Article:
Lorenc, Theo orcid.org/0000-0001-8937-6378, Stokes, Gillian, Fulbright, Helen et al. (2 more authors) (2024) Communicating cardiovascular risk:Systematic review of qualitative evidence. Patient Education and Counseling. 108231. ISSN 0738-3991

https://doi.org/10.1016/j.pec.2024.108231

Patient Education and Counseling 123 (2024) 108231

Contents lists available at ScienceDirect

Patient Education and Counseling

journal homepage: www.journals.elsevier.com/patient-education-and-counseling

Communicating cardiovascular risk: Systematic review of qualitative evidence

Theo Lorenc [a,*], Gillian Stokes [b], Helen Fulbright [a], Katy Sutcliffe [b], Amanda Sowden [a]

[a] Centre for Reviews and Dissemination, University of York, York YO10 5DD, UK
[b] EPPI-Centre, Social Science Research Unit, University College London, Gower Street, London WC1E 6BT, UK

ARTICLE INFO

Keywords:
Cardiovascular diseases
Risk assessment
Systematic review
Qualitative research

ABSTRACT

Introduction: Cardiovascular risk prediction models are widely used to help individuals understand risk and make decisions.
Methods: Systematic review of qualitative evidence. We searched MEDLINE, Embase, PsycINFO and CINAHL. We included English-language qualitative studies on the communication of cardiovascular risk. We assessed study quality using Hawker et al.'s tool and synthesised data thematically.
Results: Thirty-seven studies were included. Many patients think that risk scores are of limited practical value. Other sources of information feed into informal estimates of risk, which may lead patients to reject the results of clinical risk assessment when the two conflict. Clinicians identify a number of barriers to risk communication, including patients' limited understanding of risk and excessive anxiety. They use a range of strategies for adapting risk communication. Both clinicians and individuals express specific preferences for risk communication formats.
Discussion: Ways of communicating risk that provide some comparison or reference point seem more promising. The broader context of communication around risk may be more important than the risk scoring instrument. Risk communication interventions, in practice, may be more about appeals to emotion than a rationalistic model of decision-making.

1. Introduction

Several different prediction models are available for calculating individuals' risk of cardiovascular disease, such as the Framingham Risk Score [1] and QRISK [2–4]. These tools combine information about individuals' demographics, behaviours (e.g. smoking status) and clinical measurements (e.g. blood pressure, cholesterol, BMI) to estimate their future risk of cardiovascular disease. Aside from its value in clinical decision-making, risk assessment may be of value in raising awareness of disease and helping to motivate behaviour change to reduce risk, for example stopping smoking. The focus of this review is on the communication of risk to patients, with the aim of increasing their understanding of risk and helping them to make decisions about how to reduce risk.

In the context of treatment decision-making, risk perception may be an important outcome of communication [5–7]. Guidance on the use of decision aids emphasises the importance of consistent presentation of risk information, and the use of appropriate methods to report risk to maximise comprehensibility [8]. For cardiovascular risk, there is a substantial body of evidence on the effectiveness of incorporating risk assessment into clinical care in reducing risk factors [9–11], and a smaller number of studies comparing different ways of communicating risk [12,13]. However, systematic reviews find that the evidence base is too limited to draw reliable conclusions on the effectiveness of risk assessment in improving patient outcomes [9,10]. Qualitative evidence can help to illuminate the pathways through which risk communication can lead to changes in health behaviour, to understand how clinicians and patients approach risk in practice, and to identify barriers and facilitators of successful communication. One previous systematic review covers some of the studies included in this review [14], but does not report a synthesis of qualitative data.

This review was commissioned to inform policy development for the NHS Health Check programme in England. This programme aims to promote early identification and management of cardiovascular risk factors among adults aged 40–74 without cardiovascular disease. A key part of this process is the standardised assessment of cardiovascular risk

* Corresponding author.
E-mail address: theo.lorenc@york.ac.uk (T. Lorenc).

https://doi.org/10.1016/j.pec.2024.108231

Available online 29 February 2024

using QRISK3 [15]. Current policy for the Health Check programme emphasises the need for risk communication to support individuals to understand and manage their cardiovascular risk [16]. This review aimed to identify and bring together what is known from qualitative data about how people understand risk assessment, and about patients' and clinicians' experiences of using risk prediction tools, to inform emerging policy and practice in this area.

2. Methods

The review was registered on PROSPERO (registration number CRD42022380742). EPPI-Reviewer Web software was used to manage data.

The search strategy included terms to represent the following concepts: cardiovascular disease; risk assessment or risk communication; and qualitative studies. The strategy used a geographic filter to limit papers to OECD countries (as this review was carried out to inform policy development in England, and studies in low- and middle-income countries may be less transferable to this context) and was limited to English language papers. No date limits were applied. The following databases were searched in October 2022: MEDLINE(R) ALL (Ovid); Embase (Ovid); PsycINFO (Ovid); and CINAHL (EBSCO). The MEDLINE strategy is reproduced in Appendix 1.

The studies were screened against the following criteria:

1. Does the study report primary qualitative data?
2. Does the study focus on the assessment or measurement of cardiovascular risk in people without diagnosed cardiovascular disease?
3. Does the study report substantive data on the views of clinicians or patients about the communication of cardiovascular risk using formalised tools?
4. Was the study conducted in a high-income country (OECD member)?
5. Is the study available in English?

A 10% sample of titles and abstracts were screened by two reviewers (TL and GS, both researchers specialising in systematic review with expertise in qualitative research), and differences resolved by discussion. The remaining titles and abstracts were screened by one reviewer alone, with reference to a second reviewer in case of uncertainty. All full-text references were screened by two reviewers (TL and GS) independently.

The quality of included studies was assessed using Hawker et al.'s tool [17]. Contextual data on the studies was extracted using a standardised form. Quality assessment and data extraction were conducted by one reviewer and checked in detail by a second. Qualitative data were coded line-by-line using the coding tool in EPPI-Reviewer Web. We coded all qualitative findings data which addressed the topic delimited by the criteria, both direct quotes from participants and authors' summaries. A qualitative thematic synthesis was undertaken to identify key themes in the data [18]. Coding was carried out by GS and TL. An initial phase of open coding was carried out, with the framework of a division between patient and clinician data. After discussion of this first phase, we categorised the emerging themes under the following broad headings: understanding of risk; contexts of risk communication; and impacts of receiving or communicating the risk score (see Appendix 3 for further details). This framework then informed a second phase where further thematic codes were identified. Where new codes emerged during the process of synthesis, all data were re-read to ensure they were captured across the data set.

