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Abstract

The Value of a Statistical Life (VSL) is a widely used measure of the value of mortality risk reduction. Since VSL should reflect preferences and attitudes to risk, there are reasons to believe that it varies depending on the type of risk involved. It has been argued that cancer should be considered a “dread disease”, which supports the use of a “cancer premium”. The objective of this study is to elicit the existence and size of a cancer premium (for pancreatic cancer and multiple myeloma) in relation to road traffic accidents, sudden cardiac arrest and Amyotrophic Lateral Sclerosis (ALS). Data was collected from 500 individuals in the Swedish general population 50 -74 years old using a web-based questionnaire. Preferences were elicited using the Contingent Valuation method, and a split-sample design was applied to test for scale sensitivity. VSL differs significantly between contexts, being highest for ALS and lowest for road traffic accident. A premium (26-76 %) for cancer was found in relation to road traffic accidents, but not in relation to ALS and sudden cardiac arrest. The premium was higher for cancer with a shorter time from diagnosis to death. Eliminating risk was associated with a premium of around 17 %. Evidence of scale sensitivity was found when comparing WTP for all risks simultaneously. This study shows that there exist a dread premium and risk elimination premium. These factors should be considered when searching for an appropriate value for economic evaluation and health technology assessment.

Keywords: willingness to pay; value of a statistical life; cancer; contingent valuation; risk elimination

JEL code: D61; D8; I18; J17

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1. Introduction

The Value of a Statistical Life (VSL) is a widely used measure of the value of mortality risk reduction, that has been studied extensively within transport economics (de Blaeij et al. 2003). Official estimates of VSL for road safety is consequently available in several countries and has been used as a reference for the VSL in other contexts (Organisation for Economic Co-operation and Development (OECD) 2012). It has also been used to derive an estimate of the value of a Quality-Adjusted Life-Year (QALY), a measure used by European Health Technology Assessment (HTA) agencies when deciding or recommending the adoption of therapies in healthcare (Mason et al. 2009; Ryen and Svensson 2014).

The strategy of using the VSL in road safety as a reference for the value of mortality risk reduction in other contexts has been questioned (Beattie et al. 1998). Since VSL should reflect preferences and attitudes to risk, there are reasons to believe that it varies depending on the type of risk involved (Jones-Lee and Loomes 1994). The way of dying will typically not leave the individual indifferent and aversion to risks will consequently differ, leading to different valuation of risk reductions. Risks that involve a period of suffering and knowing you will die (Hammitt and Liu 2004), that are involuntary and/or uncontrollable (McDaniels et al. 1992; Savage 1993), or that have a higher incidence (Jones-Lee 1974; Weinstein et al. 1980) could cause more dread and might be seen as more urgent to reduce.

It has been argued that cancer should be considered a “dread disease”, which supports the use of a “cancer premium”. The US Environmental Protection Agency (EPA) (US Environmental Protection Agency 2010) and the European Commission (European Commission 2000) suggest using a 50 % premium, while the UK Health and Safety Executive (HSE) (Health and Safety Executive 2001) recommends doubling the VSL in road traffic accidents for application to cancer risk reductions. The Cancer Drug Fund (CDF), which was introduced by the UK government in 2011, pays for cancer drugs that has not been reviewed or was not approved by the National Institute for Health and Care Excellence (NICE) (CDF 2015). The fund implies assigning a higher value to health benefits generated by cancer drugs. The OECD however did not recommend the use of a cancer premium after failing to find support for this in a review of studies of VSL. Instead it was recommended that morbidity costs due to cancer are added separately (Organisation for Economic Co-operation and Development (OECD) 2012).

The application of a “cancer premium” is mainly based on assumptions about people’s preferences since the empirical support for the existence and size of this premium is inconclusive. Studies using risk-risk trade-off methodology point to the existence of a cancer premium in relation to road traffic accidents which varies with the latency period (time from exposure to symptom development) and morbidity period (McDonald et al. 2016; Van Houtven et al. 2008). These studies do however not report any monetary value and do not present real baseline risks to the respondents. Research on the willingness to pay (WTP) for reducing environmental-related cancer risks have shown diverging results with respect to the existence of a cancer premium (Adamowicz et al. 2011; Alberini and Scasny 2013; Hammitt and Haninger 2010; Hammitt and Liu 2004; Viscusi et al. 1987). A reason for this might be the small baseline risks which may offset any dread effect and the indirect comparisons between contexts which may complicate the valuation task or include confounding factors. Alberini and Scasny (Alberini and Scasny 2013) did not specify the cancer type and used a conjoint choice experiment to assess the existence of a cancer premium, allowing for higher baseline risk of cancer and direct comparison between contexts. The study showed evidence of a cancer premium. However, it did not consider the impact of morbidity which has been shown to have an impact in the study by McDonald et al (McDonald et al. 2016).

The objective of this study is to elicit the existence and size of a cancer premium using the Contingent Valuation (CV) method to estimate the WTP of the general population. In contrast to the study by Alberini and Scasny 2013, the cancer type is specified in order to assess the impact of morbidity. By specifying the morbidity period and symptoms we expect to account for factors that are known to have an impact on preferences. It also allows us to study if it is of a higher value to avoid a long period of morbidity or a short period between diagnosis and death. This study estimate a cancer premium in a non-environmental context, enabling us to apply cancer of a higher risk and avoid specifying the cause. It is also the first study using sudden cardiac arrest and amyothrophic lateral sclerosis (ALS) (in addition to road traffic accidents) as comparator contexts when studying the existence and size of a cancer premium. It is hoped that this will shed additional light on the reasons for a cancer premium and, to our knowledge, provide a first estimate of the VSL for ALS. We also study the WTP for eliminating different health risks. A study by Viscusi et al. 2014 found a risk elimination premium of 14 percent in the context of cancer (Viscusi et al. 2014). This study is expected to show if and how a risk elimination premium differ by context. A secondary objective is to investigate if there is scale sensitivity between samples and if and how it differs by context.

The following presentation is organized as follows. Section 2 describes the theoretical framework and previous research, while section 3 presents the details of the methods used. The main result is presented in Section 4 and the article ends with a discussion of the result in Section 5.

2. Background

2.1 Value of a statistical life (VSL)

2.1.1 Definition

The theoretical model for VSL builds upon the assumption of individuals being expected utility maximizers. The individual faces a situation in which she may die with a certain probability or stay alive. The expected utility (E(U)) in this situation is a function of the probability of death (p) and the utility of wealth when being alive (L(W)) or dead (D(W)) (eq.1) (Jones-Lee 1974).

$$(Eq.1)\quad E(U) = (1-p)L(W) + (p)D(W)$$

The utility of wealth when being dead (D(W)) is usually assumed to be zero, simplifying the above equation to E(U) = (1-p)L(W). A potential change in the fatality rate means a small change in the probability of death for the individual (dp). The individual will be willing to pay up to an amount (V) that will leave her with the same expected utility as before the risk reduction (eq.2).

$$(Eq.2)\quad (1-p-dp)L(W-V) = (1-p)L(W)$$

Differentiating the equation while holding expected utility constant gives the marginal rate of substitution (MRS) between wealth and mortality risk reduction, which is equal to the VSL (eq.3).

$$(Eq.3)\ \ VSL = \frac{V}{dp}$$

2.1.2 Theory and VSL

It can be shown that – given certain assumptions - VSL will be an increasing function of baseline risk and wealth (Jones-Lee 1974). Differences in VSL could therefore simply reflect different baseline risk. However, the size of the baseline risk does not necessarily have an impact when risks are low (Hammitt and Graham 1999). It is also generally assumed that WTP is an increasing, concave function of risk reduction. Figure 1 show the assumed relationship between V and risk. V is positive when risk is below the current level (p0) and negative when risk is above the current level. Thus, individuals are willing to pay to reduce risk, but require compensation (Willingness To Accept, WTA) for an increase in risk. Figure 1 also show that there is a certain level of risk above which the individual cannot be compensated (p*). That is, there is no amount of money that could compensate an individual for the certainty (or close to certainty) of death (Jones-Lee 1974) It is usually assumed – and there is some evidence - that there exist a certainty premium of eliminating risk. The certainty premium arise because the individual no longer needs to spend any time on worrying about the risk or make decisions on how to handle it (Viscusi et al. 1987).

