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Public perceptions of coronary events risk factors: a discrete choice experiment

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ABSTRACT

Objectives: To assess public perceptions of coronary heart disease (CHD) risk factors.

Design: Discrete choice experiment questionnaire.

Setting: Six provincial centres in Northern Ireland.

Participants: 1000 adults of the general public in Northern Ireland.

Primary and secondary outcomes: The general public's perception of CHD risk factors. The effect of having risk factor(s) on that perception.

Results: Two multinomial logit models were created. One was a basic model (no heterogeneity permitted), while the other permitted heterogeneity based on respondents' characteristics. In both models individuals with very high cholesterol were perceived to be at the highest risk of having a coronary event. Respondents who reported having high cholesterol perceived the risk contribution of very high cholesterol to be greater than those who reported having normal cholesterol. Similar findings were observed with blood pressure and smoking. Respondents who were male and older perceived the contribution of age and gender to be lower than respondents who were female and younger.

Conclusions: Respondents with different risk factors perceived such factors differently. These divergent perceptions of CHD risk factors could be a barrier to behavioural change. This brings into focus the need for more tailored health promotion campaigns to tackle CHD.

STUDY SUMMARY

Article focus

- How would individuals perceive various coronary heart disease (CHD) risk factors.
- Would having risk factor(s) affect the individual's perception of the CHD risk factors.

Key messages

- Respondents were mistaken in their perception of the contribution of individual CHD risk factors.
- Respondents with different risk factors perceived such factors differently.
- These mistaken and divergent perceptions of CHD risk factors could be a barrier to behavioural change. This brings into focus the need for more tailored health promotion campaigns to tackle CHD.

Strengths and limitations of this study

- To our knowledge this is the first study which uses discrete choice experiment methodology to assess the general public's perceptions of CHD risk factors. This methodology allows the assessment of the individual's perception of CHD risk factors and also provides an opportunity to take a closer look at the risk contribution which the individual places on different risk factors.
- Despite using a convenience sample the characteristics of the sample corresponded closely with the general population in Northern Ireland with the exception of an over-representation of smokers.
- The choice sets used had not been formally validated, however, it was assumed before conducting the study that individuals, with different risk factors, would perceive such factors differently and this was confirmed upon the analysis of the data. This confirms the method's internal validity (which assesses the extent to which the results are consistent with prior expectations) and is in line with the evidence that individuals will answer a discrete choice experiment in a consistent and internally valid manner.

INTRODUCTION

Coronary heart disease (CHD) is attributable to a number of risk factors, which can be classified as modifiable and non-modifiable.[1] There are various approaches that can be used to calculate an individual's risk of having a coronary event using these risk factors, one of the most commonly used approaches being the Framingham equation[2] which arose from the results of the Framingham Heart Study. This study began in 1948 and set out to identify the common factors that contribute to CHD by following a large cohort of asymptomatic patients over a prolonged period. By analysing the characteristics of the patients who suffered from CHD in the follow-up period, gender-specific equations were formulated to predict the risk of having a coronary event in the next 10 years in patients according to their age, diabetic status, smoking status, blood pressure, total cholesterol or low-density

lipoprotein (LDL) cholesterol and high-density lipoprotein (HDL) cholesterol values.[2]

Considering the well-established link between health and individuals' knowledge about the disease,[3] it is not surprising that many health promotion strategies attempt to motivate preventative health behaviours by addressing the public's knowledge of diseases and their risk factors. Nevertheless, individuals continue to engage in unhealthy behaviours even when the risks are well known. For example, according to the Office for National Statistics, approximately one-quarter of individuals aged 16 and over in Great Britain continue to smoke despite the explicit health warning labels on cigarette packets.[4]

Knowing that individuals continue to engage in unhealthy behaviour despite knowing the risks and given that prevention, as opposed to cure, is the most effective way to deal with CHD,[1 5] it is of major interest to know how the general public perceive CHD risk factors and whether their perceptions are in line with their actual CHD risk. Knowledge of this information will help to address the misconceptions held by the general public and ultimately lead to more successful approaches to tackle CHD.