3. Results

The searches returned 7298 unique records. After screening, a total of 37 studies were included in the review. The flow of literature through the review is shown in Fig. 1. The characteristics of the studies (population and setting) are shown in Table 1. Studies were conducted in a range of countries, most commonly the UK (n = 16) and Australia (n = 8), perhaps reflecting the implementation of large-scale Health Check

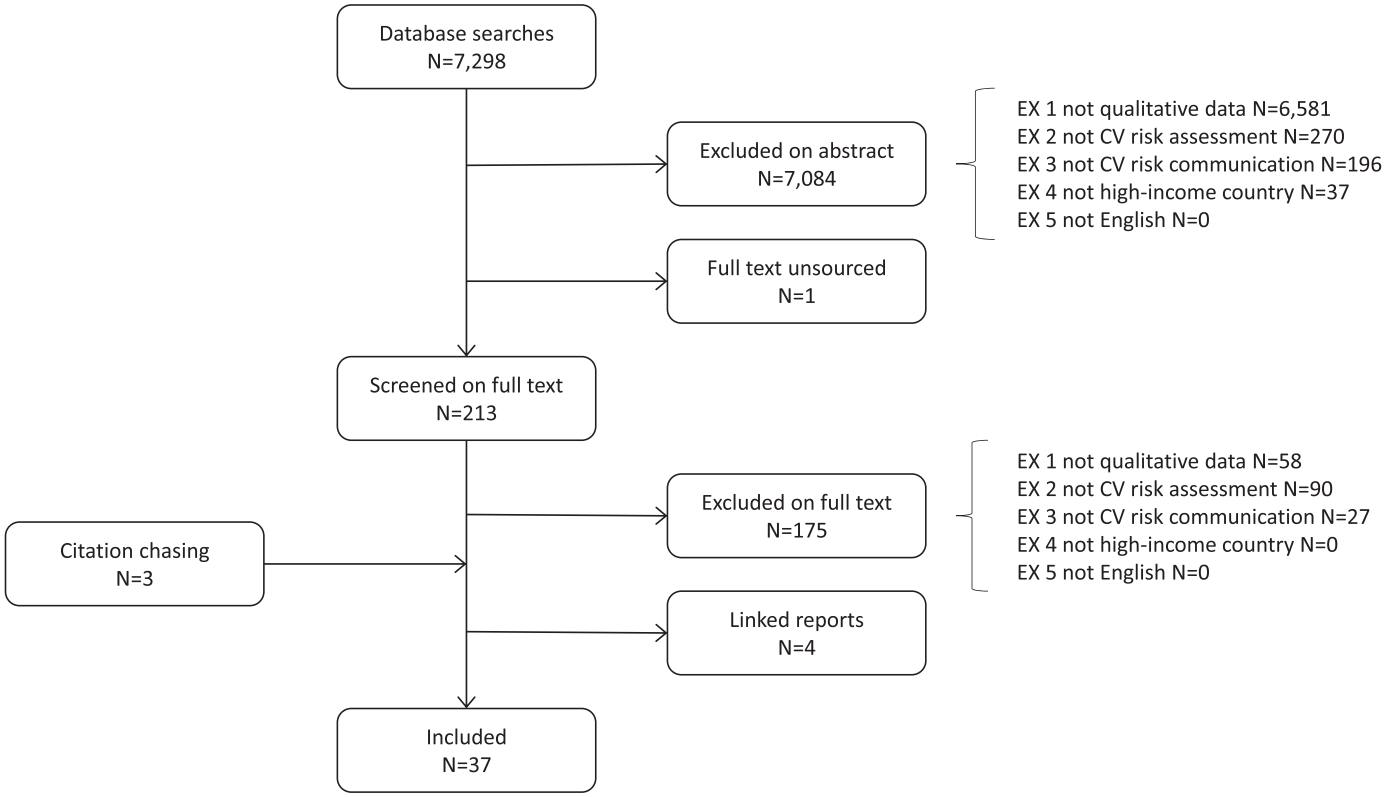

Fig. 1. Flow of literature through the review.

Table 1
Characteristics of the studies included in the review.

