabetes. Duplicates, studies published in languages other than English or Chinese, conference papers, articles published in nonpeer-reviewed journals, editorials and letters to editors and literature with no full text were excluded. In the case of various articles from the same research team, only the one with more detailed descriptions of the concept was retained.

The initial search yielded 2902 articles and 16 tracked references. After 863 duplicates were removed, 1886 articles were excluded based on titles and abstracts, and 169 were retained for further scrutiny. To ensure the eligible articles would not be left out, two authors (JW and XYB) conducted the literature screening independently. The discrepancy would be resolved by a senior researcher (YL). Following a more detailed analysis of the papers retrieved by reading the full text, in terms of their full compliance with the inclusion criteria, we included 21 articles in the final concept analysis (Fig. 2). Among them, 10 were qualitative studies, and 11 were quantitative studies. Nineteen were written in English and 2 in Chinese.

2.3. Data extraction and analysis

The literature analysis was performed based on the classical concept analysis by Walker and Avant [17]. We extracted defining attributes, antecedents, consequences, and outcome measurement indicators from the literature and construct cases to demonstrate the concept. Data collection and analysis were conducted independently by two researchers and comprehensively judged by a third researcher when there was a disagreement.

3. Results

3.1. Defining attributes

Through the review and analysis of the literature, we extracted common features of social isolation in individuals with type 2 diabetes shown in the included studies and categorized them into two parts. These factors together distinguished concepts from similar phenomena or related ones. Subsequently, it was possible to identify key defining attributes. The defining attributes of social isolation for type 2 diabetes are outlined in Fig. 3.

3.1.1. Objective

Social isolation is a structural indicator of social connection that refers to an objective and quantitative measure of network size, diversity, and interpersonal contact frequency [19]. For people with type 2 diabetes, social isolation is defined as limited social networks and social support, which manifests in a decrease in social networks or social participation, such as reduced social contact

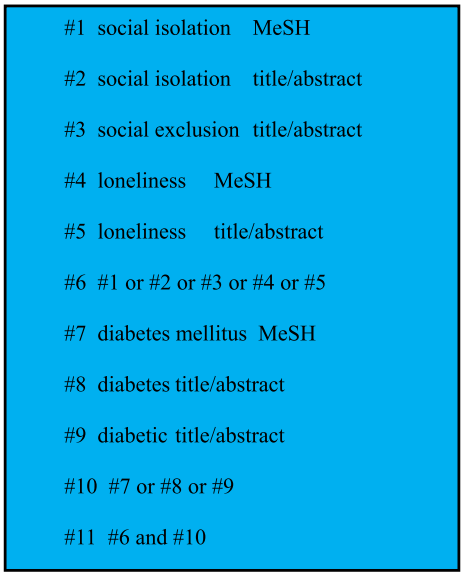

Fig. 1. PubMed search strategy.

