

Health beliefs, self-management experiences, and needs for digital health support among young and middle-aged adults at high cardiovascular risk: a qualitative study

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Abstract

Background

Young and middle-aged adults at high cardiovascular risk face not only cardiovascular risk but also pressures arising from multiple social roles, including work and family responsibilities. Their risk perceptions and self-management mechanisms may therefore be specific to their stage of the life course. Existing research has provided limited in-depth explanation of how this population understands cardiovascular risk, maintains health behaviours, and perceives digital health support. Guided by the Health Belief Model (HBM), this study aimed to explore their health beliefs, facilitators and barriers to self-management behaviours, experiences of using smart health technologies, and needs for related support.

Methods

A descriptive qualitative design was used. The study was conducted from January to March 2026 at a tertiary hospital in Guangzhou, China. Seventeen young and middle-aged adults at high cardiovascular risk were recruited using purposive sampling combined with a maximum-variation strategy and participated in face-to-face semi-structured interviews. Interview recordings were transcribed verbatim and analysed using directed content analysis, with the six core constructs of the HBM serving as the initial analytical framework; data falling outside this framework were coded inductively. Two researchers coded the data independently and reached consensus through team discussion. Data collection continued until no new themes or concepts emerged.

Results

Four themes and ten subthemes were identified: (1) coexistence of risk awareness and emotional detachment; (2) behavioural motivation driven by family responsibility; (3) the initiation–maintenance gap in self-efficacy; and (4) barriers to realising the value of smart health technologies. Participants were often able to identify their risk factors but did not consistently experience them as personally relevant threats. Symptoms, illness among peers, and hospitalisation experiences could temporarily increase the perceived reality of risk. Family responsibility was an important motivation for behaviour, whereas long-term maintenance was affected by previous experiences of failure, occupational contexts, and time pressure. Regarding smart health technologies, participants placed greater emphasis on risk interpretation, actionable guidance, and emergency support than on simply increasing data monitoring.

Conclusions

Self-management among young and middle-aged adults at high cardiovascular risk may be jointly shaped by cognitive, emotional, family-relational, and real-world contextual factors. Beyond risk education, public health and clinical preventive interventions could strengthen contextualised risk communication related to family roles and support behavioural maintenance through low-threshold, staged goals. Digital health technologies should prioritise improved interpretation of abnormal information, actionable recommendations, and safety support, while also considering compatibility with occupational contexts, user autonomy, and privacy and ethical issues. The explanatory pathways identified in this study require further examination in broader populations.

Introduction

Cardiovascular disease (CVD) is one of the leading causes of death and disability worldwide. The prevalence of CVD in China continues to increase, with an estimated 330 million people currently affected, including 11.39 million with coronary heart disease and 13 million with stroke^[1]. Notably, in recent years, declines in acute myocardial infarction, acute coronary syndrome, and cardiac mortality among young and middle-aged populations in some countries and regions have been smaller than those observed among older populations. In some young and middle-aged subgroups, the incidence, hospitalisation, and mortality rates have even increased, suggesting a trend towards a younger age distribution of the CVD burden^[2–4]. Meanwhile, the burden of cardiovascular mortality among young and middle-aged populations has also received continued attention^[5].

Unlike older adults, young and middle-aged adults at high cardiovascular risk are generally still at a critical stage of career development and often assume multiple social roles, including serving as the primary financial providers for their families, raising children, and supporting ageing parents^[6]. If an acute cardiovascular event occurs in this population, it may not only pose a serious threat to the individual's life and health but also lead to cascading adverse consequences for family structure and social functioning^[7, 8]. Therefore, understanding the health beliefs of this population regarding CVD and the mechanisms underlying the formation of their self-management behaviours is important for designing tailored preventive interventions.

The Health Belief Model (HBM) is one of the most widely used theoretical frameworks for explaining and predicting health behaviours^[9]. The model proposes that the likelihood of an individual engaging in a health behaviour depends on six core constructs: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and cues to action^[10]. The HBM has been used to explain health behaviours related to cardiovascular risk screening, medication adherence, hypertension self-management, diet, and physical activity^[11, 12]. Relevant systematic reviews have also suggested that the model has explanatory value for preventive and self-management behaviours in chronic disease^[13]. However, existing studies have predominantly focused on older populations or patients with established cardiovascular or cerebrovascular disease^[12], while comparatively limited attention has been paid to the

health belief characteristics of young and middle-aged populations at high cardiovascular risk and the mechanisms through which these beliefs influence self-management behaviours^[14].

Compared with older adults, young and middle-aged individuals may be more likely to underestimate cardiovascular risk or assign a lower priority to long-term health threats^[15]. At the same time, occupational stress, working hours, family responsibilities, and patterns of healthcare utilisation may also affect their ability to sustain health behaviours^[16]. These differences may result in a configuration and operation of health beliefs that differ from the general patterns described by existing theoretical models^[17]. It is therefore necessary to undertake an in-depth investigation of young and middle-aged adults at high cardiovascular risk within the HBM framework.

Meanwhile, with the rapid development of digital health technologies, wearable devices such as smart bands and smartwatches have been widely used for personal health management. These devices can continuously record indicators such as heart rate, physical activity, and sleep, while some devices can also provide information on cardiac rhythm, blood pressure, and blood oxygen saturation, thereby offering new technological approaches to risk identification, health feedback, and behavioural support^[18, 19]. In theory, wearable devices can strengthen cues to action through data feedback and reminder functions, increase individuals' perceptions of health risks, and promote self-monitoring and health behaviour change^[20, 21]. However, existing evidence indicates that long-term adherence to wearable devices in chronic disease management is generally low, with some users discontinuing use or reducing the frequency of use after only a short period^[22, 23].

This phenomenon may be particularly prominent among young and middle-aged adults. Although this population generally demonstrates relatively high acceptance of digital technologies, their busy working lives and substantial family responsibilities mean that device use may be affected by insufficient time, information burden, difficulties in interpreting data, a lack of individually tailored feedback, and inadequate perception of health risks^[21, 24]. Thus, the availability of technology does not necessarily translate into sustained and effective health behaviour change^[23].

Previous research on wearable devices has largely focused on monitoring accuracy, functional development, and health data collection. Technology design often follows a logic of "data quantification"^[25], emphasising the recording of indicators, presentation of data, and alerts for abnormal values, while paying insufficient attention to how users interpret health data, how feedback is translated into specific actions, and how devices can be aligned with users' real-life contexts and mechanisms of behaviour change^[26]. Among young and middle-aged adults requiring ongoing cardiovascular risk management, individuals may differ in their risk perceptions, assessments of benefits, real-world barriers, self-efficacy, and cues to action, resulting in varying levels of behavioural intention and persistence. Relying solely on standardised approaches to data presentation and reminders may therefore be insufficient to address these individual differences^[27].