Reference	Country	Population (age)	Data collection methods	Sample size	Context
Bengtsson et al.[19]	Sweden	GPs	Semi-structured interviews	15	Health Check
Boase et al.[20]	UK	Nurses	Focus groups, semi-structured interviews	28	Primary care
Bonner et al.[21,22]	Australia	GPs	Semi-structured interviews	25	Primary care
Bonner et al.[23]	Australia	Gen. pop. (40-67)	"Think-aloud" interviews	26	Web-based risk tool
Bonner et al.[24]	Australia	Gen. pop. (35-74)	"Think-aloud" interviews	25	Web-based risk tool
Coorey et al.[25]	Australia	GPs + gen. pop. (mean 68)	Focus groups, semi-structured interviews	72	Primary care
Cupit et al.[26]	UK	Clinicians + gen. pop. + stakeholders	Interviews and observation	47	Health Check
Damman et al.[27]	Netherlands	Gen. pop. (mean 53) with low health literacy	"Think-aloud" interviews	23	Web-based risk tool
Damman et al.[28]	Netherlands	Gen. pop. (45-65)	Semi-structured interviews	16	Web-based risk tool
Farrimond et al.[29]	UK	Gen. pop. (mean 58)	Structured interviews	38	Primary care
Frolund and Primdahl [30]	Denmark	People with rheumatoid arthritis (51-70)	Focus groups	14	Hospital
Gidlow et al.[31–33]	UK	Clinicians + gen. pop. (40-74)	Observation (video-recorded) and "video-stimulated" interviews	183	Health Check
Gooding et al.[34]	USA	Young people (17-21) + parents	Semi-structured interviews	72	Hypothetical risk results
Grauman et al.[35,36]	Sweden	Gen. pop. (52-65)	Focus groups	31	Health Check
Hall et al.[37]	UK	GPs + nurses + gen. pop. (20-60)	Observation (video-recorded) and semi-structured interviews	28	Primary care
Hawking et al.[38]	UK	Gen. pop. (40-64)	Semi-structured interviews	18	Health Check
Hill et al.[39]	Australia	GPs + gen. pop. (mean 50)	Focus groups	37	Hypothetical risk tools
Honey et al.[40]	UK	People at high CV risk (46-74)	Semi-structured interviews	37	Health Check
Kirby and Machen[41]	UK	GPs + nurses + gen. pop.	Focus groups and interviews	35	Primary care
Lenz et al.[42]	Germany	Clinicians + people with type 2 diabetes	Structured interviews	32	Hypothetical risk tools
Marshall et al.[43]	UK	People with hypertension (51-90)	Semi-structured interviews	24	Hypothetical risk tools
McKinn et al.[44]	Australia	GPs	Semi-structured interviews	25	Hypothetical patients
McNaughton[45]	UK	People at high CV risk (57-76)	Semi-structured interviews	26	Health Check
Middlemass et al.[46]	UK	Gen. pop. (median 59)	Interviews	29	Primary care
Nielsen et al.[47]	Denmark	Gen. pop.	Interviews	22	Health Check
Nolan et al.[48]	UK	People with diabetes (44-77)	Focus groups, "think-aloud" interviews, semi-structured interviews	36	Web-based risk tool
Peiris et al.[49]	Australia	GPs	Semi-structured interviews	21	Primary care
Perry et al.[50]	UK	Gen. pop.	Focus groups, semi-structured interviews	36	Health Check
Polak and Green[51]	UK	Gen. pop. (53-87)	Semi-structured interviews	34	General views
Riley et al.[52]	UK	Clinicians + gen. pop. (>40)	Interviews	43	Health Check
Sheridan et al.[53]	USA	People at moderate to high CV risk (52-75)	Focus groups	29	Pilot risk tool
Snell and Helen[54]	Finland	Gen. pop. (46-65)	Focus groups	40	Hospital
Taylor et al.[55]	New Zealand	Gen. pop. (61-91)	Interviews and focus groups	39	General views
Usher-Smith et al.[56]	UK	Gen. pop. (40-80)	Interviews	37	Web-based risk tool
Vaidya et al.[57]	Australia	GPs + gen. pop. (53-71)	Semi-structured interviews	70	Primary care
van Steenkiste et al. [58]	Netherlands	GPs	Semi-structured interviews	15	Primary care
Wan et al.[59]	Australia	GPs + gen. pop. (42-81) + stakeholders	Focus groups, semi-structured interviews	57	Primary care

Abbreviations: GPs = general practitioners; gen. pop. = general population

programmes in those countries. Twenty-nine studies included patients and sixteen studies included clinicians (ten studies included both). Most of the studies including patients focused on general-population samples in late middle age or older (again, reflecting the population targeted by Health Checks). Study quality was moderate overall, with some low scores on question 4 (sampling) and question 8 (transferability and generalisability). The full results of quality assessment are shown in Appendix 2. The study contexts varied, with five main types:

- studies of established health check programmes in clinical settings;
- studies of clinicians' views and practices around risk assessment, generally in primary care settings;
- studies of the general population or specific risk groups, eliciting broad views of risk assessment;
- trials or pilots of specific novel risk assessment tools;
- studies of the general population or specific risk groups, eliciting reactions to the presentation of hypothetical risk data.

The results of the thematic coding are reported in two parts according to whether views were expressed by patients or clinicians, followed by data on specific preferences for risk communication, where we have combined the two. See Appendix 3 for further detail.

3.1. Patient data

3.1.1. Understanding of risk

Two studies which directly aimed to assess participants' understanding of risk scores generally found that most participants correctly understood the information presented [42,43]. However, participants in several studies expressed uncertainty about what the risk score referred to [23,24,28,31,35,41,48,50,51]. Several studies found that some participants identified as at high risk were under the impression that they had received a low risk rating [27,28,31,39,45,52]. In some cases participants tended to think of risk in binary terms – 'at risk' versus 'not at risk', or 'abnormal' versus 'normal' – so that the concept of percentage risk was seen as irrelevant or confusing [24,35,38,50,51].

3.1.2. Interpretation and credibility of risk scores

However, the data do not suggest that participants (with a handful of exceptions) literally did not understand the meaning of a percentage risk score. More commonly, the percentage risk in isolation from any 'normal' or average risk was not felt to be meaningful or actionable.

> I think with the percentage unless you have been given the range it should be in for your age and for your, you know, capabilities, then it's kind of a mismatch of information. I don't know which to kind of … they are saying it's high, but I think it's quite low, but I don't know what high is because I haven't been given anything to compare it against. (participant [31])

In other cases participants were willing to translate risk scores into practical implications, but applied their own tacit thresholds which were often much higher than those in clinical guidelines (often 50% or even higher) [24,27,28,31,39,45,57].

> When they said that I was 28 out of 100, well I thought that was quite low. If I was 50%, 60%, 70% then I would be quite worried. At 28% I wasn't all that worried, if you know what I mean? (participant [45])

Some participants suggested that probabilistic reasoning about future events is inherently questionable, and contrasted the overall risk scores with more concrete information such as blood pressure or cholesterol readings [25,27,31]. Some argued that the applicability of population risk algorithms to individuals is always debatable [42,43,45,51].

> [Interviewer:] So getting your actual cholesterol result, so rather than having kind of your 10-year risk or your heart age, or your survival age, it would be your cholesterol … ? [Participant:] Yeah very much so because that is the now, you know all those other things are projections. (participant [31])

3.1.3. Risk factors and model inputs

Many participants who received high risk scores questioned their validity on the grounds that they conflicted with their own sense of themselves as healthy, either as a subjective perception or on the basis of their lifestyle behaviours or physical capacities [23,25,28,29,31,34,35,43,45,48,56].

> It was a bit of a shock to be honest, because as I say, I thought that when I would get the results of that my, say, I'm 59, I know, but I thought my heart would be, or my rating would be say down much lower at 54, 55 or something like that.'cos of the amount of exercise I do and, you know, my weight I think is about right and I'm, I don't get ill at all and fortunately I haven't got any, you know, any long-term health problems. (participant [56])

Participants in several studies pointed to the importance of genetic or family history factors in determining risk, and some were sceptical of risk assessment because it did not incorporate these [25,28,29,31,34,40,43,45,55]. However, studies focusing specifically on the use of genetic information into risk scoring found that it was sometimes challenging to incorporate into risk assessment, and seen as of limited practical value [37,46,54].