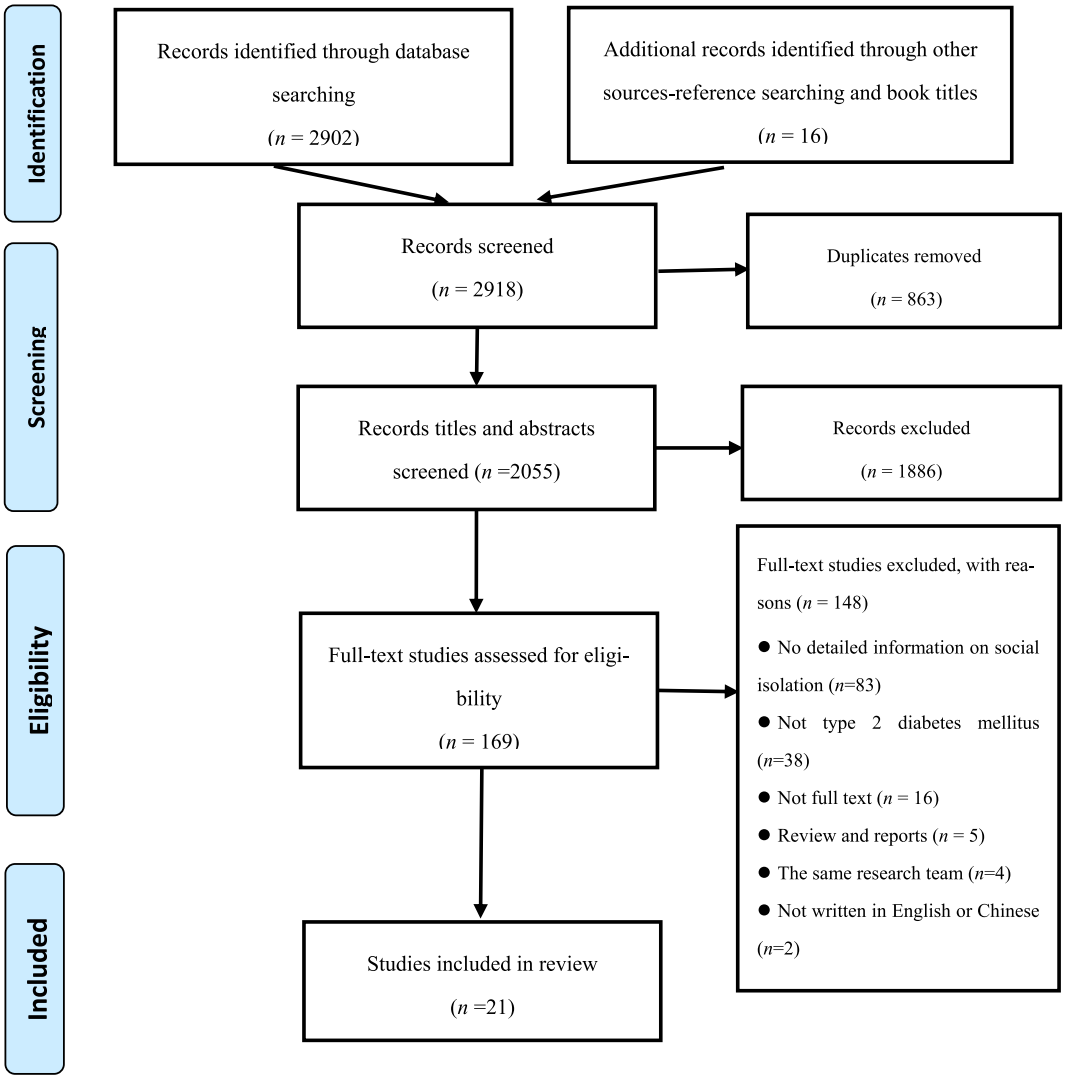

Fig. 2. PRISMA flow diagram.

with family, friends, or groups, or living alone [7,20,21]. Social isolation can also be measured and described using objective indicators. For example, Ida et al. [22] described social isolation as a state in which the frequency of interactions with others was reduced to less than once a week. Additionally, total scores of less than 12 on the Lubben Social Network Scale-6 indicate an insufficient social network, namely, social isolation [23].

3.1.2. Subjective

At a subjective level, social isolation is often described as the negative feelings or subjective experiences of people with diabetes [24,25]. For people who were diagnosed with diabetes and then changed lifestyles to treat diabetes, social isolation is an emotional toll [26]. A study showed that social isolation was a perception, and no difference was found in social isolation between patients who cohabited and those who lived alone [27]. For immigrants, they viewed their feeling of disconnection with their American neighbors as a form of what they called “home-based” isolation arising from their “foreign accent and broken English” [20] Moreover, in some qualitative studies [20,28,29] participants with diabetes always mentioned that they felt isolated, which can be concluded as being an isolated feeling.

3.2. Case construction

The following cases were all presented based on the experience and qualitative description of social isolation in people with type 2 diabetes in the included studies. These cases could help with conceptual understanding and better distinguish between similar phenomena or concepts.

