

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

**Illness Risk Representation (IRR) beliefs underlying adolescents' cardiovascular disease
risk appraisals and the preventative role of physical activity**

Katie Newby^{1*}, Laura Varnes^{2*}, Eleanor Yorke², Susanne F Meisel³ and Abi Fisher²

¹ Coventry University, Centre for Advances in Behavioural Science, Richard Crossman Building, Priory Street, Coventry, CV1 5FB

² University College London, Department of Behavioural Science & Health, 1-19 Torrington Place, London, WC1E 7HB

³ Susan Meisel, Department of Psychology, Institute of Psychology, Psychiatry and Neuroscience, Kings College London, SE5 9JR

*Joint first author

Word count (exc. figures/tables): 5876/6000

Abstract

Objectives: The primary aim was to explore adolescents' cardiovascular disease risk appraisals and establish whether they understood the preventative role of physical activity (PA). The secondary aim was to examine whether adolescents' cardiovascular disease risk appraisal fitted with the Illness Risk Representations (IRR) framework.

Design: Qualitative.

Methods: Thirty-one adolescents aged between 13 and 15 years participated in semi-structured interviews. Data were analysed using Framework Analysis.

Results: Knowledge of lifestyle behaviours contributing to cardiovascular disease was good. Participants reflected on their current (or expected future) patterns of these behaviours when making judgements about lifetime risk. They struggled however to explain how different health behaviours, including physical activity, affected the development of the disease. Cardiovascular disease was viewed as potentially fatal, but participants had only a superficial understanding of the consequences of, or treatments for, the disease. The IRR framework, as proposed by Cameron (2003), largely captured the way in which adolescents' made judgements about their risk of cardiovascular disease.

Conclusions: The findings suggest that adolescents are underestimating their risk of cardiovascular disease due to unhelpful beliefs. Interventions should: provide clear and simple explanations of how different health behaviours contribute to cardiovascular risk, highlight discrepancies that exist between current levels of preventative behaviour and that required to confer a protective effect, expose the false belief that a lack of PA in early life can be compensated for in later adulthood, and aid understanding of the true impact that the disease and its treatment could have of health and quality of life outcomes.

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

Acknowledgements

The authors would like to thank Ele Yorke (EY) for her assistance with data collection and coding, all the young people who participated in this study and the schools for their assistance in recruiting participants and organising the interviews.

Background

Cardiovascular disease is the leading cause of death worldwide, associated with 31% of global deaths (World Health Organization, 2017). In the United Kingdom (UK), cardiovascular disease is the second leading cause of death after cancer (Bhatnagar, Wickramasinghe, Williams, Rayner, & Townsend, 2015) with 28% of deaths attributed to it. Despite a slight decrease in overall prevalence rates in the developed world, predominantly due to reduced fatality rates after myocardial infarction, and improved pharmaceutical management of cardiovascular conditions, cardiovascular disease remains a considerable health and economic burden (Bhatnagar et al., 2015).

Atherosclerosis, a process whereby fatty material builds up in arteries, is responsible for 75% of all cardiovascular disease deaths (American Heart Association, 2005). Although clinical manifestations of cardiovascular disease typically occur in late adulthood, atherosclerotic processes often begin during childhood (Hong, 2010). The development of atherosclerosis is influenced throughout one's lifetime by several cardiovascular disease risk factors such as physical inactivity, smoking, and family history (Graham et al., 2007). While available treatments can slow the process of atherosclerosis, currently, it cannot be stopped or significantly reversed once established (British Heart Foundation, 2014; Bittencourt & Cerci, 2015).

Consistent evidence suggests moderate-to-vigorous physical activity (MVPA) decreases the risk of developing cardiovascular disease (Li & Siegrist, 2012; Palmefors, DuttaRoy, Rundqvist, & Börjesson, 2014; Alves et al., 2016) and can improve subclinical atherosclerosis (National Heart, Lung and Blood Institute, 2012). Importantly, there is evidence that physical activity (PA) during adolescence, independent of adult PA, reduces the risk of cardiovascular disease in adulthood. For example, in a large, prospective cohort study of nearly

75,000 Chinese women aged 40-70 years at enrolment, self-reported exercise participation in adolescence was associated with reduced cardiovascular disease after adjusting for birth year and other potential confounders (Nechuta et al., 2015). A prospective study of nearly 5,000 US adults aged 18-30 years at enrolment measured cardiorespiratory fitness via treadmill assessment at baseline, and reported similar findings (Shah, Murthy, Colangelo, Reis, Venkatesh, et al., 2016); with benefits in reductions of cardiovascular disease observed independently of other risk factors. There is also evidence that PA levels in adolescence 'track' to adulthood (Telama, 2009), meaning that physically active adolescents are more likely to be physically active as adults.

Despite the importance of adolescent PA, population levels are extremely low. In the UK, less than 11% of 13- to 15-year olds are meeting the recommendation of at least 60 minutes of moderate PA per day (Health Survey for England, 2012). Therefore, increasing PA as a means of primary prevention of atherosclerosis is a key public health strategy (Public Health England, 2014).

Many health behaviour theories, for example, the Protection Motivation Theory (Maddux & Rogers, 1983) and Extended Parallel Process Model (Witte, 1992), identify risk and efficacy appraisals as primary motivators for health behaviour change. These theories propose that when individuals appraise a health threat as high and believe that they are able to perform a behaviour capable of removing that threat, the behaviour will be enacted. Risk appraisals are generally considered as a combination of the perceived likelihood and severity of the threat, such that cardiovascular disease for example, would only be perceived as a risk if it was both considered to be likely to occur and also to have serious consequences. Efficacy appraisals on the other hand, concern individuals' perceptions of their ability to perform a behaviour (self-efficacy) capable of negating that threat (response efficacy). Evidence from meta-analyses suggest that risk appraisals have a small effect on behavioural intentions and action, with the largest effects

found when both risk and efficacy appraisals are simultaneously heightened (Peters, Ruiter, & Kok, 2013; Sheeran, Harris, & Epton, 2014; Tannenbaum, Hepler, Zimmerman, Saul Jacobs et al., 2015).