Many participants emphasised the importance of lifestyle factors – physical activity, diet, smoking, alcohol, stress and so on – in determining their perceptions of risk. The fact that risk assessment procedures generally did not include information on these factors, other than smoking, was a source of scepticism [23–25,27,28,45,53]. Participants often interpreted risk scores in the light of their perceptions of their lifestyle, and were sceptical where they perceived a dissonance [23,27–29,43,45,46,48,50,54].

> The only thing is, eh, lifestyle, eh, whether you exercise or not, whether you have a sedentary job or not, use drugs, smoke, and eh, your eating habits, those are the most important, I think it would be better to explore those in more detail than to ask about my length and eh waist circumference and things like that. (participant [28])

On the other hand, many participants also expressed the opposite view that cardiovascular events were a matter of chance, and could happen even to people leading healthy lifestyles [31,35,37,40,45], hence calling into question the quantification of future risks.

3.1.4. Impacts of risk assessment

Participants expressed a range of reactions to receiving risk scores, with many reporting anxiety or shocked surprise [25,31,34,35,40,43,45,46,48,50,52,56]. These emotions were not necessarily negative: they could be a "wake-up call" [50] and a stimulus to reducing risk [46,50,52].

> I got a letter from the doctor's saying 'as you are at a high risk of a stroke or heart attack'. well I nearly died, and I thought 'well what have my results come up as?' And so of course I made an appointment and I went on. (participant [40])

In contrast, many participants felt reassured by the risk assessment, particularly those who had previously had concerns about their health [23,30,31,34,35,45–47,50,52,54]. This includes a substantial number who received a high risk score as well as those at low risk [31,45].

Participants' perceptions of CVD had an impact on how they felt about their risk scores. CVD was sometimes seen as not very serious, particularly in comparison with other diseases such as cancer [28,45,48,55]. A few participants expressed the view that a relatively rapid death from a heart attack might be preferable to other causes of death [40,55]. People with other long-term conditions or disabilities were particularly likely to regard CVD as not a major concern [29,30,42,43,45,48].

3.2. Clinician data

3.2.1. Attitudes to risk assessment

Clinicians expressed broadly positive perceptions of risk prediction models, and high confidence in using them and communicating the results to patients [31,52,57,59], although some studies raised concerns about the accuracy of clinicians' understanding [26,31,41,42,58]. Clinicians who were used to managing single risk factors (e.g. elevated cholesterol) were sometimes reluctant to move to a multifactorial risk algorithm [21,57,58], and some found it challenging to explain multifactorial risk scores to patients [26,31]. A few participants also suggested that the detail of the risk assessment process is less important than having an opportunity to discuss cardiovascular risk factors with patients [49,59].

3.2.2. Perception of patients' understanding

Many clinicians found that some patients had difficulties in understanding risk. Several thought that many patients simply did not understand numerical probabilities [22,31,39,41,58,59] or graphical ways of presenting risk [22,39,58]. Even where risk is well understood in the abstract, a percentage risk may not be meaningful in isolation [26], and even where patients understand individual risk factors they may not grasp the idea of combining them into an overall risk score [21,41,42,49].

> I find people don't really respond very well to having figures and risks and charts and things. the average person often chickens out when I start talking graphs and numbers and charts. (participant [39])

3.2.3. Strategies for communicating risk results

Participants reported that some patients reacted with excessive fear or anxiety [19–22,58], and that they changed their communication style when dealing with patients they perceived to be anxious.

> Ones that have a high cholesterol just about freak out and they don't need anybody more telling them … their risks of having a heart attack … I would be a bit dubious about showing them straight off because they would only get themselves into more of a state. (participant [48])

Participants were sometimes reluctant to communicate risk where patients received low risk scores but had risky lifestyles or behaviours, for fear of demotivating them to make changes [21,58]. There were varying perceptions as to how far risk assessment was likely to motivate patients to change [31,41]. Some participants felt that patients may have more immediate concerns, such as socio-economic issues or mental health, which made conversations about cardiovascular risk less useful [20,22].

Partly due to these challenges, clinicians described using different strategies for tailoring risk, based both on their prior knowledge or overall impressions of the patient, and on their moment-by-moment reactions in the consultation [20,22,31,59]. Participants viewed a generic 'box-ticking' approach to communicating risk that did not incorporate these adjustments and situational awareness as inappropriate and potentially harmful [20].

> … there's no one uniform way, I don't think of going about it … it's your own experience, knowing your patients. personality, social class. all those kinds of things … (participant [20])

A range of factors may come into play in tailoring communication, including: patients' understanding of risk; their anxiety around risk and future illness; their current health behaviours; and their willingness to change these behaviours [20,22,59]. Participants described using negatively-framed fear appeal strategies, with emphasis on the likely harms of cardiovascular disease, where they judged that this was necessary to make an impression on the patient, and more positive framings where this was judged to be counter-productive, e.g. for patients who were already anxious [20–22,59]. Participants in several studies reported sometimes not communicating the risk score at all, if they felt the patient would not understand, or that it would be counter-productive in terms of having a constructive conversation about risk factors and behaviours [20,22,31].

3.2.4. *Impacts on treatment decisions and care delivery*

The studies reported conflicting data on treatment decision-making. Some participants found that risk assessment made them more likely to consider preventive treatment, while others reported that it made them more likely to consider lifestyle modification and less likely to prescribe treatment [19,57,58]; some felt that risk prediction models could be valuable in choosing between the two types of response [59]. Similarly, some clinicians saw risk prediction models as a useful tool for involving patients in shared decision-making around treatment, while others were more sceptical due to perceived limitations in patients' understanding [19,58].

Many participants reported that they had limited time to conduct risk assessment and communication, hence limiting the value, and in some cases the usability, of risk tools [19,20,41,49,57,59]. They emphasised that the tools needed to be integrated with existing platforms for data management and decision support, and not unduly time-consuming or complicated, to maximise uptake [41,49,57–59].

3.3. *Specific preferences for risk communication*

Finally, both patients and clinicians expressed specific preferences for ways of communicating or representing risk. In general, both groups expressed a preference for visually engaging formats which use colour and design to focus attention [23–25,39,41,48,49,53].