It is therefore necessary to begin with users' actual experiences and health management needs and to gain an in-depth understanding of the supportive value of wearable devices in their self-management, the barriers encountered during use, and their expectations regarding device functions, thereby providing a basis for functional optimisation and more targeted application of these technologies.

In summary, guided by the HBM, this qualitative study aimed to explore the health belief characteristics of young and middle-aged adults at high cardiovascular risk, the factors that facilitate and hinder their self-management behaviours, and their actual needs and experiences regarding wearable smart health technologies, with the aim of identifying key factors influencing the entire process from "risk perception" to "behavioural enactment". The findings may provide a theoretical basis for developing tailored nursing interventions that are consistent with the life contexts and behavioural characteristics of young and middle-aged adults and may also provide a reference for the application of wearable smart health technologies in the ongoing risk management of populations at high cardiovascular risk.

Methods

Study design and setting

This study employed a descriptive qualitative design and aimed to explore, within the framework of the Health Belief Model (HBM), the health belief characteristics of young and middle-aged adults at high cardiovascular risk, the mechanisms underlying the formation of their self-management behaviours, and their needs for support from smart health technologies. A descriptive qualitative design can provide a relatively faithful representation of participants' subjective experiences and behavioural characteristics and is appropriate for exploring the processes underlying the formation of health behaviours and their influencing factors.

The study was conducted from January to March 2026 at a tertiary hospital in Guangzhou, Guangdong Province, China. Purposive sampling combined with a maximum-variation strategy was used. Participants were selected according to factors including age, sex, occupational type, cardiovascular risk-factor profile, and previous experience with smart health technologies to obtain an information-rich and diverse sample. Sample size was determined according to the principle of information saturation, with recruitment ceasing when no new themes emerged^[28]. Two researchers separately assessed newly emerging codes, categories, and themes across successive interviews and jointly determined whether information saturation had been reached following discussion within the research team. Recruitment ceased when successive interviews no longer generated any new substantive codes, categories, or themes.

Participants and eligibility

The inclusion criteria were as follows: (1) young and middle-aged adults aged 18–59 years who were at high cardiovascular risk. The operational definition of "high risk" used in this study was based on published Chinese implementation studies of the programme for early screening and comprehensive

intervention among populations at high cardiovascular risk. These studies stated that their criteria were derived from the Technical Plan for Early Screening and Comprehensive Intervention for High-risk Populations of Cardiovascular Disease. However, the research team was unable to obtain a complete, publicly available official version of this technical plan. Therefore, the present study applied the operational criteria consistently reported in published Chinese studies^[29-31].

Participants were classified as being at high cardiovascular risk if they met at least one of the following three categories of criteria: (i) medical history, defined as meeting at least one of the following four criteria: a history of myocardial infarction, a history of stroke (ischaemic or haemorrhagic), a history of percutaneous coronary intervention (PCI), or a history of coronary artery bypass grafting (CABG); (ii) blood pressure or blood lipids, defined as meeting at least one of the following three criteria: systolic blood pressure ≥ 160 mmHg or diastolic blood pressure ≥ 100 mmHg, low-density lipoprotein cholesterol ≥ 4.14 mmol/L, or high-density lipoprotein cholesterol < 0.78 mmol/L; or (iii) cardiovascular risk factors, whereby cardiovascular risk was assessed using the risk prediction charts in the Guidelines for Assessment and Management of Cardiovascular Risk issued by the World Health Organization in 2008^[32], and individuals with a 10-year risk of cardiovascular disease $\geq 20\%$ were classified as being at high risk. The remaining inclusion criteria were: (2) clear consciousness and good communication ability; (3) provision of informed consent and voluntary participation in the study; and (4) the ability to clearly describe their own health management experiences and needs.

The exclusion criteria were: (1) being in the acute phase of myocardial infarction, acute stroke, or another acute cardiovascular condition, with an unstable clinical condition; (2) severe heart failure, malignancy, or another serious disease that could substantially affect the interview or the individual's health management experiences; (3) cognitive impairment, psychiatric illness, or any other condition affecting normal communication; and (4) inability to complete the full interview.

Data collection

Interview guide

The interview guide was developed on the basis of the six core constructs of the HBM—perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and cues to action—as well as relevant literature. Questions concerning digital health support were additionally incorporated in consideration of the current application of smart health technologies.

Before the formal interviews, two participants who met the inclusion criteria were purposively selected for pilot interviews. Based on their feedback, the wording of some questions and the sequence of follow-up probes were adjusted, resulting in the final semi-structured interview guide. Because only the wording and sequence of questions were modified following the pilot interviews, without changes to the core interview content, the research team assessed the two pilot interview datasets and included them in the formal analysis.

The final interview guide covered eight core questions concerning perceptions of disease risk, health behaviour change, self-management experiences, facilitators and barriers to behaviour, experiences of using smart health technologies, and future support needs. These questions included: (1) How do you perceive your likelihood of developing cardiovascular diseases such as heart disease or stroke in the future? (2) When you think about “cardiovascular disease”, what specific images come to mind? What would this mean for your life? (3) What efforts are you currently making to maintain a healthy lifestyle? (4) For you, what are the greatest benefits and the greatest difficulties associated with changing your lifestyle? (5) Under what circumstances would you pay particular attention to your health and take action? (6) Is there anyone around you whom you consider to manage their health particularly well? Have they influenced your thoughts or behaviours? (7) If a smart device were available to help you manage your cardiovascular health, what functions would you want it to have? (8) Apart from technological tools, what kinds of interpersonal or professional support would you like to receive to help you maintain your health?

Interview procedures

Potential participants were first identified by clinical healthcare professionals from the departments of cardiology, endocrinology, and preventive treatment of disease based on medical record information. The research team then reassessed their eligibility according to the inclusion and exclusion criteria before inviting them to participate. No eligible individuals who were invited to participate refused participation or withdrew from the study. The researchers explained the purpose and content of the study and the principles of confidentiality to potential participants, and interviews commenced after informed consent had been obtained.

All interviews were conducted face-to-face in a quiet, private meeting room within the hospital, with no individuals other than the participant and the two researchers present. The first author, a female master's student who had received training in qualitative research and semi-structured interviewing, conducted all interviews. The second author assisted by observing and recording participants' emotional changes, body language, and other important non-verbal information. Each interview lasted 20–60 min. With participants' permission, the entire interview was audio-recorded and transcribed verbatim within 24 h after completion. Field notes were compiled alongside the interview records. The verbatim transcripts and field notes were returned to the respective participants for confirmation. No repeat interviews were conducted.

Data collection and analysis proceeded concurrently. Information saturation was considered to have been reached when successive interviews generated no new substantive codes, categories, themes, or concepts, at which point recruitment was discontinued.