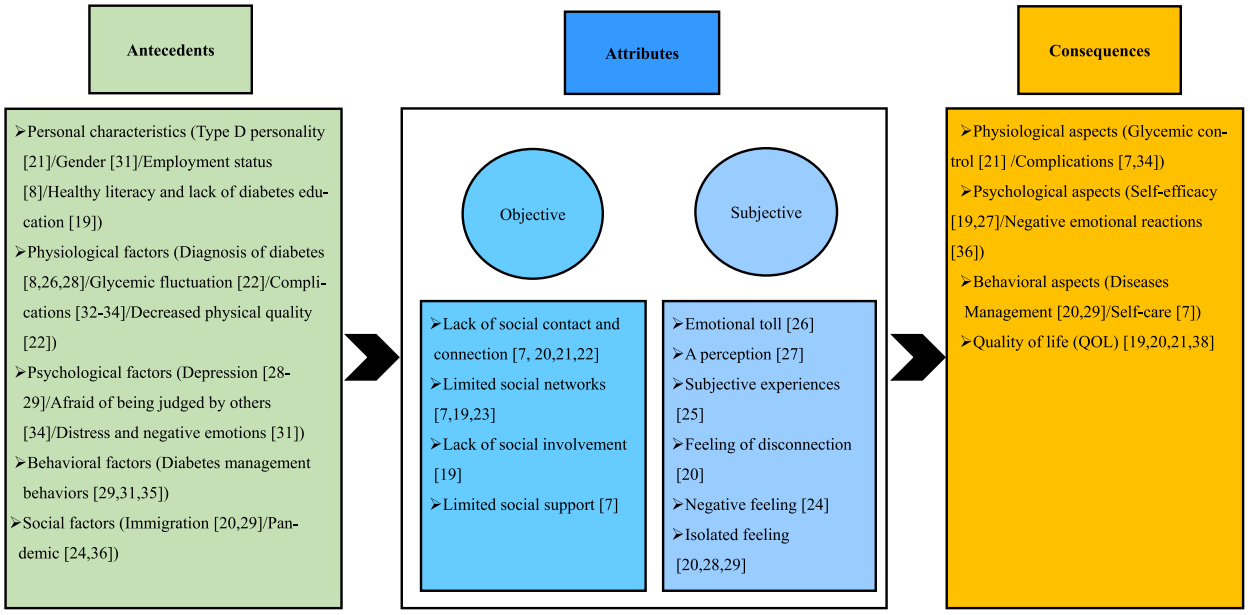

Fig. 3. Antecedents, attributes, and consequences of social isolation in people with type 2 diabetes.

3.2.1. A model case

Ming, a 65-year-old retired Chinese woman, has been diagnosed with type 2 diabetes for two years. She also had multiple comorbidities, such as hypertension and hyperlipidemia. After the diagnosis of diabetes, her functional ability decreased, and her blood sugar was unstable, causing depressive symptoms, diabetes distress and other negative emotions. Although she did not receive systematic diabetes health education, she still conducted self-considered strict self-management, especially dietary restrictions, to maintain blood sugar in the normal range to prevent diabetes complications. However, she still developed diabetic retinopathy, causing vision damage. For all these reasons, she avoided social activities and restricted her social life (**Lack of social involvement**). The Corona Virus Disease 2019 (COVID-19) pandemic and lockdown limited her face-to-face communication with her family and friends, with little online communication and lack of overall social contact and interaction (**Lack of contact**). Her social network was also compromised, with its downsizing and insufficient diversity (**Limited social network**). In addition, she seldom participated in social activities, such as retired colleagues' dinner parties and family travel (**Lack of social involvement**). Nobody supported her, either (**Limited social** support). Sometimes, she also felt out of touch from her neighbors and friends (**Feeling of disconnection**).

3.2.2. A borderline case

Maria is a 52-year-old unretired woman who has just been diagnosed with type 2 diabetes. She believed that the progression of diabetes was irreversible and chose to deal with diabetes using negative avoidance strategies. This strategy may lead to the avoidance of treatment and social and emotional support. However, her husband and other family members believed that diabetes was not a big deal, and they could help supervise treatment and control diet together. Maria decided to perform diabetes self-management with their support. However, after treatment, although she had communicated with colleagues and friends, she reduced most social activities. She was afraid that strict dietary restrictions and insulin injections would be judged by others.