<<Figure 1>>

Theoretically it is standard to assume that WTP should increase close to proportional in relation to risk reduction (Hammitt and Graham 1999). This is often referred to as scale sensitivity. If WTP is shown to increase with the size of the risk reduction it is said to exhibit weak scale sensitivity. If it also increases close to proportional in relation to risk reduction it is said to have strong scale sensitivity. Most empirical studies on VSL show weak scale sensitivity, but fail to show strong scale sensitivity (de Blaeij et al. 2003; Hultkrantz and Svensson 2012). Failure of scale sensitivity can be a consequence of survey design (Corso et al. 2001), but evidence also points to cognitive restraints in respondents when it comes to understanding and valuing small reductions in risk (Andersson and Svensson 2008). Respondents who are more confident about their answers have been shown to be more sensitive to the size of the risk reduction (Hammitt and Graham 1999).

The relation between VSL and age depends on assumptions about saving and borrowing, discount rate (Johansson 2002; Shepard and Zeckhauser 1984), and preferences with respect to the number of life-years saved (Hammitt 2008, 2013). Most of the empirical evidence point to an “inverted-U” life-cycle relation, peeking in ages of 40 to 50 (Carthy et al. 1999; Hammitt 2008; Jones-Lee et al. 1985). Theoretically it is also possible with a positive relationship due to income and wealth rising with age or a negative relationship due to fewer expected life years remaining when one becomes older (Hammitt

2008). Since health risks vary with age, heterogeneity in VSL could simply reflect preferences at different ages.

Risks that develop over time – e.g. cancer – will have a latency period, i.e. the time from exposure to symptom development. This means that measures taken to reduce risk of cancer in the current period will change the expected outcome in future periods. Measures taken to reduce risks that have an immediate impact, e.g. road traffic accidents, will however change the expected outcome in the current period. WTP for risk with a latency period will differ from WTP for immediate risk because of discounting and less life-years lost in the future (Hammitt and Haninger 2010). The difference will depend on assumptions, but the empirical evidence suggests that WTP is negatively related to latency (Hammitt and Liu 2004; McDonald et al. 2016; Van Houtven et al. 2008). Studies that have not considered latency have consistently failed to show evidence of a cancer premium, since a possible premium is offset by latency (Adamowicz et al. 2011; Magat et al. 1996).

It is generally assumed that individuals care about the welfare of others, i.e. expressing altruistic concerns. The provision of the good – i.e. if it is framed as public or private – will consequently have an impact on WTP. The impact and relevance of altruistic concerns depends on what type of concerns (pure or safety-focused) the individuals can be assumed to hold and what they expect others to pay. Studies comparing the WTP for a public and private good have shown different results. While most evidence suggests that WTP for a public good is lower than the WTP for a private good in the context of road traffic accidents (Johannesson et al. 1996; Svensson and Vredin Johansson 2010), other studies show the opposite relationship in the context of ambulance helicopter service (Gyrd-Hansen 2016) and environmental risks (Alberini and Scasny 2013). One explanation for this difference might be that individuals have attitudes concerning the provision of the good, which may differ depending on context (Gyrd-Hansen 2016). Alberini and Scasny have shown that a higher share believes that private actions are effective at reducing risk for road traffic accidents and cancer while a higher share believes that public programs are effective at reducing respiratory problems (Alberini and Scasny 2013).

2.2 Previous research

Jones-Lee et al. 1985 is one of the first studies of the existence of a cancer premium. Respondents were asked to indicate how much they would contribute to help raise the money needed to save 100 people from death due to cancer, heart disease or motor vehicle accidents (Jones-Lee et al. 1985). Savage 1995 applied a similar approach with respect to commercial airplane accidents, household fires, automobile accidents and stomach cancer (Savage 1993). A clear majority (76 %) chose to reduce cancer in the first study and the implied VSL in both studies was two to three times higher than for motor vehicle accidents.

Other analysts have used choice-based stated preference approaches ("risk-risk trade-off"). Magat et al. 1996 studied relative preferences for avoiding lymphoma and auto death (Magat et al. 1996). Respondents (n=727, US) were asked to decide where they would choose to live when the risk of these outcomes differed between areas. The study showed indifference between auto death and fatal lymphoma. Van Houtven et al. 2008 used the same approach but differed by explaining the latency period (time from exposure to symptom development) to the respondents (n=1,010, US), finding that there exists a cancer premium that is negatively associated with latency period (Van Houtven et al. 2008). With a latency period of 5 years, avoiding cancer risk was rated three times higher than avoiding accidental risk. Recently, McDonald et al. 2016 published a study designed to identify the effect of context, morbidity, and latency on the cancer premium (McDonald et al. 2016). An interview of a total of 157 respondents reveals that there is a cancer premium in relation to road traffic accidents that is primarily driven by morbidity and negatively related to latency. However, there is no premium when latency is 10 years, and a negative premium when latency is 25 years.

Another strand of research has estimated the WTP for reducing environment-related cancer risks. Hammit and Liu 2004 studied a case where the risk of lung disease and liver disease could be reduced by improving air or water quality (Hammitt and Liu 2004). Both diseases were framed as either a non-cancer disease (bronchitis or liver failure) or a cancer disease (lung cancer or liver cancer) in order to reveal a possible cancer premium due to the word "cancer". Respondents (n=1,248, Taiwan) stated a 30 % higher WTP to reduce risk when the disease was framed as cancer, but the difference was not significant. Another study by Hammit and Haninger 2010 estimated the WTP for reducing risk of different types of diseases (cancer and non-cancer) by choosing to buy food with pesticide safety system (Hammitt and Haninger 2010). The respondents (n=2,018, US) were also questioned about their WTP for reducing their risk for automobile accidents by buying a safety device. The result of the study did not show any evidence of a cancer premium with respect to the word “cancer” or compared to automobile accidents. Similarly, the WTP for a new municipal water treatment program that would reduce the risk of microbial illness and bladder cancer was estimated by Adamovicz et al. 2011, finding no significant differences in VSL for microbial illness and bladder cancer (Adamowicz et al. 2011). However, the estimates of cancer would be higher than for microbial illness when taking latency– which were implied (although not explicitly) to respondents (n=1,219, Canada) - into account. Alberini and Scasny 2013 performed a conjoint choice experiment on 983 respondents from Milan, Italy which showed support for a cancer premium in relation to respiratory illness and road traffic accident. The study allowed direct comparison of different contexts and supported a cancer premium of around 80 % in relation to VSL in road traffic accidents.(Alberini and Scasny 2013) Finally, Viscusi et al. 2014 elicited the WTP for a new water treatment system which would reduce risk of bladder cancer (n=3,430, US). The study – when taking latency into account - resulted in a VSL which was 21 % higher than the VSL used for acute accidents. The study also showed a risk elimination premium of 14 % (Viscusi et al. 2014).