Research team and reflexivity

The research team consisted of one head nurse specialising in cardiovascular care, two professors of nursing, one head nurse specialising in chronic disease management, and two nursing postgraduate

students who had received systematic training in qualitative research. The first author conducted all interviews, while the second author assisted with observation and field-note recording. Both had received training in qualitative research and semi-structured interviewing and were familiar with the theoretical framework of the HBM. During data analysis, two researchers independently coded the entire dataset. Any disagreements were discussed within the research team until consensus was reached.

Data analysis

The data were analysed using directed content analysis and managed using NVivo 15.0. The HBM served as the theoretical analytical framework and guided coding and theme development. First, two researchers repeatedly read the interview transcripts to gain an overall understanding of the data and identify meaning units relevant to the research objectives. Second, an initial coding framework was established according to the six core constructs of the HBM, and relevant meaning units were assigned to the corresponding categories. Codes with similar meanings were then inductively integrated to form categories, subthemes, and themes. New concepts that could not be accommodated within the existing HBM constructs were analysed inductively to form new analytical categories, thereby avoiding the omission of important information. Finally, the two researchers independently completed the coding of the entire dataset and compared their analytical results, after which the final thematic structure was established through discussion within the research team.

Rigour and reporting

The study was designed and reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) to enhance credibility, dependability, and confirmability. During each interview, the first author conducted the interview, while the second author observed and documented participants' emotional changes, body language, and other non-verbal information. Field notes and an interview memo were prepared to supplement the verbatim transcripts. The verbatim transcripts and corresponding field notes were returned to participants for confirmation, allowing them to verify the accuracy of the interview records. However, participants were not asked to provide feedback on the final themes or findings because some had been discharged from hospital or were otherwise unavailable at that stage.

Researcher triangulation was used during data analysis. Two researchers independently coded the entire dataset and compared their coding; disagreements were resolved through discussion within the research team until consensus was reached. The interview audio recordings, verbatim transcripts, field notes, and coding records were retained in full to ensure the traceability of the research process. Members of the research team engaged in ongoing reflexivity during data analysis to minimise the influence of their prior experiences on data interpretation.

The interviewers had not previously been involved in the direct clinical care of the participants and had no prior relationships with them. Throughout data collection and analysis, the research team maintained

reflexive memos, with particular attention to how the researchers’ nursing backgrounds and prior understanding of HBM constructs might influence interview probing, coding, and interpretation.

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the First Affiliated Hospital of Guangzhou University of Chinese Medicine (approval no. K-2026-014). All participants provided written informed consent after being fully informed of the study purpose, content, and potential risks. Participants were free to withdraw from the study unconditionally at any stage without affecting their usual medical care. All interview data were anonymised using participant codes, used solely for scientific research, and stored appropriately in accordance with ethical requirements, with strict measures taken to protect participants’ privacy.

Results

Participant characteristics

A total of 17 participants were interviewed. The interviews lasted 395.2 min in total, and approximately 113,000 Chinese characters of interview transcripts were generated. Participant characteristics are presented in Table 1.

Table 1. Participant characteristics

Characteristic		Value
N		17
Sex	Male	13 (76%)
	Female	4 (24%)
Age, years	Mean (SD), range	40.82 (12.60) 20 - 58
	Median (IQR)	38 (36, 53)
Education	Primary school	3 (18%)
	Secondary school	9 (53%)
	College diploma	1 (5%)
	Bachelor's degree or above	4 (24%)
Occupational characteristics	Sedentary office work	4 (24%)
	Manual labour	2 (12%)
	Shift work	3 (18%)
	Retired	1 (5%)
	Other	7 (41%)
Residence	Rural	4 (24%)
	Urban	13 (76%)
BMI	Mean (SD), range	27.72 (4.32) 23.66 - 32.65
	Median (IQR)	26.45 (24.56, 29.35)
High-risk factors	Hypertension	17 (100%)
	Dyslipidaemia	7 (41%)
	Diabetes	4 (24%)
	History of coronary intervention	1 (5%)
	History of cerebral infarction	1 (5%)
Currently receiving relevant medication	Yes	10 (59%)
	No	7 (41%)
Experience with smart devices	Never used	12 (70%)

Currently using	3 (18%)
Previously used	2 (12%)

Themes

Directed content analysis of the 17 interview datasets generated 635 codes, from which four themes and ten subthemes were identified. The themes progressed from risk perception and behavioural motivation to behavioural maintenance and needs for digital health support and were mapped onto the corresponding HBM constructs (Table 2).

Table 2. Overview of themes and subthemes

Theme	Subtheme	Corresponding HBM construct
Coexistence of risk awareness and emotional detachment	Tension between cognitive recognition and psychological distancing	Perceived susceptibility
	Transient symptom-driven vigilance	Perceived susceptibility; cues to action
	Fear centred on the collapse of family roles	Perceived severity
Behavioural motivation driven by family responsibility	Family-oriented perceived benefits	Perceived benefits
	External events as behavioural triggers	Cues to action
The initiation - maintenance gap in self-efficacy	Discrepancy between willingness to initiate change and confidence in maintaining it	Self-efficacy
	Gradual compromise as an adaptive strategy	Perceived barriers; self-efficacy
Barriers to realising the value of smart health technologies	Superficial use and rapid abandonment	Perceived barriers
	Emergency alerts prioritised over routine data monitoring	Perceived benefits; cues to action
	An individual perspective on autonomy and humane support beyond data monitoring	Emergent category outside the initial HBM framework

1. Coexistence of risk awareness and emotional detachment

1.1 Tension between cognitive recognition and psychological distancing

Participants were able to accurately identify their own cardiovascular risk factors, including hypertension, dyslipidaemia, and family history, indicating a basic awareness of their health status. However, while acknowledging these risk factors, most participants used various psychological strategies to diminish their perceived personal threat.

Some used the absence of physical symptoms as a reason to discount their risk: "I usually don't feel anything." (G6, G13) Others interpreted the common occurrence of risk factors around them as evidence that these factors were normal rather than threatening: "I don't feel anything. I see it a lot around me, so it seems quite normal." (G13) Some participants believed that their age protected them from immediate risk: "It's too early, isn't it? I'm only 38. It's too early." (G3) Others deferred the risk to the future: "Cardiovascular disease is possible, but I don't think it could become that serious that quickly." (G2) Some participants discounted the possibility of risk because previous health examinations had produced normal results: "I just thought my annual health examination reports had always been so good and there was nothing wrong with me, so I just kept following the same habits." (G12)

Similarly, G14 stated: "Basically, it seems that everything I've had checked has been fine." (G14) Family health history was also used as a source of reassurance: "In our family, everyone has generally been very stable and healthy in all respects... My mother lived into her nineties. She was very long-lived and only passed away last year. She basically had no illnesses throughout her life." (G14)

These accounts indicate that although participants were able to recognise cardiovascular risk factors, this cognitive recognition was not necessarily accompanied by a sustained subjective sense of susceptibility.