In order to change cardiovascular disease risk appraisals in ways that motivate PA, the beliefs underlying these risk and efficacy appraisals must first be understood. It may be that adolescents for example underestimate their personal vulnerability to cardiovascular disease because they do not know that atherosclerotic processes often begin during childhood, or underestimate disease severity because they do not know that this process is irreversible. Furthermore, the response efficacy of PA may be underestimated because they do not possess an understanding of the effect of this action on the development of atherosclerosis. Having a coherent understanding of the link between the threat and the recommended behaviour may in particular be an important precursor to accepting messages about prevention and putting these into action (Bishop, Marteau, Hall, Kitchener, & Hajek, 2005; Marteau, Rana and Kubba, 2002; Cameron, Marteau, Brown, Klein, & Sherman, 2012; Sherman, Kilby, Moore & Shaw, 2017).

Cameron (2003) proposed the Illness Risk Representation (IRR) framework for understanding beliefs underlying risk appraisals. The IRR framework is based on the common-sense model (Leventhal, Brissette, & Leventhal, 2003), which has predominately been used to understand illness cognitions and coping behaviours (Hagger & Orbell, 2003). The IRR framework incorporates the five components of the common-sense model and constructs commonly associated with risk appraisal literature, including likelihood and severity estimates. The five components include identity (symptoms and illness label), cause (factors related to the cause of the illness), timeline (time of onset and progression of illness), consequences (outcome or consequences of the illness), and control (control over illness progression) (Leventhal et al., 2003). The components of identity, cause, timeline, and control over prevention, are proposed as the basis for likelihood estimates, and the components of

consequences, and control over treatment and cure, are proposed as the basis for severity estimates (Cameron, 2003). Notably, there is a clear overlap between the illness risk representation of control over prevention and the theoretical concepts of self-efficacy and response efficacy (Cameron, 2008).

It has been proposed that IRRs for estimating likelihood develop through matching self-characteristics with the relevant IRR components (Cameron, 2003). In the case of cardiovascular disease for example, perceptions of likelihood will be formed by matching self-characteristics (“I am physically inactive”) with beliefs about cause (“physical inactivity causes cardiovascular disease”). The content of beliefs will not necessarily be accurate and may serve to undermine perceptions of risk (e.g. “my grandfather has cardiovascular disease” but “cardiovascular disease is not hereditary”). A key attribute of illness risk representations is that they are dynamic in nature and therefore evolve and develop over time (Cameron, 2003). Accordingly, the richness of representations will vary from person to person reflecting differing ages, experiences, and exposure to information. Ultimately it is proposed that these representations set the stage for coping, guiding the selection of strategies to control the threat, including engaging in preventative behaviour. Understanding the content of these representations and how they might influence perceptions of likelihood and severity therefore has potential value in informing the content of interventions aiming to change behaviour through changing risk appraisals.

Any efforts to alter adolescent risk appraisals should take into consideration that adolescence is a unique period of development, characterised by significant changes in the way that risk is understood and processed. Contrary to popular wisdom, adolescents see themselves as more vulnerable to health risks than adults do, and tend to overestimate important risks (Millstein & Halpern-Felsher, 2002a; Fischhoff, Parker, De Bruin, Downs, Palmgren, Dawes, & Manski, 2000; Halpern-Felsher, Millstein, Ellen, Adler, Tschann, & Biehl, 2001). From

early to late adolescence however, likelihood judgements are observed as decreasing in strength (Millstein & Halpern-Felsher, 2002b). Two factors are likely responsible for this. Firstly, as young people move through adolescence their cognitive ability increases, and they become better able to reflect on theories about contingencies (such that physical inactivity contributes to CVD) and to question their accuracy. Secondly, they are becoming increasingly exposed to risk behaviour and learning that risky actions do not always result in negative consequences. Also of importance, whilst adolescents may perceive themselves as more likely than adults to experience negative outcomes (such as a future illness), they tend to underestimate the degree to which these outcomes are harmful, and also to place greater weight on behavioural outcomes which are positive and/or proximal (e.g. social acceptance from peers) than those which are negative and/or distal (Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004; Gilpin & Pierce, 2003; Goldberg, Halpern-Felsher, & Millstein, 2002). As adolescents move into adulthood, there is an increased use of intuition and heuristics to make judgements about risk (Reyna & Farley, 2006; Millstein & Halpern-Felsher, 2002b). These strategies tend to favour the risk aversion more characteristic of adults, with individuals intuitively grasping the gist of risky situations and retrieving appropriate risk-avoidant values ('the likelihood of that happening is small but the consequences are too great') without paying any heed to the potential pros of behaviour (Reyna 2004). These broader developmental changes are important to bear in mind when examining adolescent risk appraisals. Age-related differences in knowledge, experience and cognition will all play a part in shaping risk appraisal, influencing the richness of beliefs and the degree to which different outcomes are prioritised.

Two previous qualitative studies have found support for the IRR framework. Newby and colleagues (2013; 2017) studied young people's risk appraisals for sexually transmitted infection and bowel cancer respectively. These studies both provided support for the framework, with beliefs relating to cause, consequences and control found to most strongly

influence risk estimates. The present study will seek to add further evidence concerning the utility of this framework in exploring and understanding the way in which young people make judgements about health risks. To the authors' knowledge, this is the first study to explore beliefs underlying adolescents' cardiovascular disease risk appraisals and their understanding of the link between preventative behaviours and cardiovascular disease. This type of study is important as not only does it improve understanding of the way in which people appraise the risk of illness, but also because it has the potential to identify unhelpful beliefs which may be having an unfavourable impact on behaviour. This understanding improves the ability of public health interventions to target risk in meaningful ways and consequently enhances their potential effect.

Study aims

The primary aim of the present study was to explore adolescents' cardiovascular disease risk appraisals, including whether they understand the preventative role that PA plays in reducing the risk of cardiovascular disease. A secondary aim was to examine whether the IRR framework captures the way in which adolescents perceive the risk of cardiovascular disease.