The result of available WTP studies varies depending on the methods used. The lack of a significant effect could be due to most studies using an indirect comparison and small baseline risks, making it difficult for the respondent to reveal preferences with respect to context. Alberini and Scasny allow respondents to compare at least two contexts directly and control for baseline risk. However, they do not specify cancer type or morbidity symptoms or duration. The result of McDonald et al. would suggest that the morbidity period does have an impact on preferences which ought to be considered when studying the existence of a cancer premium. This study specify cancer type and morbidity symptoms and duration, and allows respondent to directly compare the value of a mortality risk reduction and risk elimination in a range of different contexts.

3. Methods

3.1 Questionnaire design and scenario presentation

The first part of the questionnaire included background questions (e.g. on sex, age, occupation, income). The respondent was then introduced to the purpose of the study as well as the concept and meaning of WTP. Next, the respondent was presented with five different fatal health risks (see translated health risk descriptions in Appendix 1), including pancreatic cancer, cancer of the plasma cells (multiple myeloma), ALS, fatal road traffic accident, and sudden cardiac arrest.

For each risk, the respondent was asked if she had any experience of it and how worried she was about suffering from it compared to previously described health risks. The respondent was also asked to rank the health risks from 1 (most dread) to 5 (least dread). Next, the respondent was presented with the risk of suffering from the health risks per 100,000 persons of her age-and sex-cohort during the next ten years (Appendix 2), and asked about her risk perception (control of risk: "can impact risk by own behavior", and subjective risk in relation to average risk). The risks were displayed using a pie chart and explained using a reference to arenas and cities with 100,000 visitors/inhabitants. The respondent was also asked to repeat ranking of the health risks from 1 (most afraid of) to 5 (least afraid of). After each ranking of health risks, the respondent was asked about her reason for choosing health risk X as number one.

In the first WTP scenario, the respondent was asked to state what she (he) would pay for a private prevention package for women (men) of her (his) age cohort to reduce the risk by 50 per 100,000 in ten years for all health risks (10 per 100,000 for each risk). A subsample was given a risk reduction of 25 per 100,000 in ten years (5 per 100,000 for each risk) in order to test for scale bias. In the second WTP scenario, the respondent was asked to allocate her WTP from the first scenario to each health risk reduction. The sum of all separate WTP amounts were presented and compared to the WTP in the first scenario. In the third and final scenario, the respondent was told that all health risks had been reduced to 10 (or 5) in 100,000 and asked to state her WTP to eliminate each risk. The sum of all separate WTP amounts were presented to the respondent.

The scenarios included a description of a prevention package including a vaccine for cancer, ALS, and sudden cardiac arrest and an application for mobile phones that could reduce risk of serious road traffic accidents. The respondent was also told that the prevention package (and its individual components) would reduce individual risk during the next ten years. This period was chosen to make baseline risks and the interventions meaningful. The ten-year time horizon was also chosen to reduce the problem of latency, i.e. duration between exposure to risk and symptom development. The respondent were told that risk would be reduced during the entire period and a specific timing of symptom development and death was not specified. It was assumed that this would allow respondents to compare health risks without considering latency. A previous study has also shown similar discounting between contexts (McDonald et al. 2016), which implies that the timing does not matter for relative valuation. There is still a possibility that respondents will assume that the timing of health risks will differ and take latency into account. If this is the case, differences will be underestimated.

A modified version of Payment Card (PC), certainty calibration, and debriefing questions for payers and non-payers were included in the WTP scenarios in order to limit the biases that are common in CV studies. The PC-procedure consists of presenting a number of amounts to the respondent in numerical order (SEK1, 100, 500, 1,000, 1,500, 2,000, 3,000, 4,000, 5000, 7,000, 9,000 per year) and to ask whether she would pay or not pay the amount (Covey et al. 2007; Bateman et al. 2002). The range of amounts were set to identify non-payers and to cover what are assumed to be the range of WTP estimates in these kind of studies, partly based on amounts chosen for discrete choice studies with similar baseline risks (Johannesson et al. 1996; Svensson 2009). This study applies two modifications to the PC-procedure. First, the amounts were presented one at a time instead of all at once. This allowed us to identify non-payers without having to use a screening question which is known to increase zero response (Gyrd-Hansen et al. 2014), and to avoid the problem of range bias which is associated with presenting all of the amounts simultaneously (Covey et al. 2007). Secondly, we added a procedure from the EuroVaq study (EuroVaq Team 2010) where the respondent is presented with the highest amount she would pay and the lowest amount she would not pay and asked to state her WTP in an open question. This allows the respondent to be more precise and generate WTP as a continuous variable. The PC-procedure was only applied in the first scenario, and amounts were presented both per year (to make it comparable to the budget of the respondent) and for 10 years (to show the entire cost of reducing risks). In scenario two and three, only open WTP questions were used asking for WTP per year. Before the PC-procedure in the first scenario, the respondents were asked to think about how much they and their household could afford and to answer as if they would have to pay for real. They were also asked to assume that they would not suffer any loss of income if they would become sick and could not work.

Certainty calibration means asking respondents to rate (on a scale from 0 to 10) how sure she is that she would pay the amount if she were given the opportunity to buy the good for that price. This question is assumed to reduce hypothetical bias (i.e. WTP responses deviating from what the respondent would pay for real) by separating certain respondents – those who are assumed to buy the good for real – from uncertain respondents – those who are assumed to not buy the good for real (Blumenschein et al. 2001; Loomis 2014). Debriefing questions means asking respondents to state their reasons for paying or not paying. Respondents who indicate that they do not take the survey seriously, do not understand the question, or who protest against the scenario can thereby be identified and possibly excluded (Bateman et al. 2002). Debriefing questions were also used to examine the reason for the respondent's relative valuation of reducing different health risks.

3.2 Pilot

The questionnaire was pre-tested by a sample of 49 respondents from an internet panel, and a convenience sample of 7 respondents who were also included in a focus group discussion after completing the questionnaire. The pilot study was performed in May 2016. The pilot (n=56) showed that the size of the risk reduction in the risk elimination question was too large and diverse to produce reliable estimates. Instead of using the real baseline risks, the scenario in the final version of the questionnaire asked respondents to assume that all risks had been reduced to 10 (or 5) in 100,000.

3.3 Sample

A randomly stratified sample of individuals from the Swedish population was drawn from the Sinitor panel (http://vocnordic.se/panel-2/; total panel population, n = 25,000). A web-based version of the questionnaire was programmed and sent to respondents in the ages between 50 and 74 years old by Enkätfabriken (http://www.enkatfabriken.se/). This age group was chosen since they have a sufficiently high baseline risk and similar relative baseline risks. The panel respondents were offered a minor incentive for their participation. Data was collected in June 2016. The questionnaire was sent to 1,400 individuals. More than half (54 %) started to answer the questionnaire and 500 respondents (36 %) completed the questionnaire. The majority of the respondents who choose not to complete the questionnaire dropped out in section 2 (experience and opinions about health risks). Respondents were more educated compared to the general population 50-74 years old (university education: 52 % vs 34 % (SCB 2016b)) and had a higher household income (SEK43,409 vs SEK37,834 (SCB 2016a)). There was a small but significant difference in mean age between respondents answering to different versions of the questionnaire (Table 1).