1.2 Transient symptom-driven vigilance

When cardiovascular risk manifested as clear physical symptoms or acute events, risk perception temporarily shifted from an abstract cognitive awareness to an immediate experience of fear. Triggering situations included severe headache, hand numbness, and extremely high blood pressure readings. One participant fully accepted being at high cardiovascular risk after his blood pressure reached approximately 250–260 mmHg (G15).

Other participants described their experiences directly: "My hand went numb, and I felt that something wasn't right, so I immediately measured my blood pressure." (G1) "I'd had headaches for several years. Recently they became more frequent, and I couldn't stand the pain anymore, so I finally came to the hospital." (G3) These situations indicate that action was initiated when risk became a tangible and personally experienced event. However, this heightened vigilance was very short-lived. Most participants reported gradually returning to their previous routines after their symptoms subsided or after hospital discharge. One participant said: "When I'm ill, when I don't feel well—like these past few days—I think, ah, I need to pay more attention in the future." (G9) The explicit temporal boundary in this account suggests

that symptoms served as a driver of only temporary change. Another participant stated: “At the time of the health examination, when it reached 140, my blood pressure was a little high. I thought I should try to cut down [on smoking].” (G12)

However, this intention did not translate into sustained behavioural adjustment or greater risk awareness; G12 still paid little attention when a subsequent examination indicated “small bilateral infarct lesions”. For some participants, the vigilance triggered by symptoms or abnormal examination findings gradually diminished once symptoms improved, suggesting that risk perception did not always translate into sustained behavioural adjustment.

1.3 Fear centred on the collapse of family roles

When participants were asked to describe the specific images and fears that came to mind when considering the consequences of CVD, their concerns centred on the familial and social consequences of illness rather than on the health outcomes themselves. They worried about the serious consequences of premature death for their young children (G9, G12), rejected the prospect of becoming dependent on family care because of paralysis following stroke (G1, G5), and feared that loss of working capacity would affect household income (G12, G15).

Participants stated: “After all, I have children. If I developed a cardiovascular problem, it would definitely place a greater burden on them in the future. If I were to die early, that wouldn’t be good for them either.” (G9) G12 described both financial pressure and anxiety about future work: “My child is still young, only in fifth grade. I also have the pressure of a mortgage, and my salary isn’t very high now.” (G12) “What I’m really worried about now is whether I’ll still be able to work later on, and how well I’ll recover. I’m very worried about this and quite anxious.” (G12)

For young and middle-aged adults who were simultaneously responsible for older and younger generations, the threat of disease was manifested first as a potential disruption of family structure. One younger participant directly framed premature death as a failure to fulfil family responsibility: “After all, I’m only 24 years old. I can’t really accept it. Although I’m not afraid of death, I’m not willing to just die so hastily... If I were to die like that, it would also be irresponsible to my family.” (G15)

Thus, perceived severity of cardiovascular risk among young and middle-aged participants appeared to be oriented towards role functioning: they tended to evaluate disease severity in terms of whether they could continue fulfilling family and social responsibilities rather than solely in terms of the health outcome itself.

2. Behavioural motivation driven by family responsibility

2.1 Family-oriented perceived benefits

When participants were asked about their main motivations for changing their lifestyle, the value of health behaviours was often framed in terms of family responsibility rather than improvement in their

own health status. One participant stated: "I'm pretty casual about things—about life and about health. I came to the hospital mainly because I was thinking about my family." (G8) "As far as I'm concerned, I can be casual about myself, but it wouldn't be good if it affected other people." (G8)

These statements reveal a central motivation for health behaviour among young and middle-aged participants: whether their health would affect others. For most participants, "being healthy for oneself" provided insufficient behavioural motivation, whereas "avoiding becoming a burden on the family" gave behavioural change a sense of obligation that could not easily be dismissed. One participant stated: "I think sudden death would actually be a little better. If it were a stroke, the pressure on the family would be very great, and the burden would be heavier." (G10)

This account indicates that the response to a health threat did not arise primarily from concern about personal survival but from an aversion to the long-term caregiving burden that disability could impose on the family. Another participant said: "If my physical condition allows it, I'll definitely exercise more. If I can't do that, I'm finished. I still have a child at home, I have elderly parents above me and a child below me, and I'm also carrying a lot of debt." (G12)

Linking health behaviour to these responsibilities transformed an abstract health goal into a concrete role obligation and endowed it with moral weight.

2.2 External events as behavioural triggers

Although family members represented a deeper source of motivation for health behaviour, behavioural initiation usually required a clear external trigger. Participants described considering behavioural change after exposure to social-media news, illnesses among people around them, or hospitalisation experiences.

G16 became vigilant after seeing a video on a short-video platform showing someone collapsing from a stroke. After subsequently obtaining a home blood pressure reading above 160 mmHg, G16 sought medical care. Another participant had personally witnessed a friend experience an acute myocardial infarction while drinking and undergo emergency resuscitation. The participant stated: "I feel that I need to start taking this seriously now. It seems I can't keep fooling myself anymore." (G2) G4 similarly stated: "It's mainly news about people my age becoming seriously ill that makes me worry about my own health as well." (G4)

The role of these external events was to transform previously psychologically distant perceptions of risk into a concrete sense of urgency to act. Hospitalisation and examination procedures themselves also acted as powerful triggers. Participants stated: "[My family] had told me to lose weight, but I thought things were still okay. Now [that I'm hospitalised], though, I think it's necessary." (G17) "It was really from the moment I came into this hospital. The injections hurt, I have all kinds of examinations every day, and I see other patients going through the same things. I feel scared, and I think I need to start changing." (G16)

3. The initiation–maintenance gap in self-efficacy

3.1 Discrepancy between willingness to initiate change and confidence in maintaining it

Participants were generally able to clearly describe the health behaviour changes they needed to make, such as increasing physical activity, controlling their diet, and maintaining a regular daily routine, indicating that they had initially established behavioural goals at the cognitive level. However, when asked to assess their confidence in maintaining these changes over the long term, most expressed a level of confidence lower than the strength of their stated willingness to change, revealing a clear discrepancy.