Method

Participants

Participants were recruited from two state-funded secondary schools in London, UK. To recruit schools, letters detailing the study were sent to head teachers of approximately 140 schools in central London; two responded and were invited to take part. To be eligible for the study, individuals at the schools had to be aged between 13 and 17 years and to not have had a diagnosis of cardiovascular disease themselves. Approximately 1300 pupils across the two school were eligible to participate. Following permission from the head teacher, eligible pupils were provided with an information sheet, consent form and parental opt out form. Forty-one

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

pupils expressed an interest in participating but not of them presented for interview; reasons for non-attendance were not collected. Institutional ethical approval was received (10213/001) and informed written consent (with prior parental agreement) was provided by all participants. A target sample size of twenty was based on prior qualitative work by Newby et al. (2017) and guidance by Fugard & Potts (2015).

Qualitative interviews

To guide interviews, a semi-structured interview schedule was used. Whilst not piloted specifically for this study, the schedule was based on one used by Newby et al. (2017), adapted to focus on cardiovascular disease rather than cancer. Questions were designed to prompt beliefs relating to the five IRR components, with further questions allowing for additional beliefs that may not be captured by the IRR framework to emerge. The schedule was designed to initially elicit beliefs relating to cardiovascular disease likelihood appraisals, before exploring whether participants understood the preventative link between PA and cardiovascular disease. This ensured likelihood estimates were not influenced by new knowledge on PA. Following this, beliefs relating to cardiovascular disease severity appraisals were explored. The present study was part of a larger study investigating the use of technology to increase PA, therefore the interview schedule also included questions relating to the use of technology. The schedule is provided as Supplementary Material (appendix A).

Data was collected between June and July 2017. Two trained researchers ([initials blinded]) experienced in interviewing adolescents conducted the interviews at the participants' school. Interviews took place during the school day. At each school, a nominated teacher facilitated data collection. This teacher organised a suitable private space for the interviews to take place, ensured permission for the pupils to be excused from lessons, and set up a timetable of

interviews. This timetable, which specified the time and location of interviews, was provided to researchers and pupils. At the allotted time, pupils made their own way to the interview room. Each interview lasted between 40 and 70 minutes. All interviews were recorded and transcribed verbatim.

Analysis

Two researchers ([initials blinded]) analysed the transcripts using Framework Analysis (Gale, Heath, Cameron, Rashid, and Redwood, 2013). This method of analysis was selected because it is suitable for a combined deductive and inductive approach in which prior codes are selected based on theory, but there is also scope for additional themes to be generated through open, unrestricted questioning and coding. The researchers familiarised themselves with the transcripts, and a preliminary set of codes was developed representing beliefs from the five IRR components. For example, for the component ‘controllability’, codes were developed to capture beliefs relating to control over prevention, treatment and cure. The preliminary codes were then used to code four interview transcripts. If the preliminary codes did not capture all aspects of the interview content, additional codes were created. The researchers met to discuss the preliminary codes. Where new codes had been created, these were reviewed by the researchers with reference to the relevant data. All revisions were minor and agreed through consensus discussion. The resulting finalised framework was then used by both researchers to independently code all remaining transcripts. Please refer to Supplementary Material (appendix B) for a copy of the finalised analytical framework.

Microsoft Excel was used to create a framework matrix. Data was summarised and illustrative quotes were included in the relevant cells of the matrix. The two researchers both interpreted the data and identified themes. The researchers then discussed their analysis. Their shared interpretation is presented within the findings section below. Quotations have been

selected to illustrate the themes. In the presentation of the results, codes follow each quotation to indicate the participant's number and gender.

To enable comparison with participants' responses, detailed information on cardiovascular disease is provided in Supplementary Material (appendix C).

Results

Participant characteristics

The sample consisted of 31 adolescents aged between 13 and 15 years; 18 females and 13 males. Participants identified their ethnicity as White British (n=7), White other (n=5), Asian other (n=5), multiple ethnicities (n=5), Indian (n=2), Bangladeshi (n=2), Black other (n=2), Pakistani (n=1), Caribbean (n=1), and African (n=1).

Physical activity

Most participants engaged in some form of PA outside of school. This included taking part in sports, attending the gym, or walking. For three participants, their only form of PA was from Physical Education at school (approximately 2 hours per week). Although not assessed in any standardised way, the descriptions of activity given by participants indicated that most were not meeting the minimum recommended amount of 60 minutes of moderate PA per day.

Cardiovascular disease

Most participants had heard of cardiovascular disease. Ten knew or had known someone with cardiovascular disease. For three, this was their father; for the remaining participants, this was a more distant family member or a friend's relative. Although all participants recognised that cardiovascular disease was a complex condition caused by an interplay of multiple factors, it was clear from the lack of detail and clarity in their answers, that they lacked specific knowledge.

Participant beliefs of cardiovascular disease are presented below reflecting the five IRR components.

Identity

Twelve participants thought gender influenced cardiovascular disease risk; the majority of those (n=10) felt males were at an increased risk. However, no participants reflected on this or any other personal characteristics such as ethnicity when making personal risk estimates.

Cause

Family History

Almost all participants knew that a family history of cardiovascular disease was a risk factor for cardiovascular disease. Most participants reported no family history of cardiovascular disease and used this as an explanation of their low perceived likelihood:

I don't have any family members [that have cardiovascular disease], so that would lower my risk. I don't think I would be that prone to it (7F)

Despite knowledge of the link between family history and cardiovascular disease, only one of eight participants who had a family member with the disease however reflected on this when making likelihood estimates:

I... think I have a little chance because of my grandma having it (4F)

Lifestyle Factors

Participants identified several lifestyle behaviours they believed influenced the risk of cardiovascular disease. These included, smoking, drinking alcohol, lack of PA, drugs, sedentary behaviour, and an unhealthy diet (e.g., fatty foods or overeating). Lifestyle behaviours thought to decrease the risk of cardiovascular disease included PA, not smoking, not taking drugs, drinking water, and a healthy diet (e.g., eating fruit and vegetables or limiting sugary foods). All participants knew that the risk of cardiovascular disease increased with an

increase in the number of unhealthy lifestyle behaviours, and appeared to derive their relatively low perceived vulnerability by ‘tallying up’ their total of positive lifestyle behaviours.