<<Table 1>>

3.4 Analysis

All respondents who completed the questionnaire were included. When analyzing the WTP responses, respondents classified as protesters or outliers where excluded in the main analysis. Protesters are respondents who do not want to pay because they think the government should pay or respondents who state any WTP because they know they do not have to pay for real. Excluding these respondents is a common procedure since they have indicated that they do not accept the scenario (Bateman et al. 2002). Outliers are defined as respondents stating a WTP in the open-ended question which is above the largest amount in the PC-procedure (SEK 9,000 per year). Trimming results with respect to outliers is also a common procedure to avoid giving extreme responses too much weight on mean results. A subgroup analysis was also performed where respondents who rated below 7 on the certainty calibration question were excluded. The cut off at 7 has been supported by previous research (Loomis 2014), while other studies argues for only treating the respondents rating 10 as certain (Svensson 2009). WTP is reported in SEK (SEK1=US$0.12).

The VSL of different health risks (h) was calculated by multiplying the mean WTP by ten and dividing it by the pre-defined risk reduction (eq.4).

$$(Eq.4)\ \mathrm{VSL_h} = \frac{\frac{1}{\mathrm{N}}\sum_{\mathrm{i=1}}^{\mathrm{N}} \mathrm{WTP_{h,i}} \times 10}{(5 \text{ or } 10/100{,}000)}$$

A Wilcoxon Signed Ranks Test was used to test for significant differences in WTP within groups – i.e. between different health risks - and a Mann-Whitney U Test was used to test for significant differences between groups – i.e. between groups with different risk reduction.

An OLS regression was performed to validate and explain the result, using the log of WTP as the dependent variable and age, age squared (defined as (age-mean age)^2), sex, university education, log of income per consumption unit (Statistics Sweden 2015), response in certainty calibration, log baseline risk, and risk experience and risk perception as explanatory variables. The logarithm of WTP and other variables is used to take account of the skewed distribution of WTP and to make the result easy to interpret. Age squared is used to assess if the relationship with WTP takes the form of an inverted U (Shepard and Zeckhauser 1984). The OLS regression was performed for each health risk separately (risk reduction and risk elimination scenarios pooled) and for all scenarios pooled.

4. Results

ALS causes most dread, followed by cancer, sudden cardiac arrest and road traffic accident. After the respondent had been presented with the real average risk, ALS and cancer were rated somewhat more dreadful while sudden cardiac arrest and fatal road traffic accident were rated less dreadful (Figure 2). Ranking for dread was significantly different between all health risks except for when comparing ranking of sudden cardiac arrest and fatal road traffic accident without risk. The main reason for ranking ALS or cancer highest with respect to dread was disease and suffering while a high risk or sudden death were the main reasons for considering sudden cardiac arrest or fatal road traffic accident the most dreadful. Around 10 % stated cancer as the main reason for rating this health risk highest with respect to dread. The mean rating of subjective risk in relation to average risk for the sex- and age-cohort of the respondent was highest for sudden cardiac arrest followed by fatal road traffic accident, cancer, and ALS. Control of risk (can impact risk by own behavior) was rated in reversed order of dread, i.e. highest for fatal road traffic accident, followed by sudden cardiac arrest, pancreatic cancer, multiple myeloma, and ALS.

<<Figure 2>>

The share of respondents definitely willing to pay the amount presented in PC differ with respect to the size of risk reduction at lower amounts but not at higher amounts among all respondents. When excluding protesters and outliers – i.e. main analysis - there is a difference in the share willing to pay over almost all amounts presented (Figure 3). The difference is pronounced when limiting the analysis to certain respondents.

<<Figure 3>>

The WTP for a reduction of all risks differ significantly, although not proportionally, with respect to the size of the risk reduction in the main analysis and among certain respondents, indicating scale sensitivity. (Table 2) The VSL is between SEK 33 million and SEK 51 million (USD 3.96-6.12 million) which is similar to the result of other studies.

<<Table 2>>

A majority (62-71 %) of respondents expressed a WTP which varied depending on the type of health risk. The share of respondents paying the same amount to all health risk and zero response were higher with a lower risk reduction and when the risk was eliminated. (Table 3) Respondents who stated the same WTP for all health risks and who indicated that they had not understood the question and respondents with a WTP above SEK 9,000 per year (USD 1,080) (Table 4) were excluded from the main analysis in addition to protesters and outliers identified in scenario 1 (Table 2).

<<Table 3>>

<<Table 4>

Consistent with the ranking of dread, the WTP was highest for reducing/eliminating risk for ALS and lowest for reducing/eliminating the risk for fatal road traffic accident. (Figure 4a-d) Compared to the WTP for reducing the risk of fatal road traffic accident, the WTP was significantly higher for reducing the risk for ALS (81-104 %), pancreatic cancer (43-76 %), multiple myeloma (26-38 %) and sudden cardiac arrest (49-65 %), suggesting the existence of a premium. (Table 5) Reducing pancreatic cancer was valued significantly higher than reducing multiple myeloma. When both cancer diseases had the same baseline risk (risk elimination scenarios), the difference was smaller but remained significant. Reducing ALS was significantly higher valued compared to reducing multiple myeloma and pancreatic cancer. The difference remained when baseline risk was similar, indicating that there is a “dread premium” unrelated to cancer. Eliminating the risk of sudden cardiac arrest was valued significantly higher compared to eliminating the risk of fatal road traffic accident even though baseline risk was similar. This suggests that there is a dread premium for sudden cardiac arrest unrelated to baseline risk. There were no significant differences between WTP for reducing/eliminating sudden cardiac arrest and pancreatic cancer, multiple myeloma, or ALS. The main reason for paying most to ALS and multiple myeloma was dread, while both dread and baseline risk were reasons for paying most to reduce risk of pancreatic disease. Perceived personal baseline risk was the main reason for paying most to sudden cardiac arrest and fatal road traffic accident.

The WTP for eliminating risk (Figure 4c-d) was higher than the WTP for reducing risk (Figure 3a-b). The difference was significant in the main analysis for all health risks in both questionnaire versions except for fatal road traffic accident and sudden cardiac arrest in the questionnaire with a risk of 5 in 100,000. The implied VSL for reducing health risks varies between SEK 25 million and SEK 81 million while the implied VSL for eliminating risks varies between SEK 35 million and SEK 95 million. Eliminating risk increase VSL by about SEK 10 million (Table 6)

The WTP for reducing/eliminating risk of 10 in 100,000 (Fig. 4a+c) was in general higher than the WTP for reducing/eliminating risk of 5 in 100,000 (Fig. 4b+d). However, no difference was statistically significant in the main analysis except for risk elimination of sudden cardiac arrest. The total WTP (summed for all health risks) was significantly different between versions when risk was eliminated (SEK 2,390 vs SEK 1,811 p=0.0928) but not when risk was reduced (SEK 1,986 vs SEK 1,586 p=0.1340). The total WTP for reducing health risks separately was significantly higher than the WTP to reduce all risk simultaneously (10 per 100,000: SEK 1,968 vs SEK 1,630 p=0.0004; 5 per 100,000: SEK 1,586 vs SEK 1,279 p=0.0000). The total WTP for eliminating health risks separately was also significantly higher than the total WTP to reduce health risks separately (10 per 100,000: SEK 2,390 vs SEK 1,968 p=0.0000; 5 per 100,000: SEK 1,811 vs SEK 1,586 p=0.0167).