Previous unsuccessful attempts at behavioural change sometimes generated negative psychological expectations. G15 had successfully lost weight twice but subsequently regained it and stated: “I have no choice but to change now. Actually, it’s not that I have ten out of ten confidence; I have ten out of ten motivation. As for confidence, I’d give myself two out of ten.” (G15)

G16 had previously attempted to lose weight through dietary restriction but had been unsuccessful: “After having so many examinations, I’m a little scared. I’m prepared to make changes, but I feel like I can’t lose the weight. It’s very difficult because I couldn’t control myself before, but I’ll definitely try my best to control it.” (G16) G9 had previously attempted to exercise at home but had been unable to maintain it: “It’s so hard to keep exercising. I’ll see how it goes. Mainly, I’m lazy. I might try to make an effort, though, since I’ve now found out that my blood pressure is so high.” (G9)

3.2 Gradual compromise as an adaptive strategy

Some participants proposed gradual goal-setting strategies. They accepted incremental behavioural goals rather than pursuing rapid and complete change.

“I don’t know how much perseverance I have to keep going. Small changes would be okay, but if you’re talking about major changes, I don’t think that’s necessary.” (G8) G14 similarly indicated that smoking cessation needed to proceed gradually: “Going from one pack a day to five cigarettes a day—that’s something I can slowly accept. But if you suddenly ask me to stop smoking completely, it’s not just me; other people would find that hard to accept too.” (G14) G9 described incorporating physical activity into daily routines: “I could probably keep up walking—for example, when I go downstairs to take out the rubbish, I could walk a couple of laps before going home. Something like that would be manageable.” (G9)

Under real-world constraints, participants therefore made choices that they considered more compatible with sustainable behavioural change rather than attempting comprehensive behavioural transformation within a short period.

4. Barriers to realising the value of smart health technologies

4.1 Superficial use and rapid abandonment

Most participants were open to smart bands or smartwatches, and some reported currently using such devices. However, actual use was heavily concentrated on basic functions such as step counting and sleep monitoring, whereas functions more closely related to cardiovascular risk—including blood pressure monitoring, analysis of heart rate variability, and alerts for abnormal values—were used less frequently.

Participants stated: “Just being able to measure blood pressure would be enough.” (G16) “For now, functions like blood pressure and sleep monitoring are enough.” (G11) “Step count and sleep monitoring. Nothing else.” (G6) Several participants reported having previously used such devices but quickly abandoning them: “Because it needed charging so often. I found it troublesome.” (G13) “Because the battery ran out and I couldn’t be bothered to charge it. Most of the time I just stopped using it.” (G15) “I’ve used a smart band before, but I couldn’t get used to wearing it, and it was inconvenient at work.” (G3, G17)

When the value provided by a device was perceived as non-essential, even minor inconveniences could become reasons for discontinuing its use.

4.2 Emergency alerts prioritised over routine data monitoring

Some participants indicated that their most urgent need from current smart health technologies was not access to more health data, but rather protection against sudden adverse events. Desired functions included automatic alerts and information transmission in emergencies, continuous non-invasive monitoring of vital signs, and preventive warnings before an abnormal event occurred.

G4 stated: “I think ECG monitoring might be necessary, but it isn’t that important. It only needs to be able to detect something when necessary—for example, if a myocardial infarction or something else happens.” (G4) G15 stated: “I think the functions it needs should include sending messages to emergency contacts in an emergency, as well as sending an intelligent alert to the hospital.” (G15)

G8 focused on what should be done after abnormal data were identified: “I know my blood pressure is high, but I don’t know what medicine I should take. I can measure my blood pressure even without a smart band. What matters is knowing what to do.” (G8)

The core functions of current smart devices may be oriented towards providing more data to help users make better health decisions. However, participants’ actual needs tended to focus more on obtaining solutions to problems and reducing anxiety about unpredictable events.

4.3 An individual perspective on autonomy and humane support beyond data monitoring

One participant expressed a distinctive need extending beyond data monitoring: “I think people need to have the right to determine their own dignity... In an emergency, you could set in advance what kinds of

treatment you would accept and what kinds you would not accept, and choose a dignified way to leave this world.” (G15)

The participant further suggested that functions allowing users to leave a will in advance or make arrangements for autonomous decision-making in emergencies: “would actually be more practical than most monitoring functions.” (G15) This perspective did not represent the shared experience of the majority of participants, but it suggests that there may be a humanistic dimension in the design of smart health technologies that has not yet received sufficient attention.

Discussion

This study used the HBM to analyse the self-management experiences of young and middle-aged adults at high cardiovascular risk. The findings revealed a disconnect between risk knowledge and the emotional experience of threat. Family responsibility played an important role in translating risk perception into behavioural motivation, while self-efficacy and real-world occupational contexts jointly influenced the long-term maintenance of health behaviours. In addition, participants’ expectations of smart health technologies extended beyond data recording, with greater emphasis placed on risk interpretation, actionable guidance, and safety support. These findings suggest that health behaviours among young and middle-aged adults at high cardiovascular risk may be jointly shaped by cognitive, emotional, relational, and contextual factors.

Risk perception: a gap between cognitive awareness and felt vulnerability

This study found that although young and middle-aged adults at high cardiovascular risk were generally able to accurately identify their own risk factors, their risk awareness did not effectively translate into an internalised sense of threat, reflecting a clear gap between “knowing” and “believing”. At the cognitive level, participants acknowledged that factors such as hypertension, dyslipidaemia, and unhealthy lifestyles could increase the risk of cardiovascular disease; emotionally, however, they still tended to perceive the disease as distant from themselves and did not develop sustained vigilance towards the risk. Similarly, previous research has suggested that, among young and middle-aged adults, the cognitive capacity to “possess health information” does not automatically translate into the psychological motivation to “experience the risk as personally relevant”^[33]. Traditional health education based primarily on disseminating risk-related knowledge may therefore have limited effectiveness in promoting behavioural change among young and middle-aged adults at high cardiovascular risk, because information provision alone may be insufficient to alter their subjective appraisal of disease threats.

This phenomenon may be related to “optimism bias” or unrealistic optimism. Previous studies have shown that when faced with potential health threats, individuals tend to underestimate their own likelihood of developing disease and to believe that negative health events are more likely to happen to others than to themselves^[34]. This psychological tendency may be particularly pronounced among young and middle-aged adults. A cross-sectional study reported that young adults are often affected by

optimism bias and consequently underestimate their own vulnerability to cardiovascular disease^[35]. On the one hand, individuals at this stage of life are usually at an important period of career development and family responsibility, and their self-identity may still be grounded in perceptions of being “young” and having “strong recovery capacity”. On the other hand, because the disease has not yet caused obvious functional impairment, their assessment of risk may rely more heavily on their current physical experiences than on the potential long-term consequences of future disease. Thus, compared with older adults, the problem among young and middle-aged adults at high cardiovascular risk may not be a lack of risk awareness, but rather the absence of a link capable of activating emotional vigilance.