I don't think I'm that likely to get it, because I don't smoke, I eat healthy, I don't drink alcohol and I'm staying fit, and I'm getting out in the sun so I have my vitamin D, vitamin A, C and B. So I'm very healthy (13M)

If I keep cycling and I eat quite healthily at home... So if I keep cycling and doing well, I don't think I will get it (8M)

Therefore, even if participants recognised that they engaged in some unhealthy behaviours, they in part appeared to offset the risk of this through engaging in others that reduced risk:

To prevent it is healthy eating, exercising... I'm just going to say that I don't think it's very likely... Sometimes I'm not that great at healthy eating. I don't smoke or drink. I'm not great with physical activity... So I don't think I'm that likely to get it (17F)

My diet isn't good though; I'll admit that. But I think I'm less likely than other people because I'm more active and outgoing (11F)

There was some evidence that young people base their understanding of risk behaviours on their observation of the health (or otherwise) of people they see around them. One participant for example reasoned that alcohol does not influence the risk of cardiovascular disease based on her observation that she had not observed any ill-effects in those around her:

I'm not going to say alcohol [causes cardiovascular disease] just because I know a lot of people who drink alcohol, and I know that they're okay (7F)

Some participants mentioned that passive smoking and pollution could influence the risk of cardiovascular disease. Participants reflected on these factors when making likelihood estimates:

I do... have second-hand smoke from cars and people, so it's quite a high chance, but if I, you know, don't smoke, eat better, go out even more, you know do physical

activities, then I think that would reduce the chance of me getting cardiovascular disease from second-hand smoke (7M)

Participants were asked how they thought lifestyle behaviours were linked to cardiovascular disease. They found this question difficult to answer. Several participants suggested that an unhealthy diet might lead to weight gain and a build-up of fatty deposits in arteries:

Poor diet means you're going to gain weight and that's going to cause fat to build up in your arteries, blocking it (10F)

Some mentioned that an unhealthy diet might prevent people from getting the correct nutrients which could impact on functioning of the body and heart:

Eating healthy in a way keeps your body functioning well because you have the greens you need, you have the nutrients, so the nutrients are getting to the heart and your heart will keep pumping well (15F)

Other dietary explanations included salt drying up the blood leading to blood clots and caffeine elevating the heart rate. Several explanations for the influence of smoking on the risk of cardiovascular were provided, these included an increase in blood clotting, a build-up of tar inside the blood vessels, and a reduction in the amount of oxygen in the blood due to carbon monoxide:

Smoking... builds up tar inside your blood vessels, and it kind of stops as much blood going into your heart, pumping round the body... I usually think of blood clotting in the heart from smoking (7M)

Explanations for the influence of alcohol on cardiovascular disease risk included alcohol increasing fat, causing strain on the heart, and damaging the inside of the body and liver:

If you drink alcohol, you can get liver damage which also affects your heart because it needs to send the blood down

Physical Activity

All but one participant mentioned levels of PA as an explanation of how cardiovascular disease occurred. Some participants believed that PA might keep the heart pumping, in turn, this might strengthen the heart muscle and keep blood flowing around the body:

If you do more exercise obviously your heart is going to get bigger and stronger, so it'll be able to pump the blood around the body (11F)

When you're exercising, you're pumping more blood around your body, so I guess if you never do any activity that's really bad for you... The blood would obviously still be pumping around your body but maybe not as much as it needs to be (17F)

Some participants believed PA might reduce obesity and fat in arteries:

The fat could get clogged in your arteries, [exercise] could take the fat away (3F)

It would be linked to obesity and like being healthy, and not getting fat (12F)

One participant believed PA might keep the body healthy and able to fight off diseases:

[Exercise] keeps you healthy, makes your body stronger to fight off anything (13F)

Timeline

On average, participants thought that people get cardiovascular disease from late middle age (40-50 years). This was attributed to an increased vulnerability to diseases as people age, an increase in the number of unhealthy behaviours, and a decline in health and body functioning.

Cardiovascular disease was therefore viewed as a condition to worry about in the future:

I'm not really worried at my age because I know most people at my age rarely tend to get it. I think maybe when I'm older I will be more concerned and definitely try to keep healthy.... Because you're probably more likely to get it when you're older (15F)

Although cardiovascular disease was viewed as a disease which affects older people, most participants recognised that it would be beneficial to adopt a healthy lifestyle from a young age to help prevent it. This was often associated with the assumption that the adoption of good habits at a young age would be easier to maintain than changing behaviours in adulthood:

If I don't keep fit then it's harder to do that when I'm older... getting a habit of it now is much easier for us to carry on in the future (13F)

Others believed a healthy lifestyle was important from a young age because behaviours can have an accumulative effect on health over time:

If your body is unhealthy from very young, and you're unhealthy for quite a long time, it has... long-term effects. So, being unhealthy for too long can be bad (10M)

Some thought adopting a healthy lifestyle from a young age was important because the body is growing. However, some participants thought that people could delay protective lifestyle behaviours until they are older:

I think the late 20s, 30s, it will be good to start getting really active and staying fit. I think you can delay [protective lifestyle behaviours] a bit... You don't need to worry about it right now, but when you get older you need to start taking care of yourself (16F)

Prevalence

A number of participants thought that cardiovascular disease was a rare disease. A few used this as an explanation for their low perceived likelihood:

I don't think it's that high [chance] to get heart disease... because not a lot of people are getting heart disease (13M)

Consequences

Most participants knew that cardiovascular disease could be fatal:

I think it's very serious because it can lead to death (13M)

Over half the participants recognised that cardiovascular disease would have an emotional impact on the family:

[The family would] always be strained because they'd always know that your relative is at risk of dying, they always are. So it'd emotionally drain that way (7F)

[The family will] be in a lot of worry and quite scared... maybe even disappointed because they can't do what they want to with the person (5M)

Around one-third of participants identified that cardiovascular disease could impact mental health:

I think it'd make you very depressed and very empty and lonely... I don't think you'd be able to work because I'd feel like you could be too depressed (13M)

A few participants mentioned that the treatment for cardiovascular disease could have financial implications:

They probably have to spend more money on healthcare. I know you have the NHS, but medication and everything, so they have less money (7F)

The majority of participants identified that cardiovascular disease might impact someone's day-to-day life such as being unable to exercise, take care of their family, socialise or work:

I think it would be hard to go places and socialise and have fun with people, I don't know, move around and do your daily thing like jobs and cleaning and looking after your family and stuff like that (6F)

And like you say, you wouldn't be able to do stuff that you used to be able to do. You wouldn't be able to stay awake for as long as you could, you'd just fall asleep, you'd go bald (10M)

Control

The majority of participants thought that medical treatment was essential in the management of cardiovascular disease and without this, the disease would progress. A few participants, however, thought that there was a chance someone could get better without medical treatment:

You can get better [on our own] if you take matters into your own hands and just exercise and you feel better (11M)

I've heard cases where people battle it mentally. If they believe they're actually getting cured they can get better (13M)

Participants lacked knowledge of cardiovascular disease treatment. The most frequently mentioned treatments were heart transplants, surgery, and medication; however, participants were unsure about their effectiveness. Heart transplants and surgery were often deemed to be more effective than medication at curing cardiovascular disease:

The medication I don't think would get rid of it, but the heart transplant, I think it would get rid of it... if your body doesn't reject it.... but you still might have some heart pain or chest pains (12F)

Some participants were aware that cardiovascular disease is a chronic condition, however, others thought it could be easily treated and recovery was possible within a short amount of time:

I think it's very serious because once... you get that kind of disease you can't really go back to having a healthy heart; you're going to always be with that. You have to have medication. You're going to be with that life-long (10F)

If there was treatment, I think you'd take probably a week or two to recover (1F)

Just under half the participants believed a healthy lifestyle could help improve, but not cure, cardiovascular disease once it was present:

You could do a lot of exercise and stay healthy. That wouldn't cure it, but it'd make it a bit better (8M)

Discussion

In this study, adolescents' appraisals of their risk of cardiovascular disease were based on the assessment of a number of factors. A family history of the disease, participating in health-reducing behaviours such as smoking, or failing to engage with health promoting behaviours

such as PA, were all seen as increasing the likelihood of disease. Environmental factors, specifically exposure to second hand smoke and pollution, were also mentioned. Participants' knowledge of lifestyle behaviours that contributed to cardiovascular disease was good. All of them reflected on their current (or expected future) patterns of these behaviours when making judgements about their lifetime risk. Participants as a whole however, struggled to explain how different health behaviours, including PA, affected the development of the disease. In terms of self-characteristics, none of the adolescents interviewed identified that people from some ethnic groups were at elevated risk, despite the sample being quite diverse. Some adolescents knew that men were more at risk of the disease than women, but none went on to reflect on this when making judgements about their own risk. Similarly, out of eight adolescents with a family history of the illness, only one acknowledged this when making an assessment of their own personal risk. Cardiovascular disease was viewed as a potentially fatal and serious disease. Whilst a range of negative quality of life consequences were expressed, these were at a somewhat superficial level, perhaps unsurprising given the age of the sample. Additionally, participants have little knowledge of treatments for cardiovascular disease or their effectiveness.

The IRR framework, as proposed by Cameron (2003), largely captured the way in which adolescents' made judgements about their risk of cardiovascular disease. Judgements of likelihood were largely based on causal beliefs, as was also found by Newby and colleagues (2013, 2017); these were closely linked to beliefs about control over prevention. Consistent with the IRR framework, if adolescents believed their lifestyle behaviours helped prevent cardiovascular disease, then their perceptions of likelihood were lowered. Identity beliefs had no impact on likelihood appraisals. This was also found by Newby and colleagues (2013; 2017). As suggested by Newby et al. (2017), one explanation for the lack of influence of identity could be due to adolescents lacking knowledge of individual features and characteristics that increase the likelihood of cardiovascular disease such as being male, or

being of Asian or African ethnicity. Alternatively, this could be explained by adolescents failing to relate personal characteristics to their personal risk estimates. In terms of timeline, and in accordance with the findings of Newby and colleagues (2017), age did not appear to affect perceptions of likelihood but instead to impact upon the relevance of the illness to the participants. In line with the IRR framework, and the findings of Newby and colleagues (2013; 2017), judgements of severity appeared to be based on participants' assessments of the health and quality of life consequence of the disease and also beliefs about the potential of medical treatment and lifestyle behaviours to cure or control the condition.

Practical and theoretical implications

Likelihood judgements were negatively influenced in the following ways. Some adolescents underestimated their risk of cardiovascular disease because they failed to match their beliefs about cardiovascular disease risk factors with self-characteristics such as their gender, ethnicity or family history. This may reflect a form of defensive processing (Croyle, Sun, & Hart, 1997; Liberman & Chaiken, 1992), where an individual downplays their vulnerability to the health threat as a way of coping with their anxiety. Furthermore, there was evidence that likelihood estimates were negatively impacted by beliefs about the low prevalence of cardiovascular disease in society. This suggests low perceptions of likelihood might be inaccurately maintained without education on, and personalisation of, prevalence rates. Whilst participants had a reasonably good understanding of health behaviours that could both positively and negatively impact upon disease risk, there was evidence of a somewhat crude tallying up of these negative and positive behaviours, to come up with an overall appraisal of personal susceptibility, an approach which may in part reflect their developmental stage as adolescents (Reyna & Farley, 2006). At the same time, there appeared to be the belief that any one 'positive' behaviour cancelled out a 'negative' behaviour, giving the sense that they were seen as directly comparable. It should be noted that the extent to which 'positive' behaviours were enacted to

a sufficient extent to confer a protective benefit was also in question; whilst a number of participants perceived their levels of PA as protective for example, it was clear that few were meeting the minimum recommended level of 60 minutes of moderate PA per day. To address this, it may be helpful to provide young people with clear and simple explanations of health behaviours and how they contribute to cardiovascular risk, in particular exposing the illogical thought process involved in trading the positive effect of one risk factor for the negative effect of another. It may also be helpful to draw attention to any discrepancies that exist between current levels of preventative behaviours being performed with that required for them to have a health protective effect. This education could be delivered through schools, and would align well with, for example, biology curricula on the relationship between lifestyle behaviour and disease, or broader non-statutory personal, social, health and emotional education.