Individuals' perceptions and knowledge of different CHD risk factors have been studied using traditional questionnaires;[6–9] however, none of the studies to date have used discrete choice experiment (DCE) methodology to assess the general public's perceptions of these risk factors. The use of DCE methodology in healthcare research is increasing as it allows researchers to investigate individuals' preferences regarding certain services or treatment approaches.[10] This methodology also provides an opportunity to take a closer look at the relative importance which the individual places on different characteristics.[11 12]

The main aim of the present study was to assess the perceptions of members of the general public (in Northern Ireland) of various factors which increase the risk of having a coronary event and to assess if these perceptions are affected by their personal risk profile.

METHODS

Study design

A total of 1000 adults (without CHD) from Northern Ireland were interviewed using DCE methodology.

DCE design

Van Helvoort-Postulart *et al*[12] have outlined that the construction of a DCE consists of the following three steps.

1. Determining the 'attributes' of interest

The risk factors age, gender, total cholesterol, HDL, blood pressure, diabetic status and smoking status, which are used in Framingham equation to estimate an individual's risk of having a coronary event in the next 10 years, were used as the DCE attributes.

2. Setting levels for these 'attributes'

The levels of these risk factors, as determined in the Framingham equation, were used as the 'attribute-levels'.

In the Framingham equation, points are allocated to each level of the risk factors according to gender and then summed to give a score which is used to assign the risk of having a coronary event in the next 10 years. The risk of having a coronary event in the next 10 years is expressed as a percentage and is categorised into three categories:

- <10% low risk
- 10–20% moderate risk
- >20% high risk.[13]

On the basis of the Framingham equation, gender attribute had two levels ('male' and 'female'); the age attribute had nine levels (ranging between 30 and 74 years in 5-year intervals); the total cholesterol, the HDL and the blood pressure attributes had five levels ('very low', 'low', 'moderate', 'high' and 'very high'); while the diabetic status and the smoking status attributes had two levels (ie, 'present' and 'absent').

As there were three attributes with five 'attribute-levels' (blood pressure, total cholesterol and HDL), one attribute with nine 'attribute-levels' (age) and three attributes with two 'attribute-levels' (gender, smoking status and diabetic status), 9000 ($(5)^3\times(9)\times(2)^3$) combinations for both genders were possible (4500 combinations for each gender).

3. Constructing the choice sets which are composed of the 'attributes' at different 'attribute-levels'

Choice sets were constructed by randomly combining risk factors at different levels to give different risks of having a coronary event in the next 10 years. The randomly constructed choice sets were used in a pilot survey, where 100 members of the general public were presented in a face-to-face interview with different number of choice sets (ranging between 8 and 16 choice sets) to explore how they would deal with the discrete choice experiment and to check how many choice sets they could process while still remaining fully engaging with the researcher.

Although it has been reported in the literature that individuals can process up to 16 choice sets comfortably,[14] the pilot work established that 8 choice sets was a more appropriate number to be included in each questionnaire to avoid prolongation of the interview beyond the point where full engagement of the respondents was achievable.

Respondents in the pilot study were found to be more familiar with the negative effects of cholesterol and found the protective effects of HDL difficult to comprehend. For this reason, the HDL was held constant within the final version of the choice sets, that is, it was held at the level of 1.30–1.55 mmol/l since this level does not contribute to the overall risk score. With the HDL held constant, the number of possible combinations was

reduced considerably from 4500 to 900 for each gender (1800 in total ($(5)^2 \times (9) \times (2)^3$)).

Since the risk factors used in the Framingham equation have different effects at different levels, and since the main aim of the present study was to assess the general public's perceptions of such risk factors, it was agreed by the authors that the risk of having a coronary event in the next 10 years should be held constant in all the choice sets.

The choice sets were designed such that the exploration of the respondent's perception of risk was limited to a risk of 20%, since this is the cut-off point between the moderate-risk and the high-risk categories. Furthermore, the number of risk factor combinations produced at the 20% risk level (124 combinations) was the closest number of combinations divisible by eight (the number of choice sets to be used in the present study following piloting). To make the number of combinations divisible by 8, 4 of the 124 selected combinations were chosen randomly to be repeated to make 128 combinations.