This finding further broadens the understanding of the applicability of the HBM across different stages of the life course. The traditional HBM proposes that perceived susceptibility and perceived severity are important psychological foundations for health behaviour^[36]. However, the present study suggests that perceived susceptibility among young and middle-aged adults at high cardiovascular risk is not simply a matter of “knowing or not knowing”; rather, there appears to be a disconnect between cognitive awareness and emotional experience. This implies that future health interventions for this population should not focus solely on education about risk factors but should also promote the contextualisation and concretisation of risk. Furthermore, this study found that participants’ understanding of disease severity centred primarily on impairment of family roles rather than solely on threats to their own life and health. This suggests that risk communication strategies may need to shift from a traditional “disease consequences” approach towards a “family role protection” framework.

Future risk communication could explore supplementing conventional education about disease consequences with contextualised information related to financial support for the family, caregiving responsibilities, and future role functioning, while the acceptability and effectiveness of such approaches should be further evaluated in intervention studies. This family-function-oriented approach to risk communication may be more consistent with the values of young and middle-aged adults and may strengthen the psychological relevance of risk information^[37]. Therefore, health education for young and middle-aged adults at high cardiovascular risk should move beyond simply increasing disease-related knowledge towards facilitating the construction of personal meaning around risk, enhancing the perceived reality and urgency of cardiovascular risk through family responsibilities, social roles, and future life circumstances.

Family responsibility as a relational motivation for health behaviour

In this study, the primary motivation for health management behaviours among young and middle-aged adults at high cardiovascular risk arose less from perceived personal health benefits and more from a sense of responsibility to maintain family stability and avoid becoming a burden on their families. This finding does not appear to be unique to the Chinese cultural context. A systematic review synthesising 11 qualitative studies from six countries found that family responsibility was a distinctive motivation for self-management among young and middle-aged adults with hypertension^[16]. Although family responsibility is not unique to Chinese culture, the specific ways in which it is expressed and the moral

weight attached to it may be jointly shaped by familistic culture and the role structure characteristic of this stage of the life course. Collectively, this evidence highlights the distinctive nature of health behaviour motivation among young and middle-aged adults: health management is not driven entirely by individual interests but is formed within networks of family relationships.

Previous health behaviour research has generally emphasised individual autonomy, such as improving disease awareness, strengthening self-management capacity, and promoting healthier lifestyles^[38]. However, among the young and middle-aged participants in this study who carried financial and caregiving responsibilities within their families, “staying healthy” had a clear relational meaning. Participants often changed their behaviours not because they feared becoming ill themselves, but because they were concerned that illness would prevent them from continuing to fulfil their family responsibilities or might even make them a burden on their spouses, children, or parents. This phenomenon is consistent with the concept of “familism”, whereby individual decisions and behaviours are profoundly influenced by family interests, family obligations, and the expectations of family members^[39].

The present study showed that family relationships functioned predominantly as a positive facilitator of health behaviour among young and middle-aged adults at high cardiovascular risk. This differs from findings in some studies of older adults with chronic diseases, in which insufficient family support may hinder health management^[40]. This difference may be related to variations in family roles across different stages of the life course. Older adults generally focus on receiving caregiving support during disease management, whereas young and middle-aged adults may be more concerned about whether they can continue to fulfil their family responsibilities^[41]. Family therefore represents not only a supportive environment for health management but also an important psychological resource that can motivate behavioural change.

This finding has important implications for future intervention design. Most current cardiovascular disease prevention programmes remain centred on the individual, for example by providing individual dietary guidance, exercise prescriptions, or health education^[42]. However, for young and middle-aged adults at high cardiovascular risk, incorporating the family into intervention programmes may have greater potential to facilitate behavioural change^[16]. For example, spouses could be encouraged to participate jointly in setting lifestyle modification goals, and family members could serve as sources of behavioural supervision and support. At the same time, “protecting the family’s future” could be incorporated as an important health management goal to strengthen the intrinsic meaning of behavioural change. Overall, within the Chinese cultural context, health management among young and middle-aged adults at high cardiovascular risk should not be regarded solely as an individual health responsibility, but should also be understood as a process of maintaining family responsibilities. Future intervention strategies may therefore need to move beyond a “patient-centred” approach towards a “family-as-a-unit” model of health promotion.

The initiation–maintenance gap in self-efficacy

This study further identified a clear “initiation–maintenance gap” in health behaviour change among young and middle-aged adults at high cardiovascular risk: most participants expressed a strong willingness to change, but lacked confidence in their ability to maintain these changes over the long term. This suggests that difficulties in behavioural change arise not primarily during the formation of awareness or intention, but rather during sustained implementation. In this study, the maintenance of health behaviours among some participants was influenced not only by individual willingness and capability but also by their specific occupational contexts. Differences across types of work suggest that occupational context may constitute an important background factor in behavioural maintenance and that barriers to health management may vary substantially across work settings^[43,44]. Therefore, the “initiation–maintenance gap” among young and middle-aged adults at high cardiovascular risk may reflect not only insufficient self-efficacy but also a mismatch between health behaviour goals and the realities of their working lives. Occupational context may represent an important external source of perceived barriers and may further undermine confidence in long-term adherence by repeatedly disrupting health plans and increasing fatigue and time pressure.

In Bandura’s social cognitive theory, self-efficacy influences not only whether an individual initiates a behaviour, but also whether that individual can sustain the behaviour when faced with difficulties^[45]. Previous successful experiences are among the most important sources of information for developing self-efficacy, whereas repeated failures may weaken individuals’ perceptions of their ability to control their own behaviour. In this study, some participants had experienced unsuccessful attempts at weight loss or difficulties maintaining exercise, and these experiences gradually contributed to a psychological pattern of “I know I should change, but I may not be able to keep it up.”

Some participants, however, described a strategy of “gradual compromise”, such as progressively reducing the number of cigarettes smoked or increasing the amount of walking in daily life. Rather than simply representing a retreat from behavioural goals, these strategies may reflect adaptive self-regulation in response to real-world constraints. Compared with requiring individuals to make comprehensive lifestyle changes immediately, small and achievable goals may be more likely to generate successful experiences and thereby further strengthen self-efficacy^[46,47]. These findings indicate that health management interventions for young and middle-aged adults at high cardiovascular risk need to focus on the maintenance of behaviour rather than only its initiation. Traditional health education often emphasises “what should be done” while overlooking “how to sustain it over time”.

Future nursing interventions could therefore assess individual self-efficacy while also incorporating working hours, physical workload, shift patterns, and discretionary time into the design of health management programmes, using staged goal-management approaches tailored to different occupational contexts. During the early stages of an intervention, priority could be given to low-threshold, achievable goals that can be integrated into existing work routines. Repeated experiences of success could then be used to strengthen self-efficacy before behavioural requirements are gradually increased^[48].