3.2.3. A related case

This case is an example of an adjustment response that is related to social isolation. Mark is a 56-year-old male company employee who has been diagnosed with type 2 diabetes for four years. At the initial diagnosis, he was afraid of injecting insulin in front of his friends and would not dine out with them. However, this did not keep his blood sugar in the normal range. Instead, because he did not communicate with friends and feel the support of others, he gradually became irritable, and his blood sugar was not easy to control. Therefore, he adjusted his mentality, continued to work, communicated with friends and participated in social activities while receiving treatment. He was also willing to talk to friends about his diabetes experience and concerns. He gained support from his family and friends, which was beneficial to his glycemic control.

3.2.4. A contrary case

Fang, a 60-year-old Chinese woman who had just retired, had been diagnosed with type 2 diabetes for 10 years. She received systematic health education, conducted strict self-management, and thought that diabetes had no impact on her life. As a result, she still participated in a variety of community activities and volunteer services. Face-to-face and online communication with family, friends or groups were still frequent. She even expanded the scale of their social network, established more contact with peers, shared management experience, and explored possible ways to control blood sugar. As a result, she achieved optimal glycemic control.

3.3. Antecedents

Antecedents are related factors that lead to the occurrence of conceptual events [17]. After reviewing the selected literature, we extracted five antecedents: personal characteristics and disease-related physiological, psychological, behavioral and social factors, as shown in Fig. 3.

3.3.1. Personal characteristics

Social isolation in people with type 2 diabetes is influenced by various personal characteristics, such as type D personality, gender, employment status, and health literacy. Type D personality influences the occurrence of diabetes distress and social isolation [21]. Women with diabetes were more likely to be socially isolated [30]. Yang et al. [8] surveyed 300 elderly people with type 2 diabetes mellitus in Beijing and found that social isolation frequently occurred among retired people with type 2 diabetes. In other words, employment status can affect patient relationships and increase the risk of social isolation. Patients with lower levels of health literacy and a lack of diabetes education are also reported to have a higher occurrence of social isolation than others because of less social engagement and contact [19].

3.3.2. Disease-related physiological factors

Social isolation experienced by patients could stem from disease-related physiological factors, including the diagnosis of diabetes, glycemic fluctuation, complications and decreased physical quality imposed by diabetes. The physiological indicators such as blood glucose and HbA1c of patients with diabetes fluctuate sometimes, so they are worried about the adverse events and tend to avoid interaction with others, leading to social isolation [22]. Diabetes influences patients' daily living capacity, role expectations, cultural and social engagement, and lifestyle changes to treat diabetes, which promote a sense of social isolation [8,26,28]. DiNardo et al. [31] also found that people with diabetes experienced social isolation due to diagnosis, complications, and physical limitations of diabetes, but the types of complications were not studied in detail. Studies addressing specific complications have also found that foot ulcers, visual impairment due to diabetic retinopathy, and other complications of diabetes can affect social interactions in patients with diabetes and increase the risk of social isolation [32–34]. In the study of Ida et al. [22], it was also found that patients with diabetes experienced more social isolation than non-diabetics because of reduced physical functional ability and multiple comorbidities.

3.3.3. Psychological factors

Studies have documented that a range of serious psychological problems arising from diabetes, such as depression, fear, distress and negative emotions, are particularly linked to the occurrence and development of social isolation in patients with diabetes [28,29,31,34]. Participants who reported depression felt isolated because depressed people closed themselves off and were unwilling to communicate with others, affecting the occurrence of social isolation [28]. When patients realize that there is no cure for diabetes, they may choose a negative way to respond to the diabetes. This negative attitude may lead to avoidance of medical, social, and emotional support and increase the risk of social isolation [29]. After in-depth interviews with people with diabetic retinopathy, Fan et al. [34] found that participants were afraid of being judged by others, gradually reduced social interaction activities, and finally experienced social isolation. The fear had to do with the culture in which Chinese people care more about what others think.

3.3.4. Behavioral factors

Social isolation in people with diabetes may also occur because diabetes management behaviors, especially those associated with dietary restrictions, have negative effects on their social integration, facilitating the occurrence of social isolation [29,31,35]. This may be because strict dietary restrictions limited one's willingness to participate in normal social life, resulting in the avoidance of certain foods and social gatherings, thus, increased feelings of isolation.