Regarding timeline, some participants felt that due to the distal nature of cardiovascular disease, preventative behaviours could be delayed until the disease was more relevant. This suggests that children of this age view adolescence as a period of time in which their body is immune to damage caused by lifestyle behaviours. To combat this, young people should be taught about the process of atherosclerosis, in particular that it can begin in childhood, and that once initiated cannot be halted or reversed. This should be communicated in a simple way that adolescents can understand and relate to. Secondary school teachers, as experienced educators of this age group, would be ideally placed to do this. Similarly, as suggested by Newby et al. (2017), it would also be helpful to highlight that a lack of PA in early life cannot be compensated for, and that increasing PA in adulthood following a sedentary childhood is likely to be very challenging.

The common-sense model proposes that a coherent understanding of the link between the preventative behaviour and health threat is crucial for the behaviour to be performed (Leventhal et al., 2003). The work by Lee, Cameron, Wunsche, and Stevens (2011)

supports this proposal and suggests that providing a clear, common-sense based explanation of the link between cardiovascular disease and PA is important in motivating PA. In the present study, participants had very little understanding of the link. Numerous explanations as to the nature of this link were provided, and these often related to what they imagined happened to the heart when someone exercised. Providing adolescents with a coherent explanation of the role that family history and lifestyle behaviours play in contributing to cardiovascular disease risk, and how these factors interact with each other, might be an important strategy in motivating the adoption of lifestyle changes. Strategies which help adolescents to visualise the physiological changes occurring inside the body at their age due to lack of PA, for example using pictures, animation or virtual reality, may be particularly helpful in communicating this (Houts, Doak, Doak, & Loscalzo, 2006).

The findings indicate unhelpful beliefs which could alter severity estimates. Some adolescents felt that cardiovascular disease was an acute disease which could be cured, with a few also believing that people could recover without treatment. Such beliefs are inaccurate and are likely to lead to downwards estimates of disease severity. To address this, it is important that all young people are made aware that cardiovascular disease is serious, chronic condition which must be managed with medical treatment, which itself can have negative health and quality of life implications. As is characteristic of children of this age (Reyner & Farley, 2006), cardiovascular disease was also viewed as a disease to worry about in the future, with distal consequences. It has been suggested that in decision-making, short- and long-term consequences are not weighed equally, with people overvaluing immediate consequences (Loewenstein & Elster, 1992). Severity estimates could be influenced by the distal nature of cardiovascular disease consequences. The work of Hall and Fong (2003) suggests that highlighting the long-term benefits of regular PA and negative effects of a sedentary lifestyle could be important in motivating PA. It might be beneficial to help adolescents imagine what

life would be like in the future if they engaged in protective lifestyle behaviours and the full range of consequences if they engaged in unhealthy lifestyle behaviours.

Strengths and limitations

The study has provided an understanding of the beliefs underlying adolescents' cardiovascular disease risk appraisals. The interview schedule was based on the schedule successfully used by Newby et al. (2017), with minor amendments made by the authors of the present study. The Framework Analysis enabled a combined deductive and inductive approach allowing beliefs not captured by the IRR framework to emerge. Reliability, trustworthiness and breadth of interpretation was increased by two researchers independently analysing the data.

The study should be interpreted in the context of its limitations. First, participants were recruited from a single English city and only consisted of those at the lower end of the age group, thus impacting on the generalisability of findings. Second, the interview structure and experimenter effects could have influenced responses. For example, nearly all participants reported that they were aware that levels of PA are linked to cardiovascular disease risk. However, this was in the context of previous questions relating to the use of technology to increase PA. This could have led participants to assume PA was important aspect of the research and as a result, to express this as a cause. The interview schedule was designed to prevent the provision of new information before discussion of likelihood estimates, however, confirming the link between PA and cardiovascular disease could have influenced severity estimates. As suggested by Newby et al. (2017) this could have led to defensive processing with the severity of cardiovascular disease being downplayed if an individual believed they were not meeting recommended PA levels. Finally, although a large, multi-ethnic sample was gained, data collection stopped without data saturation being assessed. Despite this, the themes were being replicated with no new themes emerging in later interviews, indicating a level of

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

completeness. It should however be acknowledged that had data collection continued, more nuanced findings may have resulted.

Conclusions

To conclude, the findings suggest that adolescents are underestimating their future risk of cardiovascular disease due to unhelpful beliefs. These beliefs are serving to undermine appraisals of likelihood and severity. The findings point to ways in which unhelpful beliefs could be changed in ways that support young people to make more realistic assessments of their risk of developing the disease. In turn, this could motivate the adoption of health behaviours that are important for its prevention, such as PA. In this study, judgements of risk were broadly made in line with theorising as set out in Cameron's (2003) IRR framework. As such, this study adds further weight to existing evidence that this is a useful framework with which to explore and understand the way in which people make judgements of risk.

Statement of contribution

What is already known on this subject?

- Physical activity (PA) throughout one's lifetime can reduce the risk of developing cardiovascular disease.
- The majority of adolescents' do not meet the recommended levels of PA.
- Changing beliefs about the risk of cardiovascular disease might be a useful strategy to motivate engagement in PA.