<<Fig. 4a-d>>

<<Table 5>>

<<Table 6>>

Income was positively related to WTP in all scenarios (Table 7), which supports the validity of the study. WTP was not related to the size of risk reduction, indicating a lack of scale sensitivity. However, there are indications of scale sensitivity in subgroups of respondents. (Table 2) Women had a higher WTP in scenarios of ALS and pancreatic cancer, which were the most dreaded risks. Age was only related to WTP in scenarios of ALS and road traffic accident. The relationship was consistent with the expected inverted U-shape form. Baseline risk was not related to the WTP in scenarios of cancer, ALS, or sudden cardiac arrest, but was negatively related to WTP in scenarios of fatal road traffic accident. This is contrary to the expected positive relationship and might be explained by respondents perceiving a risk reduction to be off a higher value when baseline risk is small, since it would imply that risk is almost eliminated. Rating on the certainty scale was significantly positively related to WTP in all scenarios. Ranking for dread was related to WTP in scenarios of pancreatic cancer, multiple myeloma, and ALS. This would suggest that dread is an important driver of the premium found for these risks. The WTP for risk elimination were around 16-17 % higher than the WTP for risk reduction except for in scenarios of road traffic accident where the risk elimination premium was 29 %.

<<Table 7>>

5. Discussion

This study showed that individual preferences for risk reduction differ depending on the context. VSL in ALS, cancer, and sudden cardiac arrest were shown to be significantly higher than VSL in road traffic accident. This would support the use of a “dread premium” for these types of outcomes in relation to road traffic accidents.

VSL for pancreatic cancer was higher compared to VSL for multiple myeloma, even when baseline risk was similar. The finding indicates that a short time to death have a larger impact on preferences than a longer time with morbidity. It challenges the view of the cancer premium as an ‘add-on’, simply reflecting the loss in quality of life during the morbidity period preceding death. No evidence was found to support a cancer premium in relation to sudden cardiac arrest. A possible explanation for this is that baseline risk offset the impact of dread.

This study showed a high correlation between dread and WTP which is in line with what has been argued in theory and shown in other studies (Chilton et al. 2006; Savage 1993). Differences in the valuation depending on contexts remained even when baseline risk was similar, suggesting that there are reasons other than baseline risk that make respondents assign a higher value to risk reduction in certain contexts. This is a finding consistent with Alberini and Scasny (Alberini and Scasny 2013). Although the morbidity period was similar between ALS and multiple myeloma, the WTP for a risk reduction was higher for ALS. The WTP for a risk reduction was also higher for sudden cardiac arrest compared to road traffic accident even though both imply sudden death. These findings indicate that the type of morbidity and death is of importance.

Consistent with the finding in Viscusi et al 2010, this study supports existence of a risk elimination premium (Viscusi et al. 2014). The premium was similar irrespective of context (16-17 %), except for scenarios of road traffic accident, which implied a risk elimination premium of 29 % A higher risk premium for eliminating risk of road traffic accidents could be due to the possibility of avoiding higher precautionary costs (e.g. car with a higher safety). When risk was small (5 in 100,000) there were no premium for eliminating risk of fatal road traffic accident and sudden cardiac arrest, suggesting that the premium for these health risks is offset by a low baseline risk. The premium remained for cancer and ALS even when risk was small, which implies that it is driven by worry and dread.

Being more certain about ones WTP was associated with stating a higher WTP. This finding is contrary to the result of studies using certainty calibration and discrete choice, where probability of saying yes to pay a certain amount is negatively related to the certainty scale (Blumenschein et al. 2001; Svensson 2009). Results based on respondents classified as certain did however show a greater sensitivity to scale, implying that certain respondents did have a better understanding of or more involvement in the study. This is in line with previous research that show more sensitivity towards the size of the risk reduction among confident respondents (Alberini et al. 2004; Hammitt and Graham 1999).

The share of zero response and protesters was lower in scenario 1 (zero response: 22-29 %; protesters: 5-6 %) where respondents were asked for their WTP using the PC-procedure compared to scenario 2 and 3 (zero response: 24-44 %; protesters 16-21 %) where respondents were asked for their WTP using only an open-ended question. This result is similar to Gyrd-Hansen et al.when comparing the outcome of PC-procedure (zero response: 27.9 %; protesters: 11.4 %) and open-ended WTP (zero response: 51.4 %; protesters: 22.7 %) (Gyrd-Hansen et al. 2014). About 8 % were classified as outliers in scenario 1 while the corresponding share was only between 0.4 and 2 % in scenario 2 and 3. The share of outliers in scenario 1 were higher than what Gyrd-Hansen et al. found when using PC-procedure (0.6 %) but lower than what they found when using open-ended WTP (23 %) which can be explained by applying a combined procedure of both PC-question and open-ended WTP in this study.

Although risk reduction did not have an impact on WTP in the regression, the WTP for reducing/eliminating a risk of 10 per 100,000 was consistently higher compared to the WTP for reducing/eliminating a risk of 5 per 100,000. There were also differences in several analysis of WTP to reduce all risks. The lack of proportionality in the WTP for separate health risks might have been caused by respondents having difficulties understanding and valuing the size of the risk reduction. Another explanation is that there is an income effect, i.e. the budget of the respondent puts a limit on the WTP. The problem of scale sensitivity is a well-known issue in WTP studies using small baseline risk and have raised some doubt with respect to the validity of the result from these type of studies (Cookson

2003). The variation in VSL found in this study does however not deviate from what is found in similar studies.

The cancer premium in relation to road traffic accidents reported in this study is lower than what was reported in studies by Jones-Lee et al. 1985 (Jones-Lee et al. 1985) and by Savage et al. 1995 (Savage 1993) where respondents were asked to contribute or allocate a certain sum to save lives in different contexts. Reasons for this finding might include that this study applied an individual perspective, that specific cancer types were described and/or that cancer cause less dread today than 20-30 years ago. This study also reports a lower premium compared to risk-risk trade off studies (McDaniels et al. 1992; Van Houtven et al. 2008). An explanation for this is that risk-risk trade off studies does not require respondents to trade off income (which places a limit on the absolute valuation) and does not specify real baseline risk. Alberini and Scasny (Alberini and Scasny 2013) reported a cancer premium of 84 % in relation to road traffic accidents, which is similar to the highest estimates in this study. The study by Alberini and Scasny did however not specify type of cancer and morbidity period which were shown to have a small but significant impact in this study. Viscusi et al. (Viscusi et al. 2014) found a cancer premium of 21 % in relation to acute fatalities in the context of bladder cancer from contaminated drinking water. The morbidity period of bladder cancer is relatively long, making this estimate most comparable to what we found in this study for multiple myeloma (27-35 %).

The VSL in this study is comparable to what has been found in other studies. Fatal road traffic accident is one of the most commonly studied area for VSL. The last major study in Sweden report estimates between SEK million 21 and SEK 53 million(Svensson 2009) which is similar to what is reported in this study (SEK 26-45 million). The VSL in cancer has to our knowledge not been studied in Sweden. Alberini and Scasny report a VSL of EUR 5.3 million (Alberini and Scasny 2013) among Italian respondents and Viscusi report a VSL of USD 8.1 (EUR 7.1) million (Viscusi et al. 2014) among US respondents. This study presents estimates between EUR 3.6 million and EUR 7.0 million. VSL for sudden cardiac arrest in this study (SEK 43-67 million) correspond to the result of another Swedish study (SEK 49-144 million) (Sund 2010). To our knowledge, there are no previous studies on the VSL for ALS. This study suggest that it is of a significant size, up to double the VSL in road traffic accidents.