> […] Because in any situation that is new to you, if there's a lot of things going on and you are not sure what's going on, you don't hear … But if you see it, it is actually much, much clearer to you. (participant [31])

On the other hand, some participants suggested that patients may have limited understanding of quantitative risk information in graphs and tables, and that visually cluttered or confusing formats could hamper comprehension [23,25,28,39,41,48]. Specific issues here included inconsistent use of colour [23], and the use of visual scales from 0%– 100% which made even relatively high risks appear visually small [28,39].

Several studies found a preference for heart age over other ways of representing risk, among both patients and clinicians [23,31,38]. This may be partly because it can be directly compared to the patient's actual age, and so is more meaningful than a decontextualised probability figure.

Several studies found that the ability to modify inputs to the risk algorithm dynamically, and see what difference this made to outputs, was a helpful feature, enabling patients to grasp the potential benefits of making lifestyle changes [25,31,37,40,41,48,49,57]. However, a few participants thought this could sometimes be demotivating, since it can suggest that the payoff of behaviour change is actually not very great [25,48].

4. Discussion and conclusions

4.1. *Discussion*

This review of qualitative evidence finds several important barriers to the communication of cardiovascular risk scores. Many patients report a sense that the risk score in isolation is irrelevant or not practically actionable; without some comparison point, an absolute risk score provides little usable information. Some patients also question the credibility of the risk score, particularly where it conflicts with their own sense of being in good health.

Clinicians report generally positive views of risk assessment, but also scepticism as to whether patients understand the information, and its value for motivating behaviour change. They are concerned about inappropriate reactions both from patients who react with excessive anxiety, and from those who take a low risk score as confirming they do not need to change any lifestyle behaviours. Clinicians report tailoring risk communication in complex ways to individuals' needs.

The findings suggest that individuals' understanding of the risk score – and the broader impacts of risk communication – may depend largely on the broader context of the clinician-patient encounter. If risk scores alone are not meaningful or actionable, the message received may depend on the broader interaction that provides the scaffolding for individuals to make sense of risk. Clinicians may use risk assessment more to generate emotional reactions by focusing attention on the prospect of death or other serious health impacts from cardiovascular disease, than to impart objective information to inform rational decisions.

We located limited data on how risk communication relates to shared decision-making around preventive treatment, and the findings are to some extent conflicting. The findings of this review should be set alongside the broader qualitative literature on decision-making about preventive treatment [60–62]. That literature suggests that patients' often sceptical attitude to risk assessment may extend to views of treatment benefits and over-medicalisation [60,61], and that clinicians find ways to negotiate these barriers while also trying to enable patients' empowerment and autonomy [62]. While some clinicians see their core role as being prescribing treatment, and view the broader consultation and risk assessment as directed to this goal, others take a more holistic view which sees behaviour change as of equal importance with medication [62].

The results of this review should be seen in light of ongoing debates about health behaviour change. These debates set social cognitive theories such as the Health Belief Model [63] and the Theory of Planned

Behaviour [64], which emphasise the role of cognition within a broadly rationalistic paradigm of individual agency, against theories which emphasise that culture, environment and 'automatic' decision-making processes play an important role [65–67]. More inclusive theories of health behaviour change, such as Michie and colleagues' 'behaviour change wheel', suggest that the pathways between individual risk information and behaviour are complex, and may not be well captured by a narrow focus on cognitive mediators [68,69]. While qualitative data cannot directly evaluate the impact of interventions, this review suggests that the potential for risk communication in isolation to facilitate changes in individuals' behaviour may be limited. Approaches such as motivational interviewing or health coaching may be promising for reducing cardiovascular risk [70–72], and the potential for integrating these with risk assessment deserves exploration.

There are some potential limitations in both the review and the primary data which should be borne in mind. The review focused specifically on the quantitative assessment and communication of risk, and did not include data either on more informal understandings of risk or on the context of the clinical encounter within which risk communication takes place; however, the findings suggest that these factors may be important determinants of understanding. Quality assessment of the primary studies (Appendix 2) suggests that many studies have weaknesses in sampling and generalisability, which may cast doubt on the transferability of the findings.

4.2. Conclusions

The findings of this review suggest that the communication of results from risk prediction models is complex and depends largely on context. Patients feel that percentage risks in isolation are largely irrelevant or meaningless, and are sceptical of risk prediction tools for a variety of reasons. Clinicians' practices vary widely depending on their perception of patients' understanding of risk and likely reactions to risk information, and the enactment of risk scores in practice often diverges from the original intentions behind the tools.

4.3. Implications for practice

Our findings suggest that a number of different strategies may be worth exploring for communicating cardiovascular risk, either in clinical consultations or as part of population-level risk reduction programmes like the NHS Health Check. While our findings do not assess the effectiveness of these strategies, they may provide some pointers for further exploration. Risk communication formats which provide some kind of anchor or comparison point for percentage risks – such as relative risks or heart age – may be more easily understood and related to action. It is worth exploring tools which enable users to manipulate model inputs and see the impact of lifestyle change on risk scores, although this may sometimes reduce patients' motivation. Graphical interfaces are likely to be helpful, but may also have negative impacts (e.g. encouraging the indexing of risk to large thresholds).

More broadly, the review indicates that the messages patients take away from risk communication may be strongly influenced by the nuances of how clinicians report the results, and the broader communication that surrounds discussions of risk. Guidelines and care pathways need to take into account the context of risk communication, including the signposting and availability of resources to help individuals take recommended actions.

Funding

This report is independent research commissioned by the National Institute for Health Research (NIHR) Policy Research Programme (PRP) for the Department of Health and Social Care (DHSC). It was funded through the NIHR PRP contract with the EPPI Centre at UCL (Reviews facility to support national policy development and implementation, PR-R6-0113-11003). The views expressed in this publication are those of the author(s) and not necessarily those of the NHS, the NIHR or the DHSC.

CRediT authorship contribution statement

Gillian Stokes: Writing – review & editing, Validation, Methodology, Formal analysis, Data curation. **Helen Fulbright:** Writing – review & editing, Resources, Data curation. **Katy Sutcliffe:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Theo Lorenc:** Writing – original draft, Validation, Methodology, Formal analysis, Conceptualization. **Amanda Sowden:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of Competing Interest

There are no competing interests to declare.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pec.2024.108231.