What does this study add?

- An increased understanding of adolescents' knowledge of cardiovascular disease and the link with PA.
- Identification of strategies to change adolescents' risk perceptions of cardiovascular disease in ways that could motivate PA.
- Evidence to support the Illness Risk Representation framework.

References

- Alves, A. J., Viana, J. L., Cavalcante, S. L., Oliveira, N., Duarte, J. A., Mota, J., . . . Ribeiro, F. (2016). Physical activity in primary and secondary prevention of cardiovascular disease: Overview updated. *World Journal of Cardiology*, 8(10), 575.
doi:10.4330/wjc.v8.i10.575
- American Heart Association. (2005). *Heart disease and stroke statistics – 2005 update*. Dallas, Texas: American Heart Association.
- Bhatnagar, P., Wickramasinghe, K., Williams, J., Rayner, M., & Townsend, N. (2015). The epidemiology of cardiovascular disease in the UK 2014. *Heart*, 101, 1182-1189. doi: 10.1136/heartjnl-2015-307516
- Bishop, A. J., Marteau, T. M., Hall, S., Kitchener, H., & Hajek, P. (2005). Increasing women's intentions to stop smoking following an abnormal cervical smear test result. *Preventive Medicine: An International Journal Devoted to Practice and Theory*, 41(1), 179-185. doi:10.1016/j.ypmed.2004.09.046
- Bittencourt, M. S., & Cerci, R. J. (2015). Statin effects on atherosclerotic plaques: Regression or healing? *BMC Medicine*, 13(1), 260. doi:10.1186/s12916-015-0499-9
- British Heart Foundation. (2014). *Atherosclerosis – your quick guide*. Retrieved on September 20, 2017, from <https://www.bhf.org.uk/information-support/publications/heart-conditions/atherosclerosis---your-quick-guide>
- Cameron, L. D. (2003). *Conceptualizing and assessing risk perceptions: a self-regulatory perspective*. Retrieved December 4, 2016, from https://cancercontrol.cancer.gov/brp/research/theories_project/cameron.pdf

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

Cameron, L. D. (2008). Illness risk representations and motivations to engage in protective behaviour: The case of skin cancer risk. *Psychology and Health*, 23(1), 91-112. doi: 10.1080/14768320701342383

Cameron, L., Marteau, T., Brown, P., Klein, W., & Sherman, K. (2012). Communication strategies for enhancing understanding of the behavioral implications of genetic and biomarker tests for disease risk: The role of coherence. *Journal of Behavioral Medicine*, 35(3), 286-298. doi:10.1007/s10865-011-9361-5

Croyle, R. T., Sun, Y. T., & Hart, M. (1997). Processing risk factor information: Defensive biases in health-related judgments and memory. In K. J. Petrie and J. A. Weinman (Eds.), *Perceptions of health and illness* (pp. 267-290). Amsterdam: Harwood Academic.

Fischhoff, B., Parker, A. M., De Bruin, W. B., Downs, J., Palmgren, C., Dawes, R., & Manski, C. F. (2000). Teen expectations for significant life events. *Public Opinion Quarterly*, 64(2), 189. doi:10.1086/317762

Fugard, A. J. B., & Potts, H. W. W. (2015). Supporting thinking on sample sizes for thematic analyses: a qualitative tool. *International Journal of Social Research Methodology*, 18(6), 669-684, doi: 10.1080/13645579.2015.1005453

Gale, N. K., Heath, G., Cameron, E., Rashid, S., & Redwood, S. (2013). Using the framework method for analysis of qualitative data in multi-disciplinary health research. *BMC Medical Research Methodology*, 13(117), 1-8. doi: 10.1186/1471-2288-13-117

Gilpin, E. A., & Pierce, J. P. (2003). Concurrent use of tobacco products by california adolescents. *Preventive Medicine*, 36(5), 575-584. doi:10.1016/S0091-7435(02)00064-6

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

Goldberg, J. H., Halpern-Felsher, B., & Millstein, S. G. (2002). Beyond invulnerability: The importance of benefits in adolescents' decision to drink alcohol. *Health*

Psychology, 21(5), 477-484. doi:10.1037/0278-6133.21.5.477

Graham, I., Atar, D., Borch-Johnsen, K., Boysen, G., Burell, G., Cifkova, R... Zampelas, A.

(2007). European guidelines on cardiovascular disease prevention in clinical practice: executive summary. *European Heart Journal*, 28(19), 2375-2414. doi:

10.1093/eurheartj/ehm316

Hagger, M. S., & Orbell, S. (2003). A meta-analytic review of the common-sense model of illness representations. *Psychology and Health*, 18(2), 141-184.

Hall, P. A., & Fong, G. (2003). The effects of a brief time perspective intervention for increasing physical activity among young adults. *Psychology and Health*, 18(6), 685-706. doi: 10.1080/0887044031000110447

Halpern-Felsher, B., Millstein, S. G., Ellen, J. M., Adler, N. E., Tschann, J. M., & Biehl, M. (2001). The role of behavioral experience in judging risks. *Health Psychology*, 20(2), 120-126. doi:10.1037/0278-6133.20.2.120

Halpern-Felsher, B., Biehl, M., Kropp, R. Y., & Rubinstein, M. L. (2004). Perceived risks and benefits of smoking: Differences among adolescents with different smoking experiences and intentions. *Preventive Medicine*, 39(3), 559-567.

doi:10.1016/j.ypped.2004.02.017

Health Survey for England. (2012). *Physical activity in children*. Retrieved December 4, 2016, from <http://content.digital.nhs.uk/catalogue/PUB13218/HSE2012-Ch3-Phys-act-child.pdf>

Hong, Y. M. (2010). Atherosclerotic cardiovascular disease beginning in childhood. *Korean Circulation Journal*, 40(1), 1-9. doi: 10.4070/kcj.2010.40.1.1

Houts, P. S., Doak, C. C., Doak, L. G., & Loscalzo, M. J. (2006). The role of pictures in improving health communication: A review of research on attention, comprehension, recall, and adherence. *Patient Education and Counseling*, *61*(2), 173-190.

doi:10.1016/j.pec.2005.05.004

Lee, T. J., Cameron, L. D., Wunsche, B., & Stevens, C. (2011). A randomized trial of computer-based communications using imagery and text information to alter representations of heart disease risk and motivate protective behaviour. *British Journal of Health Psychology*, *16*, 72-91. doi: 10.1348/135910710X511709

Leventhal, H., Brissette, I., & Leventhal, E. A. (2003). The common-sense model of self-regulation of health and illness. In L. D. Cameron and H. Leventhal (Eds.), *The self-regulation of health and illness behaviour* (pp. 42-65). London: Routledge.