Digital health support: from data quantification to actionable and humane support

This study found that although young and middle-aged adults at high cardiovascular risk generally recognised the potential value of smart health technologies, their actual use was often limited to basic functions such as step counting and sleep monitoring, and these technologies were frequently abandoned because of factors such as the burden of device maintenance and failure to establish regular usage habits. This suggests that a degree of mismatch remains between the current development logic of digital health technologies and users' actual needs. Existing smart devices are largely based on the concept of the "quantified self", whereby physiological and behavioural data are continuously collected to help users monitor and understand their health status and support health management and disease prevention^[49,50]. However, the present study found that what young and middle-aged adults at high cardiovascular risk were genuinely concerned about was not obtaining more health data, but rather gaining a sense of security and decision-making support when confronted with sudden health risks. This discrepancy in needs may help explain why many users are willing to purchase smart devices but find it difficult to maintain long-term use. Previous studies have similarly shown that long-term adherence to wearable devices in chronic disease management remains limited and is often affected by device burden, difficulties in interpreting data, and a lack of continuous feedback^[51,52].

The present study further found that, for individuals at high cardiovascular risk, the main issue was not simply access to data, but how those data could be translated into actionable health decisions. For example, when abnormal blood pressure or changes in heart rate occurred, users were more concerned with "what should I do next?" than with being shown additional indicators. In addition, some participants expressed needs for functions such as emergency-contact notifications and autonomous medical decision-making, further broadening the humanistic dimension of the value of digital health technologies. Current smart wearable technologies tend to focus more on disease monitoring and risk prediction, with comparatively less attention to patients' psychological sense of security, preservation of dignity, and need for autonomous choice when facing uncertainty related to illness^[51,53].

Future smart health technologies may therefore need to evolve from "health monitoring devices" into "safety support systems", providing not only data but also risk interpretation, behavioural recommendations, emergency support, and decision-making assistance consistent with individual values. These needs reflect participants' expectations for reassurance about their safety and guidance on appropriate actions. However, the development of such functions will require clinical validation, risk stratification, management of false alerts, and assessment of privacy and ethical considerations.

At the same time, the needs associated with smart technologies may differ across age groups. Previous studies of older users have found that older adults may place greater emphasis on measurement accuracy, ease of operation, and comfort, whereas young and middle-aged users may be more concerned with whether devices can reduce uncertainty about illness and anxiety related to sudden health risks^[54,55]. Digital health products therefore need to be personalised across multiple dimensions, including age, disease risk, and psychological needs. The development of health technologies should not

be limited to improving monitoring accuracy, but should move from a “data-driven” towards a “user-value-driven” approach, integrating technological capabilities with humanistic care to genuinely support the long-term health management of high-risk populations.

Finally, the acceptability of smart health technologies also depends on whether they can be integrated into users’ occupational contexts. For individuals engaged in shift work, manual labour, or jobs with intensive work schedules, frequent charging, discomfort during wear, poorly timed reminders, and complicated operating procedures may all increase the burden of use. Technology design should therefore also consider compatibility with the working environments of users in different occupations in order to reduce the burden associated with sustained use.

Preliminary explanatory conceptual framework

In summary, based on participants’ accounts, this study developed a preliminary explanatory conceptual framework that, on the basis of the HBM, gives further consideration to two factors—“emotional risk connection” and “family responsibility”—within a potential explanatory pathway for the formation of health behaviours among young and middle-aged adults at high cardiovascular risk (Fig. 1). Here, “emotional risk connection” refers to the process by which individuals relate objective risk factors to their own real-life circumstances, potential future consequences of disease, and important social roles, thereby transforming abstract knowledge of risk into a personally relevant and urgent subjective experience of threat. This factor may play a transitional role among perceived susceptibility, perceived severity, and cues to action, potentially explaining why some individuals have relatively high levels of risk knowledge but nevertheless lack motivation to act.

“Family responsibility” refers to the process by which individuals reappraise the benefits of health behaviours and the consequences of disease in light of role-based obligations, including providing financial support for the family, caring for children, supporting ageing parents, and avoiding becoming a caregiving burden. It may not only strengthen perceived severity and perceived benefits but may also transform individually centred behavioural goals into motivation to maintain family stability and fulfil role responsibilities.

Based on the findings of this study, the data suggest a possible explanatory pathway in which health behaviours among young and middle-aged adults at high cardiovascular risk may progress through risk perception → emotional risk connection → activation of family responsibility → formation of behavioural intention → regulation by self-efficacy → behavioural initiation and maintenance. Within this process, cues to action, such as symptom experiences, cardiovascular events among peers, abnormal examination results, and hospitalisation experiences, may enhance the perceived reality of risk and trigger an emotional connection. Family responsibility may further imbue behavioural change with a sense of moral responsibility, while self-efficacy may ultimately determine whether behavioural intentions can be translated into sustainable self-management practices. Within this framework, the constructs of the traditional HBM may not operate independently among young and middle-aged adults,

but may instead form a continuous chain of influence through emotional intention, appraisal of family roles, and judgements of self-efficacy.

This preliminary interpretation is not intended as a formal extension or validation of the HBM, but rather as a context-specific supplement based on the present data, highlighting the potential emotional and relational processes involved in health decision-making within a particular stage of the life course and social context. Its theoretical significance lies in providing further explanation for phenomena that traditional models may not fully account for, such as “being aware of risk but not taking action” and “being willing to change but finding it difficult to maintain change over time”. Its practical significance is that, beyond education about risk factors, intervention providers may need to facilitate the translation of risk knowledge into sustained health behaviours through family-contextualised risk communication, motivation based on role responsibilities, and staged support for self-efficacy.

Strengths and limitations

This study has several strengths. First, maximum-variation purposive sampling was used, taking into account participants’ age, occupation, composition of cardiovascular risk factors, and previous experience with smart health technologies, which helped to obtain a relatively diverse range of experiences. Second, the HBM was used as the initial analytical framework, while data that fell outside this framework were coded inductively, thereby maintaining a theoretical focus while reducing the likelihood that newly emerging experiences would be overlooked. Third, the traceability and reflexivity of the analytical process were strengthened through independent coding by two researchers, reflexive memo writing, and research-team discussions.

This study also has several limitations. First, all participants were recruited from a single hospital in Guangzhou, Guangdong Province, China. The sample size was relatively limited, and male participants accounted for a relatively high proportion of the sample. The findings may therefore have been influenced by regional culture, the healthcare environment, and the composition of the sample, and their applicability to populations from different regions, genders, and socioeconomic backgrounds requires further investigation. Second, purposive sampling was used and participants’ previous experience with smart health technologies was considered during sampling, which may have introduced selection bias. In addition, the interview data were derived primarily from participants’ subjective accounts and may therefore have been affected by recall bias and social desirability, and may not fully reflect their actual and sustained health management behaviours.