References

[1] Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. Circulation 1998; 97:1837–47. https://doi.org/10.1161/01.cir.97.18.1837.
[2] Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, May M, Brindle P. Derivation and validation of QRISK, a new cardiovascular disease risk score for the United Kingdom: prospective open cohort study. BMJ 2007;335:136. https://doi.org/10.1136/bmj.39261.471806.55.
[3] Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, Minhas R, Sheikh A, et al. Predicting cardiovascular risk in England and Wales: prospective derivation and validation of QRISK2. BMJ 2008;336:1475–82. https://doi.org/10.1136/bmj.39609.449676.25.
[4] Hippisley-Cox J, Coupland C, Brindle P. Development and validation of QRISK3 risk prediction algorithms to estimate future risk of cardiovascular disease: prospective cohort study. BMJ 2017;357:j2099. https://doi.org/10.1136/bmj.j2099.
[5] van Weert JCM, van Munster BC, Sanders R, Spijker R, Hooft L, Jansen J. Decision aids to help older people make health decisions: a systematic review and meta-analysis. BMC Med Inform Decis Mak 2016;16:45. https://doi.org/10.1186/s12911-016-0281-8.
[6] Saheb Kashaf M, McGill ET, Berger ZD. Shared decision-making and outcomes in type 2 diabetes: a systematic review and meta-analysis. Patient Educ Couns 2017; 100:2159–71. https://doi.org/10.1016/j.pec.2017.06.030.
[7] Stacey D, Légaré F, Lewis K, Barry MJ, Bennett CL, Eden KB, et al. Decision aids for people facing health treatment or screening decisions. Cochrane Database Syst Rev 2017. https://doi.org/10.1002/14651858.CD001431.pub5.
[8] Elwyn G, O'Connor A, Stacey D, Volk R, Edwards A, Coulter A, et al., International Patient Decision Aids Standards (IPDAS) Collaboration. Developing a quality criteria framework for patient decision aids: online international Delphi consensus process. BMJ 2006;333:417. https://doi.org/10.1136/bmj.38926.629329.AE.
[9] Karmali KN, Persell SD, Perel P, Lloyd-Jones DM, Berendsen MA, Huffman MD. Risk scoring for the primary prevention of cardiovascular disease. Cochrane Database Syst Rev 2017. https://doi.org/10.1002/14651858.CD006887.pub4.
[10] Studziński K, Tomasik T, Krzysztoń J, Jóźwiak J, Windak A. Effect of using cardiovascular risk scoring in routine risk assessment in primary prevention of cardiovascular disease: an overview of systematic reviews. BMC Cardiovasc Disord 2019;19:11. https://doi.org/10.1186/s12872-018-0990-2.
[11] Collins DRJ, Tompson AC, Onakpoya IJ, Roberts N, Ward AM, Heneghan CJ. Global cardiovascular risk assessment in the primary prevention of cardiovascular disease in adults: systematic review of systematic reviews. BMJ Open 2017;7: e013650. https://doi.org/10.1136/bmjopen-2016-013650.
[12] Bonner C, Batcup C, Cornell S, Fajardo MA, Hawkes AL, Trevena L, et al. Interventions using heart age for cardiovascular disease risk communication: systematic review of psychological, behavioral, and clinical effects. JMIR Cardio 2021;5:e31056. https://doi.org/10.2196/31056.
[13] Schulberg SD, Ferry AV, Jin K, Marshall L, Neubeck L, Strachan FE, et al. Cardiovascular risk communication strategies in primary prevention. A systematic review with narrative synthesis. J Adv Nurs 2022;78:3116–40. https://doi.org/10.1111/jan.15327.
[14] Muthee TB, Kimathi D, Richards GC, Etyang A, Nunan D, Williams V, et al. Factors influencing the implementation of cardiovascular risk scoring in primary care: a mixed-method systematic review. Implement Sci 2020;15:57. https://doi.org/10.1186/s13012-020-01022-x.

[15] Public Health England, NHS Health Check: Best practice guidance for commissioners and providers, 2019. ⟨https://www.healthcheck.nhs.uk/seecmsfile/?id=1480⟩.

[16] Office for Health Improvement and Disparities, Preventing illness and improving health for all: a review of the NHS Health Check programme and recommendations, GOV.UK (2021). ⟨https://www.gov.uk/government/publications/nhs-health-check-programme-review/preventing-illness-and-improving-health-for-all-a-review-of-the-nhs-health-check-programme-and-recommendations⟩ (Accessed February 22, 2023).

[17] Hawker S, Payne S, Kerr C, Hardey M, Powell J. Appraising the evidence: reviewing disparate data systematically. Qual Health Res 2002;12:1284–99. https://doi.org/10.1177/1049732302238251.

[18] Barnett-Page E, Thomas J. Methods for the synthesis of qualitative research: a critical review. BMC Med Res Methodol 2009;9:59. https://doi.org/10.1186/1471-2288-9-59.

[19] Bengtsson A, Lindvall K, Norberg M, Fharm E. Increased knowledge makes a difference! - general practitioners' experiences of pictorial information about subclinical atherosclerosis for primary prevention: an interview study from the VIPVIZA trial. Scand J Prim Health Care 2021;39:77–84. https://doi.org/10.1080/02813432.2021.1882083.

[20] Boase S, Mason D, Sutton S, Cohn S. Tinkering and tailoring individual consultations: how practice nurses try to make cardiovascular risk communication meaningful. J Clin Nurs 2012;21:2590–8. https://doi.org/10.1111/j.1365-2702.2012.04167.x.

[21] Bonner C, Jansen J, McKinn S, Irwig L, Doust J, Glasziou P, et al. General practitioners' use of different cardiovascular risk assessment strategies: a qualitative study. Med J Aust 2013;199:485–9.

[22] Bonner C, Jansen J, McKinn S, Irwig L, Doust J, Glasziou P, et al. Communicating cardiovascular disease risk: an interview study of General Practitioners' use of absolute risk within tailored communication strategies. BMC Fam Pract 2014;15:106. https://doi.org/10.1186/1471-2296-15-106.

[23] Bonner C, Jansen J, Newell BR, Irwig L, Glasziou P, Doust J, et al. I don't believe it, but i'd better do something about it: patient experiences of online heart age risk calculators. J Med Internet Res 2014;16:e120. https://doi.org/10.2196/jmir.3190.