Using the approach described by Ryan *et al*[15], choice sets were then constructed by randomly pairing the 128 combinations to create 64 choice sets. These were then divided to give eight blocks of eight choice sets, with each block contained within a different version of the questionnaire, each to be completed by one-eighth of the respondents.[15]

To measure their perception of CHD risk factors, respondents were presented with eight choice sets; each composed of two hypothetical individuals and they were asked to choose the individual they perceived to be at greater risk of having a coronary event in the next 10 years. A 'don't know' option was available when respondents could not make a choice between the options presented (table 1).

Participants and data collection

Ethical approval to carry out this study was granted by the Queen's University Belfast, School of Pharmacy Ethics Committee.

Data were collected as part of a survey which investigated CHD health knowledge and behaviour among members of the general public in Northern Ireland.[9] Data obtained in the pilot study referred to above were not included in the final analysis.

Table 1 Choice set representing two hypothetical individuals

Person A	Person B	
60-year-old female	55-year-old male	
Very high cholesterol	Low cholesterol	
High blood pressure	Very high blood pressure	Don't know
Non-diabetic	Diabetic	A
Smoker	Non-smoker	B

Once the survey instrument had been refined, the questionnaire was administered face-to-face to a convenience sample of 1000 members of the general public in Northern Ireland (dispersed over six provincial centres; the methodology of administering the questionnaire is described elsewhere).[9] A researcher from Queen's University Belfast approached the members of the public, then explained the nature of the survey and indicated that the questionnaire would take approximately 10 min to complete. Having been given this information, members of the public were asked if they were willing to participate in the study. The researcher spent approximately 2 weeks in each provincial centre, where members of the public were approached in a variety of outdoor locations (eg, parks, city centre shopping areas and bus stops) on different days and times (including evenings, weekends and bank holidays).[9]

Data analysis

All the collected data were entered into Nlogit 3 software. The data were analysed using multinomial logit (MNL) models (which represent the association between the probability of a particular choice being made by an individual and one or more independent variables which reflect attributes of the choice or the individual). In the MNL models $\hat{\beta}$ represents the MNL model coefficient which indicates the contribution of the independent variable to the final model (variables with a larger $\hat{\beta}$ have a higher contribution in the final model). McFadden's rho^2 measures the goodness-of-fit for the model (McFadden's r^2 values between 0.2 and 0.4 are considered a good fit[16]). The t-ratio is usually used in the MNL model to assess the significance of the contribution of each independent variable to the MNL model ($|\text{t-ratio}|>1.96$ is considered significant).[16]

RESULTS

Demographics and clinical characteristics

Of the 1000 respondents interviewed, 14 were excluded from the analyses as they did not disclose their age and/or did not know their cholesterol or blood pressure status. Thus, the final usable sample consisted of 986 respondents. In the analyses the cholesterol and the blood pressure variables were dichotomised into normal and high. Age was dichotomised into younger respondents (<50-years-old) and older respondents (≥50-years-old)[17 18] to facilitate evaluation of the impact of these risk factors on the study outcomes.

The demographic and self-reported clinical characteristics of the study respondents are presented in table 2. Of the 986 respondents, more than half were males (54.8%); almost two-thirds were less than 50-years-old (65%); just less than one-fifth reported having high cholesterol (18%) and high blood pressure (17.2%); less than one-tenth had diabetes (7.7%); less than half reported being current smokers (41.6%) while almost one-quarter reported smoking in the past (23.8%).

Table 2 The demographic and self-reported clinical characteristics of the study respondents (n=986)

Characteristics	Frequency	Percent
Gender		
Male	540	54.8
Female	446	45.2
Age (years)		
20–49	641	65
50–79	345	35
Cholesterol level		
Normal	809	82
High	177	18
Blood pressure level		
Normal	816	82.8
High	170	17.2
Diabetic status		
Diabetic	76	7.7
Non-diabetic	910	92.3
Smoking status		
Current smoker	410	41.6
Ex-smoker	235	23.8
Non-smoker	341	34.6

Discrete choice experiment analysis

Two MNL models were constructed: Model 1 (table 3) is the basic MNL model, where the respondents' reported characteristics were not taken into account in the analysis. Model 2 (table 4) permits heterogeneity based on respondents' reported characteristics (ie, respondents' characteristics were taken into account in the analysis).