This study showed that context do matter in the valuation of a reduction of mortality risk and that there exists a dread premium and risk elimination premium. The result supports the use of a premium for cancer which is negatively related to the time from diagnosis to death. The premium for cancer varies between 26 and 76 % which is in line with the practice of some governmental agencies that apply a premium between 50 and 100 %. The VSL result is in line with the outcome of several other studies and would suggest that to use the accepted VSL in road traffic accidents as a reference for other contexts or for the value of a QALY is not in accordance with the preferences of the general population.

Tables

Table 1 Sample characteristics

Variable	Risk reduction 10 per 100, 000 (n=256)	Risk reduction 5 per 100,000 (n=244)	p-value
Mean age (Std.Dev.)	66.2 (5.6)	64.8 (6.7)	0.0108**
50-55 years	4 %	12 %	
56-59 years	10 %	15 %	
60-64 years	20 %	16 %	
65-69 years	31 %	26 %	
70-74 years	35 %	32 %	
Females	50 %	49 %	0.7872
One adult in household	30 %	25 %	0.1422
Child in household	3 %	4 %	0.7288
University education	52 %	52 %	0.9476
Employed	26 %	32 %	0.1537
Mean household income per month[a]	42,773	44,100	0.4857

[a]Optional question, 10 in 100,000 n=229; 5 in 100,000 n=211, transformed from interval using intermediate values.

Table 2 WTP for a reduction of all health risks

Sample	Risk reduction 50 per 100,000 (n=256)	Risk reduction 25 per 100,000 (n=244)	p-value	VSL[a] (MSEK)
All respondents	2540 (5409), 1000	2625 (6383), 500	0.1007	50.8-105.0
Main analysis (excl. protesters and outliers)	1630 (2141), 550	1279 (1990), 500	0.0259	32.6-51.2
Main analysis, certain respondents	1712 (2385), 500	1282 (2196), 175	0.0424	34.2-51.3
Zero response (n)	57 (22.2 %)	70 (28.7 %)		
Protesters (n)[b]	15 (5.9 %)	11 (4.5 %)		
Outliers (n)[c]	19 (7.4 %)	20 (8.2 %)		
Uncertain (n)[d]	83 (32.4 %)	75 (30.7 %)		

[a]VSL= value of a statistical life, VSL=(WTP x 10)/(risk reduction)
[b]Nonpayers "because government should pay" + Payers stating any amount "because they do not have to pay".
[c]WTP open question > SEK9000 per year.
[d]Below 7 on a scale from 0 to 10.

Table 3 Proportion of zero and same (equal WTP to all health risks) response

	10 per 100,000 (n=256)		5 per 100,000 (n=244)	
	Risk reduction	Risk elimination	Risk reduction	Risk elimination
Pancreatic cancer	24.2 %	23.8 %	26.2 %	25.0 %
Multiple Myeloma	25.8 %	24.6 %	29.5 %	28.3 %
ALS	24.6 %	24.2 %	27.5 %	25.8 %
Fatal road traffic accident	41.4 %	38.7 %	43.9 %	41.4 %
Sudden cardiac arrest	30.1 %	28.1 %	34.0 %	33.2 %
ALL zero response	**18.0 %**	**19.1 %**	**19.7 %**	**20.5 %**
ALL same response	**32.8 %**	**37.1 %**	**39.8 %**	**43.9 %**
whereof excluded[a]	**35.7 %**	**30.5 %**	**38.1 %**	**29.0 %**

[a]Reason for paying the same: "I don't know" or "I didn't consider the baseline risk".

Table 4 Number of outliers (WTP above SEK9,000 per year)

	10 per 100,000 (n=256)		5 per 100,000 (n=244)	
	Risk reduction	**Risk elimination**	**Risk reduction**	**Risk elimination**
Pancreatic cancer	3	5	2	4
Multiple Myeloma	3	3	2	4
ALS	3	5	5	5
Fatal road traffic accident	0	1	1	1
Sudden cardiac arrest	1	2	2	5

Table 5 Difference in WTP for reducing/eliminating different health risks (main analysis)

Comparison	**10 in 100,000**		**5 in 100,000**	
	Risk reduction	**Risk elimination**	**Risk reduction**	**Risk elimination**
Pancreas vs Multiple Myeloma	38 %***	19 %***	6 %*	2 %**
Pancreas vs ALS	-14 %*	-13 %**	-21 %***	-23 %**
Pancreas vs fatal road traffic accident	76 %***	57 %***	43 %***	38 %***
Pancreas vs sudden cardiac arrest	6 %	4 %	-4 %	-3 %
Multiple Myeloma vs ALS	-38 %***	-27 %***	-26 %***	-24 % ***
Multiple Myeloma vs fatal road traffic accident	27 %***	32 %***	35 %***	35 % ***
Multiple Myeloma vs sudden cardiac arrest	-23 %*	-13 %**	-10 %	1 %
ALS vs fatal road traffic accident	104 %***	80 % ***	81 %***	78 %***
ALS vs sudden cardiac arrest	23 %	19 %	22 %	33 %*
Sudden cardiac arrest vs fatal road traffic accident	65 %***	51 % ***	49 %***	34 %***

*p<0.10, **p<0.05, ***p<0.01

Table 6 VSL[a] (in million SEK) for different health risks (main analysis)

Health risk	**10 per 100,000**			**5 per 100,000**		
	Risk reduction	**Risk elimination**	**Difference**	**Risk reduction**	**Risk elimination**	**Difference**
Pancreatic cancer	44.8	54.3	9.5 (21 %)***	64.0	73.4	9.4 (15 %)***
Multiple Myeloma	32.4	45.5	13.1 (40 %)***	60.4	72.0	11.6 (19 %)**
ALS	52.1	62.2	10.1 (19 %)***	81.2	94.8	13.6 (17 %)***
Fatal road traffic accident	25.5	34.6	9.1 (36 %)***	44.8	53.2	8.4 (19 %)
Sudden cardiac arrest	43.2	52.4	9.2 (21 %)***	66.8	71.2	4.4 (7 %)

[a]VSL=Value of a statistical life, VSL=(WTP x 10)/risk reduction
*p<0.1, **p<0.05, ***p<0.01