3.3.5. Social factors

In addition to the individual factors of people with diabetes themselves, external factors may also affect the occurrence of their social isolation. In previous studies, researchers have found that people with diabetes who encounter immigration, language and ethnic differences may have more difficulties establishing cultural and social connections with others in different cultural environments and were not included in social activities, resulting in a higher risk of social isolation [20,29]. After the outbreak of COVID-19, studies also found that the disease epidemic and the lockdown measures taken at the time also affected the occurrence of social isolation in people with diabetes because they negatively affected patients' daily social life [24,36].

3.4. Consequences

Consequences are events or incidents that are the result of the occurrence of a concept [17]. In people with type 2 diabetes, social isolation is more likely to cause undesirable consequences, such as adverse physiological consequences, poor psychological experience, failure to manage the disease, and poor quality of life (Fig. 3).

3.4.1. Physiological aspects

Some studies have shown that social isolation will bring about adverse health outcomes, such as poor glycemic control and worsened symptoms. Lee et al. [21] supposed that Type D personality affected glycemic control via diabetes stress and social isolation. Therefore, the conclusion that social isolation would negatively impact glycemic control was well supported. Furthermore, social

isolation can also worsen diabetes complications. Among people with foot ulcers, the proportion of severe ulcers (Wagner grade 3 to 5) was higher in the social isolation group, and social isolation can delay wound healing [7]. Visual impairment caused by diabetic retinopathy is related to people's dependence on activities of daily living, social isolation, reduced physical activity, decreased quality of life, and negative psychological emotions, which in turn aggravate the progression of diabetic retinopathy [34].

3.4.2. Psychological aspects

The psychological effects of social isolation include both self-efficacy and emotional reactions. Self-efficacy is defined as the individual's perception of one's ability to perform particular behaviors through four processes: cognitive, motivational, affective, and selection processes [37]. A structural model has been established to demonstrate the relationship between social isolation, self-efficacy and diabetes management. One of the pathways showed that self-efficacy was the mediator between social isolation and diabetes management [19]. A cohort study showed that a 1-point increase in social isolation decreased dietary self-efficacy by 3.3 points which means that patients who felt more isolated reported more difficulties in regulating dietary behaviors [27]. Likewise, Fisher described the negative effects of social restrictions and isolation as a series of emotional reactions, including confusion, anger, posttraumatic stress disorder-like symptoms, insomnia, frustration, boredom, and increased fearfulness [36].

3.4.3. Behavioral aspects

Social isolation is an important factor negatively influencing diabetes management and self-care. For older Middle Eastern immigrants in particular, feelings of loneliness and social isolation can play a crucial role in their failure to manage the disease [29]. For Haitian immigrants, the lack of interaction with neighbors of a different race might have prevented them from acknowledging or accessing freely available public health services after arriving in new communities. Subsequently, inadequate access to healthy food and increasingly sedentary lifestyles lead to poor medical outcomes and health inequities [20].

Similarly, compared with the group without social isolation, the proportion of patients in the social isolation group who never examined their feet and the proportion of delayed visits was higher. Patients with high levels of social isolation ultimately were led to a lack of self-care behaviors or decreased adherence due to less social support from members of the social network. Failure to detect early wounds in time delayed visits and eventually led to further aggravation of foot ulcers [7].

3.4.4. Quality of life

Several studies have found that social isolation can negatively affect quality of life [20,21,38]. Through interviews with 20 older adult Haitian immigrants with type 2 diabetes, Lee et al. [19] concluded that social isolation was a major barrier to quality of life. Due to isolation, Haitian immigrants cannot live well outside the Haitian community [20]. In addition, after controlling for diabetes distress, the indirect effect of Type D personality on health-related quality of life via social isolation was statistically significant. This means that less interpersonal contact with others (e.g., family, friends or health professionals) and being socially withdrawn will negatively impact health-related quality of life [21].