In Model 1, when choosing which individual was at greater risk of having a coronary event in the next 10 years, respondents perceived individuals with very high cholesterol to be at the highest risk. This was followed closely by smoking. The results also indicate that the respondents considered very high and high blood pressure, diabetes and high cholesterol to increase the risk of having a coronary event in the next 10 years. Moreover, respondents considered non-modifiable risk factors to also contribute to having a coronary event, in particular, respondents deemed males and older respondents to be at higher risk of having a coronary event in the next 10 years. Respondents regarded individuals with very low and low cholesterol and very low and low blood pressure to be at lower risk of having a coronary event in the next 10 years.

Table 3 The basic multinomial logit model (Model 1)

Variable	$\hat{\beta}$*	t-Ratio†
Gender	0.285	6.4
Age	0.067	11.4
Very low cholesterol	−0.902	−7.0
Low cholesterol	−0.741	−16.2
High cholesterol	0.574	9.5
Very high cholesterol	1.613	19.3
Very low blood pressure	−0.735	−10.3
Low blood pressure	−0.629	−9.4
High blood pressure	0.641	13.4
Very high blood pressure	0.957	12.4
Diabetic status	0.661	14.1
Smoking status	1.358	31.3
Don't know	1.210	2.9
Log-likelihood ratio	−4189.758	
r^2‡	0.517	

*$\hat{\beta}$ represents the multinomial logit (MNL) model coefficient which indicates the contribution of the independent variable to the final model.
†t-Ratio is usually used in the MNL model to assess the significance of the contribution of each independent variable to the MNL model[16].
‡McFadden's r^2 measures the goodness-of-fit for the model[16].

In Model 2, respondents perceived individuals with very high cholesterol to be at the highest risk of having a coronary event in the next 10 years. Respondents, who reported that they themselves had high cholesterol, perceived the contribution of very high cholesterol to the overall risk of having a coronary event in the next 10 years to be greater than those who reported having normal cholesterol. The same findings were observed with blood pressure and smoking, that is, respondents who reported having high blood pressure and smoking currently, perceived the contribution of very high blood pressure and smoking (respectively) to the overall risk of having a coronary event in the next 10 years to be greater than those who reported having normal blood pressure or reported being an ex-smoker or a non-smoker.

Male respondents perceived the contribution of the male gender to the overall risk of having a coronary event in the next 10 years to be lower than female respondents. Similarly, older respondents perceived the contribution of age to the overall risk of having a coronary event in the next 10 years to be lower than younger respondents.

The risk associated with diabetes was found to be similar for diabetic and non-diabetic respondents.

As indicated by the increase in the log-likelihood, Model 2 provides a better fit to the data, when compared with Model 1.

DISCUSSION

Risk factors perception

In the present study, respondents perceived the contribution of very high cholesterol to the overall risk of having a coronary event in the next 10 years to be the highest, followed by smoking and very high blood pressure. Respondents were mistaken, as the main individual contributors to the overall risk of having a coronary event in the next 10 years are being in an older age group (50 years and older), followed by very high cholesterol and very high blood pressure in males, while in females the main individual contributors are being in an older age group (50 years or older) followed by diabetes, very high cholesterol and very high blood pressure.[2].

In the present study respondents with different risk factors perceived such factors differently, a finding

Table 4 Heterogeneous multinomial logit model (Model 2)

Variable	Characteristic	$\hat{\beta}$*	t-Ratio†
Gender	Male	0.223	4.6
	Female	0.344	6.9
Age	Aged 20–49 years	0.069	11.5
	Aged 50–79 years	0.054	10.4
Very low cholesterol	Normal cholesterol	−0.927	−7
	High cholesterol	−0.941	−5.2
Low cholesterol	Normal cholesterol	−0.714	−14.2
	High cholesterol	−0.756	−7.8
High cholesterol	Normal cholesterol	0.584	9.2
	High cholesterol	0.607	5.9
Very high cholesterol	Normal cholesterol	1.610	19
	High cholesterol	1.653	15.2
Very low blood pressure	Normal blood pressure	−0.729	−9.7
	High blood pressure	−0.775	−4.3
Low blood pressure	Normal blood pressure	−0.651	−9.2
	High blood pressure	−0.747	−5.7
High blood pressure	Normal blood pressure	0.677	13.2
	High blood pressure	0.639	6.2
Very high blood pressure	Normal blood pressure	0.946	12
	High blood pressure	0.973	8.5
Diabetic status	Non-Diabetic	0.660	13.8
	Diabetic	0.657	7.5
Smoking status	Current smoker	1.564	28.7
	Ex-smoker	1.293	22.2
	Non-smoker	1.203	23.5
Don't know		1.213	2.9
Log-likelihood		−4158.543	
r^2‡		0.520	