[24] Bonner C, McKinn S, Lau A, Jansen J, Doust J, Trevena L, et al. Heuristics and biases in cardiovascular disease prevention: How can we improve communication about risk, benefits and harms? Patient Educ Couns 2018;101:843–53. https://doi.org/10.1016/j.pec.2017.12.003.

[25] Coorey G, Peiris D, Usherwood T, Neubeck L, Mulley J, Redfern J. Persuasive design features within a consumer-focused eHealth intervention integrated with the electronic health record: A mixed methods study of effectiveness and acceptability. PLoS ONE [Electron Resour] 2019;14:e0218447. https://doi.org/10.1371/journal.pone.0218447.

[26] Cupit C, Rankin J, Armstrong N, Martin GP. Overruling uncertainty about preventative medications: the social organisation of healthcare professionals' knowledge and practices. Sociol Health Illn 2020;42(Suppl 1):114–29. https://doi.org/10.1111/1467-9566.12998.

[27] Damman OC, Bogaerts NM, van Dongen D, Timmermans DR. Barriers in using cardiometabolic risk information among consumers with low health literacy. Br J Health Psychol 2016;21:135–56. https://doi.org/10.1111/bjhp.12149.

[28] Damman OC, Bogaerts NMM, van den Haak MJ, Timmermans DRM. How lay people understand and make sense of personalized disease risk information. Health Expect 2017;20:973–83. https://doi.org/10.1111/hex.12538.

[29] Farrimond H, Saukko PM, Qureshi N, Evans PH. Making sense of being at "high risk" of coronary heart disease within primary prevention. Psychol Health 2010;25:289–304. https://doi.org/10.1080/08870440802499382.

[30] Frolund JC, Primdahl J. Patients' experiences of nurse-led screening for cardiovascular risk in rheumatoid arthritis. Musculoskelet Care 2015;13:236–47. https://doi.org/10.1002/msc.1104.

[31] Gidlow CJ, Ellis NJ, Cowap L, Riley V, Crone D, Cottrell E, et al. Cardiovascular disease risk communication in NHS health checks using QRISK®2 and JBS3 risk calculators: the RICO qualitative and quantitative study. Health Technol Assess 2021;25:1–124. https://doi.org/10.3310/hta25500.

[32] Gidlow CJ, Ellis NJ, Riley V, Cowap L, Crone D, Cottrell E, et al. Cardiovascular disease risk communication in NHS health checks: a qualitative video-stimulated recall interview study with practitioners. BJGP Open 2021;5. https://doi.org/10.3399/BJGPO.2021.0049.

[33] Riley V, Ellis NJ, Cowap L, Grogan S, Cottrell E, Crone D, et al. A qualitative exploration of two risk calculators using video-recorded NHS health check consultations. BMC Fam Pract 2020;21.

[34] Gooding HC, Sheldrick RC, Leslie LK, Shah S, de Ferranti SD, Mackie TI. Adolescent perceptions of cholesterol screening results: "young invincibles" or developing adults? J Adolesc Health 2016;59(2):162–70. https://doi.org/10.1016/j.jadohealth.2016.03.027.

[35] Grauman Å, Hansson M, James S, Veldwijk J, Höglund A. Exploring research participants' perceptions of cardiovascular risk information—room for improvement and empowerment. Patient Educ Couns 2019;102:1528–34. https://doi.org/10.1016/j.pec.2019.03.010.

[36] Å. Grauman, The publics' perspective on cardiovascular risk information: Implications for practice, PhD, Uppsala University, 2020. ⟨https://www.diva-portal.org/smash/get/diva2:1509397/FULLTEXT01.pdf⟩.

[37] Hall R, Saukko PM, Evans PH, Qureshi N, Humphries SE. Assessing family history of heart disease in primary care consultations: a qualitative study. Fam Pract 2007;24:435–42.

[38] Hawking MKD, Timmis A, Wilkins F, Potter JL, Robson J. Improving cardiovascular disease risk communication in NHS health checks: a qualitative study. BMJ Open 2019;9:e026058. https://doi.org/10.1136/bmjopen-2018-026058.

[39] Hill S, Spink J, Cadilhac D, Edwards A, Kaufman C, Rogers S, et al. Absolute risk representation in cardiovascular disease prevention: comprehension and preferences of health care consumers and general practitioners involved in a focus group study. BMC Public Health 2010;10:108. https://doi.org/10.1186/1471-2458-10-108.

[40] Honey S, Hill K, Murray J, Craigs C, House A. Patients' responses to the communication of vascular risk in primary care: a qualitative study. Prim Health Care Res Dev 2015;16:61–70. https://doi.org/10.1017/S1463423613000509.

[41] Kirby M, Machen I. Impact on clinical practice of the Joint British Societies' cardiovascular risk assessment tools. Int J Clin Pract 2009;63:1683–92. https://doi.org/10.1111/j.1742-1241.2009.02201.x.

[42] M. Lenz, J. Kasper, I. Muhlhauser, Development of a patient decision aid for prevention of myocardial infarction in type 2 diabetes - Rationale, design and pilot testing, GMS Psycho-Social-Medicine Vol 6 2009, ArtID Doc05 6 (2009).

[43] Marshall IJ, Wolfe CDA, McKevitt C. "People like you?": how people with hypertension make sense of future cardiovascular risk-a qualitative study. BMJ Open 2018;8:e023726. https://doi.org/10.1136/bmjopen-2018-023726.

[44] McKinn S, Bonner C, Jansen J, Teixeira-Pinto A, So M, Irwig L, et al. Factors influencing general practitioners' decisions about cardiovascular disease risk reassessment: findings from experimental and interview studies. BMC Fam Pract 2016;17:107. https://doi.org/10.1186/s12875-016-0499-7.

[45] R.J. McNaughton, Utilising Normalisation Process Theory to understand the patient journey for high-risk individuals participating in the NHS Health Check programme, 2018. ⟨https://research.tees.ac.uk/ws/portalfiles/portal/8058619/Rebekah_McNaughton⟩.

[46] Middlemass JB, Yazdani MF, Kai J, Standen PJ, Qureshi N. Introducing genetic testing for cardiovascular disease in primary care: a qualitative study. e282-9 Br J Gen Pract 2014;64. https://doi.org/10.3399/bjgp14X679714.