3.5. Empirical referents

No assessment tools for social isolation have been specifically developed for type 2 diabetes. We discovered that several researchers use the following generic measures to assess social isolation in the field of diabetes (as shown in Table 1). Of these scales, three refer to the measurement of social isolation. Nottingham Health Profile [39] measures social isolation based on the subjective feelings of patients. Coping strategies were assessed by a Swedish self-report questionnaire, and the orientation dimension was dichotomized into

Table 1
Defining attributes involved in social isolation measures.

Social isolation measures	Author(s)	Target population	Number of items	Defining Attributes Involved	
				objective	Subjective
Nottingham Health Profile	Hunt et al., 1980	Adults	45	/	✓ Subjective experiences
Coping strategies questionnaire	Gåfvels & Wändell, 2006	Adults	47	✓ Limited social network	/
Emotional/Social Loneliness Inventory	Corcoran & Fischer, 2013,	Adults	15	✓ Limited social network	/
Lubben Social Network Scale-Revised	Lubben et al., 2002	Elderly (age 60+)	10	✓ 1) Limited social network; 2) Limited social support	/
Lubben Social Network Scale-6	Lubben et al., 2006	Elderly (age 60+)	6	✓ 1) Limited social network; 2) Limited social support	/
Social Isolation Index	Shankar et al., 2011	Adults	5	✓ 1) Limited social network; 2) Lack of social involvement	/

social trust and social isolation to assess stressful situations in general [30]. Six items in the Emotional/Social Loneliness Inventory measure real-life human interactions in patients [40]. There are also two scales that specifically measure social network size regarding family and friendship networks. The Lubben Social Network Scale includes the Lubben Social Network Scale-Revised and the Lubben Social Network Scale-6 [22,41], which is for elderly individuals. With a possible total score of 24, a score less than 12 indicates insufficient social networks (social isolation). Shankar et al. [42] developed a Social Isolation Index based on five binary items. All of the above scales reflect only one dimension of social isolation, objective or subjective. Except for the Nottingham Health Profile, the existing scales only measure the objective attribute of social isolation and ignore the subjective measurement. For people with diabetes, the influence of disease or complication factors is not considered in existing tools. In summary, existing tools cannot fully reflect the social isolation of patients with diabetes. Further research on scale development is needed in this regard.

3.6. Operational definition of social isolation in people with type 2 diabetes

In studies of people with type 2 diabetes, social isolation has subjective and objective dimensions. In the objective dimension, it is an objective measure of limited social networks and social support, reduced social contact and participation; in the subjective dimension, it is a negative perception of disconnection from the outside world. Objective and subjective dimensions may not exist at the same time, and one existence can be called social isolation. Personal characteristics and physiological, psychological, behavioral and social factors may precede social isolation for people with type 2 diabetes. Social isolation will also affect the physiological, psychological, behavioral aspects and quality of life of people with type 2 diabetes. A conceptual map of social isolation in people with type 2 diabetes with antecedents, attributes, and consequences is shown in Fig. 3.

4. Discussion

Based on the review of the literature, defining attributes, antecedents and consequences of social isolation in type 2 diabetes were summarized by using the concept analysis method of Walker and Avant [17] in this study. To the best of our knowledge, this is one of the first reviews to comprehensively analyze the conceptual attributes of social isolation in people with type 2 diabetes and to link the intrinsic characteristics of type 2 diabetes with social attributes to analyze the antecedents and consequences of the occurrence of social isolation. This facilitates the understanding of social isolation in people with type 2 diabetes, and the concept is more comprehensive, expanding the potential application of this concept.

Regarding the defining attributes, objective representation and subjective perception are the two overarching attributes that can be frequently and explicitly found in the literature. Detailed attributes can be classified under these two dimensions. Lack of social contact and connection [7,20–22], limited social networks [7,19,23], lack of social involvement [19] and limited social support [7] are all objective attributes. These characteristics are quantitative measures of network size, diversity, and interpersonal contact frequency. In simple terms, the objective social isolation refers to the phenomenon that the communication, interaction and integration with other social members are restricted. They help identify social isolation that occurs objectively in people with type 2 diabetes. In addition, social isolation has been de-scribed as negative feelings at the subjective level. Patients with diabetes always mentioned that they felt isolated, which can be concluded as being an isolated feeling [20,28,29]. At this level, social isolation refers to the state of loneliness, exclusion or unacceptance felt by individuals or groups at the psychological, emotional or cognitive level. Compared to the previous studies which only mentioned one dimension, we combined the objective and subjective dimensions in this concept analysis. We proposed these two aspects as the overarching defining attributes and incorporated them into the operational definition. It should be noted that the objective and subjective aspects may not exist simultaneously, and the existence of either aspect can be called social isolation. However, the two aspects are interrelated. The recognition of social isolation from objective and subjective perspectives would facilitate the adoption of comprehensive interventions to promote social participation and mental health of patients with type 2 diabetes.