*$\hat{\beta}$ represents the multinomial logit (MNL) model coefficient which indicates the contribution of the independent variable to the final model.
†t-Ratio is usually used in the MNL model to assess the significance of the contribution of each independent variable to the MNL model[16].
‡McFadden's r^2 measures the goodness-of-fit for the model[16].

which was also reported by Weinstein *et al*[19] who reported that smokers in the USA perceived the risk of smoking differently, when compared with non-smokers, when they were presented with questions which measure their belief about smoking risks.

In the present study, respondents who reported having hyperlipidaemia, hypertension or who were smokers, perceived the contribution of these individual risk factors to the overall risk of having a coronary event in the next 10 years to be greater than those who did not report having such risk factors. This finding can perhaps be explained by the fact that the respondents were presented with hypothetical scenarios and were not asked about their own risk. Individuals may have been convinced by the general health risk messages regarding these risk factors, yet still believe that other individuals rather than themselves should take the required corrective measures.[20] Other researchers have found that smokers acknowledge the risk associated with smoking yet they still perceive themselves to be at lower risk compared with other smokers.[19]

In the present study the risk placed on diabetes was found to be similar for diabetic and non-diabetic respondents. This finding can be explained by the poor public knowledge about the link between diabetes and cardiovascular disease. The present finding is supported by the results of Jafary *et al*[7] who assessed CHD knowledge in a Pakistani population and reported that less than 2% of their respondents highlighted diabetes as a CHD risk factor.

In the present study, males perceived the contribution of the male gender to the overall risk of having a coronary event in the next 10 years to be lower, when compared with females. Also, older respondents perceived the contribution of age to be lower, when compared with younger respondents. This can be explained by the fact that individuals tend to process health risk information in a biased way.[20–22] This 'defensive' bias is driven by the individuals' motivation to protect their sense of self-integrity and their view of themselves as 'adaptively and morally adequate'[23] and also by the fact that individuals tend to possess an unrealistic optimism of their own risk and susceptibility.[19]

Importance of targeted health promotion campaigns

The present study highlighted that respondents were mistaken in their perception of the contribution of individual CHD risk factors. It also highlighted that respondents with different risk factors perceived such factors differently. These mistaken and divergent perceptions of CHD risk factors could be a barrier to behavioural change.

This brings into focus the need for more tailored health promotion campaigns to tackle CHD. Nollen *et al*[24] have proposed using group-targeted campaigns to allow individuals within particular risk groups to receive advice based on the common group characteristics. Also a tailored approach was requested by CHD patients who took part in a study conducted by Leathem *et al*[25]. In the latter study, CHD patients' opinions were taken into account when designing a health education booklet which could be used by their general practitioners.[25]

Limitations

The fact that a convenience sample was used may have introduced selection bias, however, on inspection, the characteristics of the sample corresponded closely with the general population in Northern Ireland[26 27] with the exception of an over-representation of smokers.[28]

The choice sets used had not been formally validated; however, it was assumed before conducting the study that individuals, with different risk factors, would perceive such factors differently and this was confirmed upon the analysis of the data. This confirms the method's internal validity (which assesses the extent to which the results are consistent with prior expectations) and is in line with the evidence that individuals will answer a discrete choice experiment in a consistent and internally valid manner.[10]

CONCLUSION

Respondents with different risk factors had different perceptions of such factors. Also they were mistaken in their perceptions about the contribution of such factors to the overall risk of having a coronary event in the next 10 years. These divergent and mistaken perceptions of CHD risk factors could be a barrier to behavioural change. This brings into focus the need for more tailored health promotion campaigns to tackle CHD.

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Contributors All the authors have helped in designing the study, conducting the analysis and writing the paper. YA also collected the data.

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