[47] Nielsen KD, Dyhr L, Lauritzen T, Malterud K. "Couldn't you have done just as well without the screening?". A qualitative study of benefits from screening as perceived by people without a high cardiovascular risk score. Scand J Prim Health Care 2009;27:111–6. https://doi.org/10.1080/02813430902808619.

[48] Nolan T, Dack C, Pal K, Ross J, Stevenson FA, Peacock R, et al. Patient reactions to a web-based cardiovascular risk calculator in type 2 diabetes: a qualitative study in primary care. Br J Gen Pract 2015;65:e152–60. https://doi.org/10.3399/bjgp15X683953.

[49] Peiris DP, Joshi R, Webster RJ, Groenestein P, Usherwood TP, Heeley E, et al. An electronic clinical decision support tool to assist primary care providers in cardiovascular disease risk management: development and mixed methods evaluation. J Med Internet Res 2009;11:e51. https://doi.org/10.2196/jmir.1258.

[50] Perry C, Thurston M, Alford S, Cushing J, Panter L. The NHS health check programme in England: a qualitative study. Health Promot Int 2016;31:106–15. https://doi.org/10.1093/heapro/dau059.

[51] Polak L, Green J. Using quantitative risk information in decisions about statins: a qualitative study in a community setting. Br J Gen Pr 2015;65:e264–9. https://doi.org/10.3399/bjgp15X684433.

[52] Riley R, Coghill N, Montgomery A, Feder G, Horwood J. Experiences of patients and healthcare professionals of NHS cardiovascular health checks: a qualitative study. J Public Health 2016;38:543–51.

[53] Sheridan SL, Behrend L, Maihan BV, Meier A, Griffith JM, Pignone MP. Individuals' responses to global CHD risk: A focus group study. Patient Educ Couns 2009;76:233–9. https://doi.org/10.1016/j.pec.2009.01.010.

[54] Snell K, Helen I. 'Well, I knew this already'-Explaining personal genetic risk information through narrative meaning-making. Sociol Health Illn 2020;42:496–509. https://doi.org/10.1111/1467-9566.13018.

[55] Taylor DA, Wallis KA, Feki S, Moala SS, Latu M, Fanueli EF, et al. Cardiovascular disease risk prediction in older people: a qualitative study. Br J Gen Pract 2021;71:e772–9. https://doi.org/10.3399/BJGP.2020.1038.

[56] Usher-Smith JA, Winther LR, Shefer GS, Silarova B, Payne RA, Griffin SJ. Factors associated with engagement with a web-based lifestyle intervention following provision of coronary heart disease risk: Mixed methods study. 2017, ArtID E351 19 J Med Internet Res 2017;Vol 19(10). https://doi.org/10.2196/jmir.7697.

[57] Vaidya R, Pandya KV, Denney-Wilson E, Harris M. Sustaining cardiovascular absolute risk management in Australian general practice. Aust J Prim Health 2012;18:304–7.

[58] van Steenkiste B, van der Weijden T, Stoffers HE, Grol R. Barriers to implementing cardiovascular risk tables in routine general practice. Scand J Prim Health Care 2004;22:32–7.

[59] Wan Q, Harris MF, Zwar N, Vagholkar S. Sharing risk management: an implementation model for cardiovascular absolute risk assessment and management in Australian general practice. Int J Clin Pract 2008;62:905–11. https://doi.org/10.1111/j.1742-1241.2008.01769.x.

[60] Ju A, Hanson CS, Banks E, Korda R, Craig JC, Usherwood T, et al. Patient beliefs and attitudes to taking statins: systematic review of qualitative studies. Br J Gen Pr 2018;68:e408–19. https://doi.org/10.3399/bjgp18X696365.

[61] Qadi O, Lufumpa N, Adderley N, Bem D, Marshall T, Kokab F. Patients' and health professionals' attitudes and perceptions towards the initiation of preventive drugs for primary prevention of cardiovascular disease: a systematic review of qualitative studies. BJGP Open 2020;4:1–12. https://doi.org/10.3399/bjgpopen20X101087.

[62] Ju I, Banks E, Calabria B, Ju A, Agostino J, Korda RJ, et al. General practitioners' perspectives on the prevention of cardiovascular disease: systematic review and thematic synthesis of qualitative studies. BMJ Open 2018;8:e021137. https://doi.org/10.1136/bmjopen-2017-021137.

[63] Janz NK, Becker MH. The Health Belief Model: a decade later. Health Educ Q 1984; 11:1–47. https://doi.org/10.1177/109019818401100101.
[64] Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process 1991;50: 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.
[65] Michie S, Wood CE. Health behaviour change techniques. In: Conner M, Norman P, editors. Predicting and Changing Health Behaviour. Research and Practice with Social Cognition Models. 3rd ed..,. Maidenhead: Open University Press; 2015. p. 358–89.
[66] Marteau TM, Hollands GJ, Fletcher PC. Changing Human Behavior to Prevent Disease: The Importance of Targeting Automatic Processes. Science 2012;337: 1492–5. https://doi.org/10.1126/science.1226918.
[67] Kelly MP, Barker M. Why is changing health-related behaviour so difficult. Public Health 2016;136:109–16. https://doi.org/10.1016/j.puhe.2016.03.030.
[68] Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement Sci 2011; 6:42. https://doi.org/10.1186/1748-5908-6-42.
[69] Michie S, Johnston M, Rothman AJ, de Bruin M, Kelly MP, Carey RN, et al. Developing an evidence-based online method of linking behaviour change techniques and theoretical mechanisms of action: a multiple methods study, Health Services and Delivery. Research 2021;9:1–168.
[70] An S, Song R. Effects of health coaching on behavioral modification among adults with cardiovascular risk factors: systematic review and meta-analysis. Patient Educ Couns 2020;103:2029–38. https://doi.org/10.1016/j.pec.2020.04.029.
[71] Mifsud JL, Galea J, Garside J, Stephenson J, Astin F. Motivational interviewing to support modifiable risk factor change in individuals at increased risk of cardiovascular disease: a systematic review and meta-analysis. PLOS ONE 2020;15: e0241193. https://doi.org/10.1371/journal.pone.0241193.
[72] McMahon J, Thompson DR, Pascoe MC, Brazil K, Ski CF. eHealth interventions for reducing cardiovascular disease risk in men: a systematic review and meta-analysis. Prev Med 2021;145:106402. https://doi.org/10.1016/j.ypmed.2020.106402.