Table 7 Linear regression of ln WTP

VARIABLES	ln(WTP) All scenarios pooled	ln(WTP) Pancreatic cancer	ln(WTP) Multiple myeloma	ln(WTP) ALS	ln(WTP) road traffic accident	ln(WTP) Sudden cardiac arrest
Risk reduction (10 per 100,000=1)	0.0787	0.149	-0.0338	0.188	0.0968	0.0542
	(0.174)	(0.191)	(0.182)	(0.195)	(0.203)	(0.201)
Female=1	0.445	0.519**	0.689	0.623***	-0.700	-0.139
	(0.765)	(0.229)	(0.500)	(0.200)	(0.593)	(0.944)
ln(age)	0.931	-2.093	-0.768	-1.921	3.142*	3.899
	(3.570)	(3.776)	(3.954)	(2.614)	(1.664)	(3.628)
ln(age-mean age)^2	0.0536	0.0714	0.0275	0.0910*	0.111*	0.0802
	(0.0471)	(0.0595)	(0.0522)	(0.0534)	(0.0659)	(0.0525)
University education=1	-0.149	-0.137	-0.117	-0.105	-0.106	-0.185
	(0.184)	(0.204)	(0.198)	(0.201)	(0.212)	(0.202)
ln(household income per consumption unit)	0.671***	0.773***	0.633**	0.547**	0.597**	0.571**
	(0.242)	(0.263)	(0.254)	(0.255)	(0.279)	(0.283)
Certainty scale	0.0970**	0.0832*	0.0951**	0.0967**	0.0943**	0.118**
	(0.0406)	(0.0423)	(0.0434)	(0.0431)	(0.0459)	(0.0458)
Risk red. Pancreas vs all	-1.424***					
	(0.0596)					
Risk red. Myeloma vs all	-1.515***					
	(0.0663)					
Risk red. ALS vs all	-1.310***					
	(0.0664)					
Risk red. Traffic vs. all	-1.751***					
	(0.0868)					
Risk red. Cardiac vs all	-1.428***					
	(0.0742)					
Risk elim. Pancreas vs all	-1.269***					
	(0.0711)					
Risk elim. Myeloma vs all	-1.344***					
	(0.0769)					
Risk elim. ALS vs. all	-1.143***					
	(0.0761)					
Risk elim. Traffic vs all	-1.461***					
	(0.0896)					
Risk elim. Cardiac vs all	-1.273***					
	(0.0843)					
Risk elimination vs. risk reduction		0.169***	0.173***	0.173***	0.290***	0.160**
		(0.0538)	(0.0588)	(0.0579)	(0.0701)	(0.0659)
ln(baseline risk)	-0.108	0.556	0.239	0.943	-0.929**	-0.670
	(0.878)	(0.899)	(0.938)	(0.705)	(0.442)	(0.869)
Experience=1		0.0411	0.299	0.0695	0.184	-0.0401
		(0.230)	(0.240)	(0.196)	(0.234)	(0.229)
Subjective risk below 3=1		-0.381*	-0.151	0.0762	-0.368	-0.262
		(0.226)	(0.199)	(0.196)	(0.234)	(0.293)
Control below 3=1		-0.222	-0.118	0.111	-0.644*	-0.177
		(0.189)	(0.197)	(0.219)	(0.329)	(0.226)
Ranking for dread		-0.153**	-0.176**	-0.316***	-0.0416	-0.0684
		(0.0746)	(0.0786)	(0.0686)	(0.0727)	(0.0626)
Constant	-3.913	2.623	0.535	3.168	-11.00*	-11.98

	(8.203)	(10.58)	(11.89)	(8.766)	(6.060)	(8.447)
Observations	3,091	595	577	591	464	537
R-squared	0.120	0.092	0.094	0.129	0.108	0.077

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figures

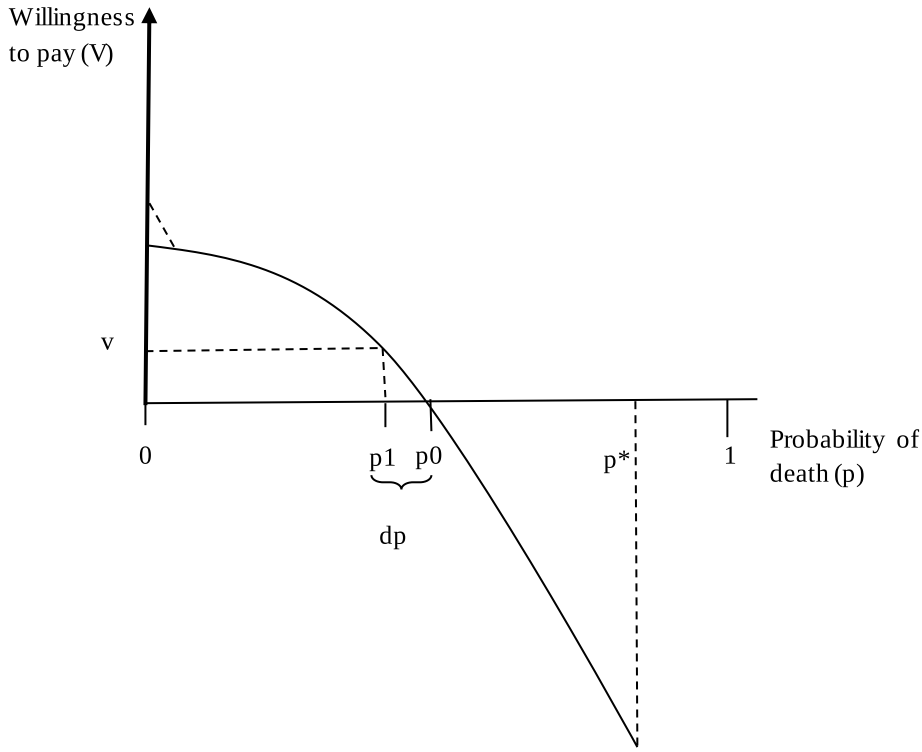


Fig 1. Relation between willingness to pay (V) and probability of death (p)
Adapted from Jones-Lee 1974

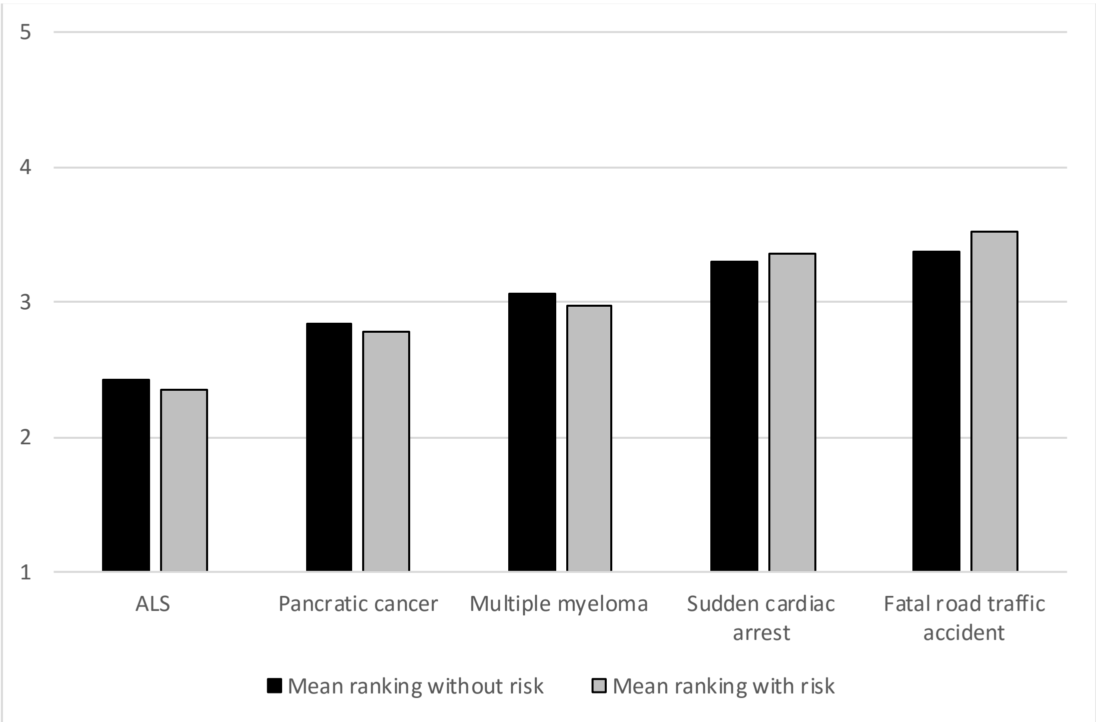


Fig. 2 Ranking for dread (1=most dreadful)