Li, J., & Siegrist, J. (2012). Physical activity and risk of cardiovascular disease – a meta-analysis of prospective cohort studies. *International Journal of Environmental Research and Public Health*, *9*(2), 391-407. doi: 10.3390/ijerph9020391

Liberman, A., & Chaiken, S. (1992). Defensive processing of personally relevant health messages. *Personality and Social Psychology Bulletin*, *18*, 669–679.

Loewenstein, G. & Elster, J. (1992). *Choice over time*. New York: Russell Sage Foundation.

Maddux, J. E. & Rogers, R. W. (1983). Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental and Social Psychology*, *19*, 469-479. doi: 10.1016/0022-1031(83)90023-9

Marteau, T. M., Rana, S., & Kubba, A. (2002). Smoking and cervical cancer: A qualitative study of the explanatory models of smokers with cervical abnormalities. *Psychology, Health & Medicine*, *7*(1), 107-109. doi:10.1080/13548500120101504

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

Millstein, S. G., & Halpern–Felsher, B. L. (2002a). Judgments about risk and perceived invulnerability in adolescents and young adults. *Journal of Research on*

Adolescence, 12(4), 399-422. doi:10.1111/1532-7795.00039

Millstein, S. G., & Halpern-Felsher, B. (2002b). Perceptions of risk and

vulnerability. *Journal of Adolescent Health*, 31(1), 10-27. doi:10.1016/S1054-

139X(02)00412-3

National Heart, Lung and Blood Institute. (2012). *Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary*

report. Retrieved on May 11, 2017, from

https://www.nhlbi.nih.gov/files/docs/peds_guidelines_sum.pdf

Nechuta, S. J., Shu, X. O., Yang, G. Gao, Y-T., Li, H-L., Xiang, Y-B., & Zheng, W. (2015).

Adolescent exercise in association with mortality from all causes, cardiovascular disease, and cancer among middle-aged and older Chinese women. *Cancer*

Epidemiology, Biomarkers & Prevention, 24(8), 1270-1276. doi: 0.1158/1055-

9965.EPI-15-0253

Newby, K. V., Cook, C., Meisel, S. F., Webb, T. L., Fisher, B., & Fisher, A. (2017). Young people's beliefs about the risk of bowel cancer and its link with physical activity.

British Journal of Health Psychology, 22(3), 449-462. doi:10.1111/bjhp.12238

Newby, K. V., French, D. P., Brown, K. E., & Wallace, L. M. (2013). Beliefs underlying chlamydia risk appraisals: the relationship with young adults' intentions to use

condoms. *Journal of Risk Research*, 16(7), 843-860. doi:

10.1080/13669877.2012.743158

Palmefors, H., Duttaroy, S., Rundqvist, B., & Börjesson, M. (2014). The effect of physical activity or exercise on key biomarkers in atherosclerosis – A systematic

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

review. *Atherosclerosis*; *Atherosclerosis*, 235(1), 150-161.

doi:10.1016/j.atherosclerosis.2014.04.026

Peters, G-J. Y., Ruiter, R. A. C., & Kok, G. (2013). Threatening communication: A critical re-analysis and a revised meta-analytic test of fear appeal theory. *Health Psychology Review*, 7(1), 8-31. doi: 10.1080/17437199.2012.703527

Public Health England. (2014). *Everybody active, every day: An evidence-based approach to physical activity*. Retrieved on September 17, 2017, from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/374914/Framework_13.pdf

Reyna, V. F. (2004). How people make decisions that involve risk: A dual-processes approach. *Current Directions in Psychological Science*, 13(2), 60-66.
doi:10.1111/j.0963-7214.2004.00275.x

Reyna, V. F., & Farley, F. (2006). Risk and rationality in adolescent decision making: Implications for theory, practice, and public policy. *Psychological Science in the Public Interest*, 7(1), 1-44. doi:10.1111/j.1529-1006.2006.00026.x

Sheeran, P., Harris, P. R., & Epton, T. (2014). Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychological Bulletin*, 140(2), 511-543. doi: 10.1037/a0033065

Sherman, K. A., Kilby, C. J., Moore, D. M., & Shaw, L. (2017). The importance of coherently understanding cervical cancer vaccination: Factors associated with young Australian women's uptake of the HPV vaccine. *Health Psychology and Behavioral Medicine*, 5(1), 358-371. doi:10.1080/21642850.2017.1381023

Telama, R. (2009). Tracking of physical activity from childhood to adulthood: A review. *Obesity Facts*, 2(3), 187-195. doi: 0.1159/000222244

Accepted Manuscript.

Article accepted for publication in the British Journal of Health Psychology, 09/12/2019.

Tannenbaum, M. B., Hepler, J., Zimmerman, R. S., Saul, L., Jacobs, S., Wilson, K., &

Albarracín, D. (2015). Appealing to fear: A meta- analysis of fear appeal

effectiveness and theories. *Psychological Bulletin*, *141*(6), 1178-1204.

doi:10.1037/a0039729

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process

model. *Journal of Communication Monographs*, *59*(4), 329–349. doi:

10.1080/03637759209376276

World Health Organization. (2017). *Cardiovascular diseases (CVDs)*. Retrieved on

September 17, 2017, from <http://www.who.int/mediacentre/factsheets/fs317/en/>