Furthermore, although inductive coding and reflexive discussions were undertaken for data that could not be accommodated within the HBM framework, the use of HBM-guided directed content analysis means that the influence of a priori theoretical assumptions on data interpretation cannot be completely excluded. Finally, the explanatory concepts of “emotional risk connection” and “family responsibility” developed in this study were derived primarily from qualitative data and require further examination.

It should also be noted that the operational criteria used in this study to define high cardiovascular risk under the Chinese programme included a history of myocardial infarction, stroke, or revascularisation. Accordingly, the sample included both participants classified as high risk on the basis of risk factors or risk scores and those classified on the basis of previous cardiovascular events or revascularisation. This definition was consistent with the Chinese implementation studies on which the operational criteria were based; however, participants classified through different pathways may have had different risk experiences and health management contexts. Given the qualitative sample size, no stratified comparisons were conducted in this study. Future multicentre studies using maximum-variation sampling could further compare the experiences of populations classified as high risk through different pathways and combine longitudinal observation, behavioural data, and quantitative research to further examine and refine the relevant constructs and conceptual framework.

Conclusions

This study suggests that self-management among young and middle-aged adults at high cardiovascular risk is influenced by more than risk knowledge alone. Emotional risk connection, family responsibility, self-efficacy, and real-life contexts may jointly contribute to the initiation and maintenance of health behaviours. The findings highlight the importance of family-based risk communication, staged enhancement of self-efficacy, and the development of digital health support systems that integrate safety monitoring with humanistic care. These findings provide empirical evidence and testable directions for the design of tailored nursing interventions for young and middle-aged adults at high cardiovascular risk, while also providing a preliminary basis for future examination of the contextualised application of the HBM in this population.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the First Affiliated Hospital of Guangzhou University of Chinese Medicine (Approval No. K-2026-014).

All participants were informed about the study objectives, procedures, confidentiality measures, potential benefits and risks, and their right to withdraw from the study at any time without affecting their medical care. Written informed consent was obtained from all participants before the interviews.

All procedures were conducted in accordance with relevant ethical guidelines and regulations.

Consent for publication

Not applicable. No directly identifiable personal information is reported in this manuscript. All participant quotations and related information have been de-identified to protect confidentiality.

Availability of data and materials

The interview transcripts generated and analysed during the current study are not publicly available because they contain sensitive personal experiences and contextual information that may compromise participant confidentiality.

De-identified data supporting the findings of this study may be available from the corresponding author upon reasonable request, subject to institutional requirements and appropriate protection of participant privacy.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

YG and JT contributed to the study conception, methodology development, data collection, and manuscript drafting. CY and ZO contributed to participant recruitment, data collection, and qualitative data analysis. JL and YL contributed to data interpretation and manuscript revision. LC and BW contributed to study supervision, methodological guidance, critical revision of the manuscript, and project administration.

All authors contributed to the interpretation of findings, reviewed the manuscript, and approved the final version.

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Figures

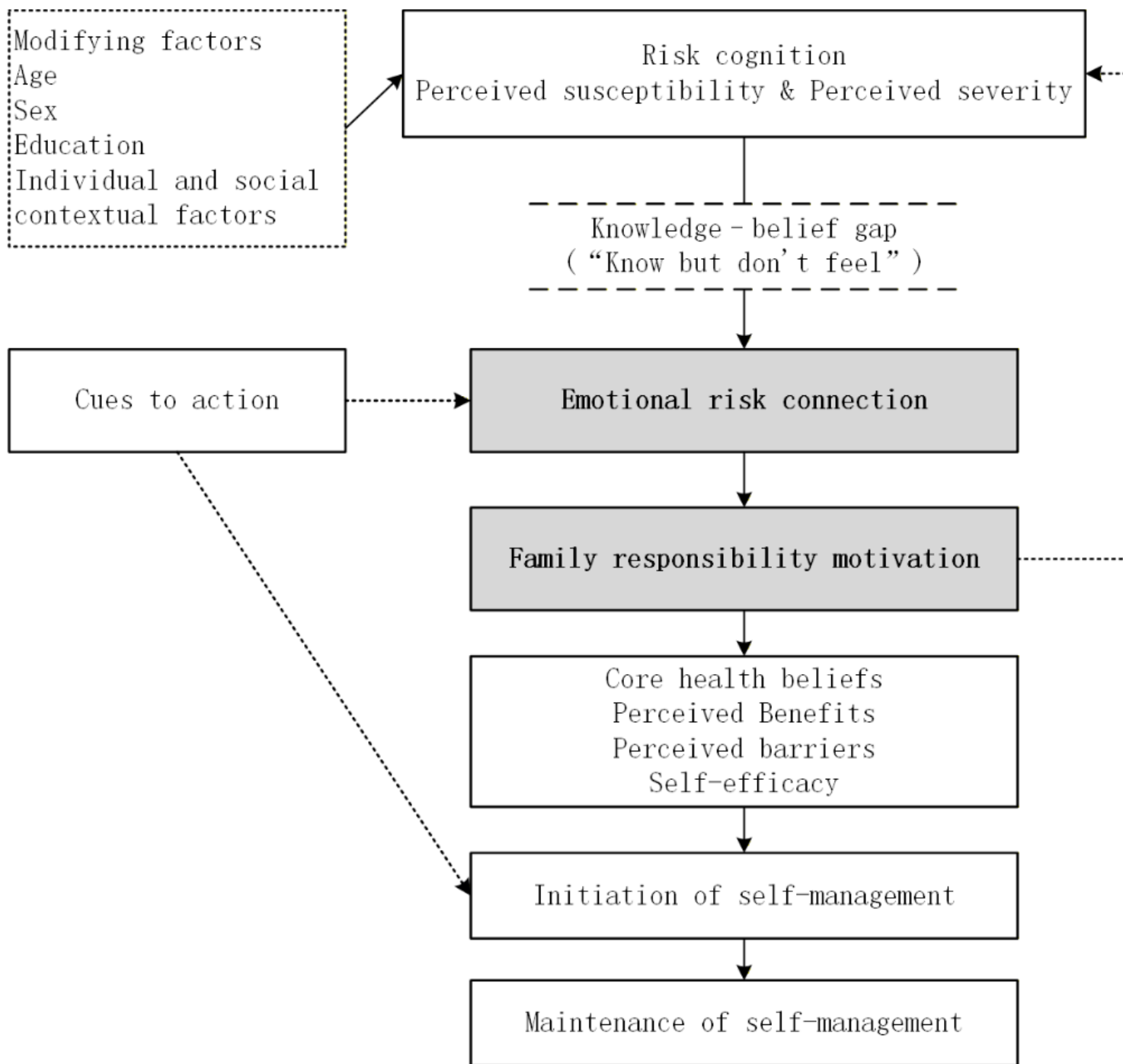


Figure 1

A preliminary conceptual framework derived from participants’ accounts of self-management among young and middle-aged adults at high cardiovascular risk