Built on previous studies, this concept analysis gives an overview of antecedents and consequences of social isolation in people with type 2 diabetes. Identifying antecedents of social isolation in people with type 2 diabetes is of great significance to prevent the occurrence of social isolation in the early stage. For example, patients with type D personality [21], decreased physical quality [22], low health literacy [19], and negative emotions [31] may be at high risk of social isolation. Therefore, screening of these groups is necessary. The antecedents emphasize that people with type 2 diabetes experience social isolation under the interaction of personal characteristics, physiological, psychological, behavioral and social factors. It is to be noted that psychological factors should be considered critical for the development of both objective and subjective social isolation. Patients who reported psychological problems may have felt isolated. Meanwhile, due to psychological problems, they were unwilling to communicate with others, which may affect the occurrence of objective social isolation [28]. Social isolation in people with type 2 diabetes can cause negative emotions reactions [36], affect the disease management and self-care [7,20,29], and reduce the quality of life [19–21,38]. Therefore, in order to avoid the adverse effects of social isolation, it is necessary to take corresponding measures to prevent the occurrence of social isolation.

4.1. Implications for future research and clinical practice

There are some important recommendations for the application of the concept of social isolation in type 2 diabetes in future research and clinical practice. According to the operational definition, researchers could further construct a scale of social isolation in type 2 diabetes. The scale could have two subscales to reflect the objective and subjective dimensions. For each dimension, items could be generated to reflect the detailed perspectives under each dimension. For example, the items asking the frequency to contact

relatives, neighbors, friends, and colleagues may infer the lack of social contact and connection under objective dimension. Next, the constructed scale could be used to investigate the status quo of social isolation in people with type 2 diabetes and further analyze the influencing factors and interactions between antecedents by structural equation modeling. This is beneficial for nursing professionals to propose targeted interventions according to patients' conditions to avoid the occurrence and aggravation of social isolation in people with type 2 diabetes.

4.2. Limitations

Some limitations should be noted in this concept analysis. First, due to language restrictions, this analysis only included articles in Chinese and English. Second, this analysis did not search databases such as ProQuest to include grey literature, so it is possible that unpublished relevant articles have been left out. However, we searched the most commonly used English and Chinese databases as well as articles in the reference lists to extract the most comprehensive and detailed description of social isolation.

5. Conclusions

This concept analysis starts with the characteristics of people with type 2 diabetes and makes a comprehensive analysis of the concept of social isolation in people with type 2 diabetes. In summary. It is an objective state of limited social network and social support, reduced social contact and social involvement, and/or a negative sense of subjective disconnection from the outside world, after which patients have adverse physiological, psychological, behavioral and social consequences. Clarification of this concept would increase nursing professionals' understanding of the nature of social isolation in people with type 2 diabetes and help them recognize the importance of assessing the occurrence of social isolation in people with type 2 diabetes. It can be also used to develop targeted interventions for social isolation. Further research is needed to develop rigorous assessment tools and to analyze the path of the antecedents to social isolation to provide a basis for nursing professionals to assess and screen high-risk groups and develop targeted interventions.

Ethics approval and consent to participate

Review and/or approval by an ethics committee was not needed for this study because this article does not contain any research involving humans or animals.

Consent for publication

Not applicable.

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Data availability statement

There is no data associated with this review.

CRediT authorship contribution statement

Keke Lin: Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Jing Wang:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Xiaoyan Bai:** Writing – review & editing, Formal analysis, Data curation. **Yu Liu:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Yu Liu reports financial support was provided by the Beijing Social Science Foundation Project, China (18SRB009).

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