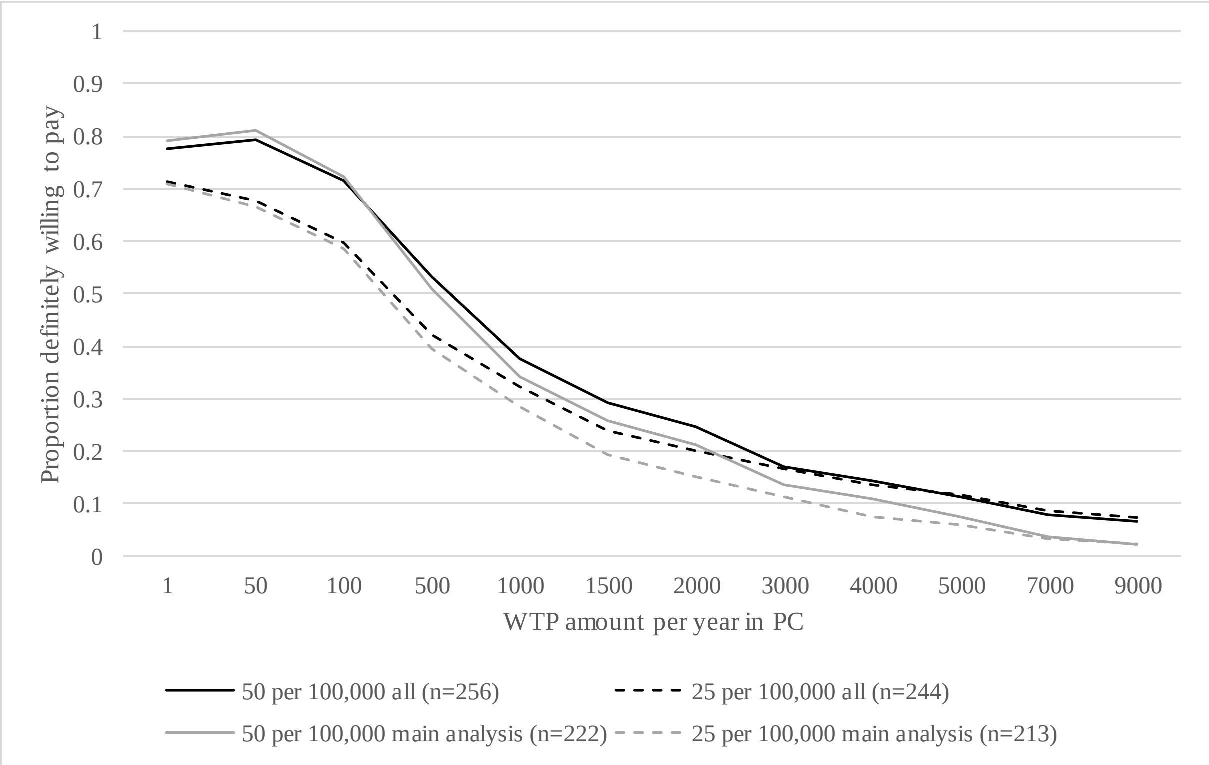


Fig. 3 Proportion definitely willing to pay in Payment Card (PC)

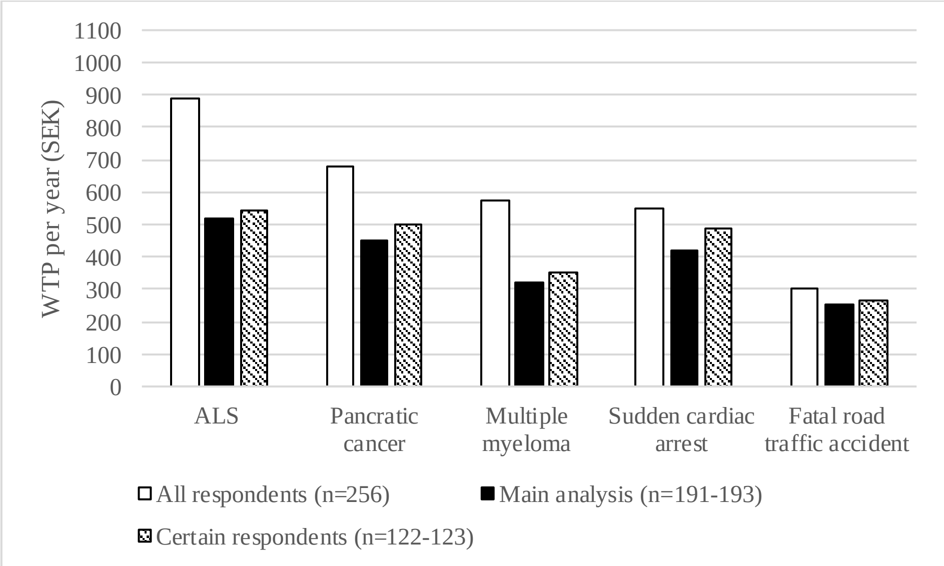


Fig. 4a WTP for a risk reduction of 10 per 100, 000

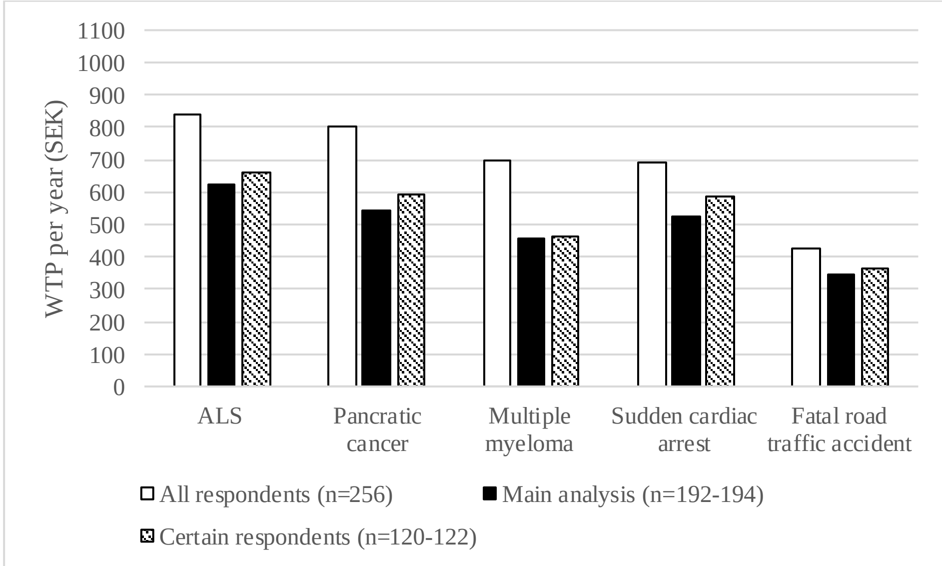


Fig. 4b WTP for a risk elimination of 10 per 100,000

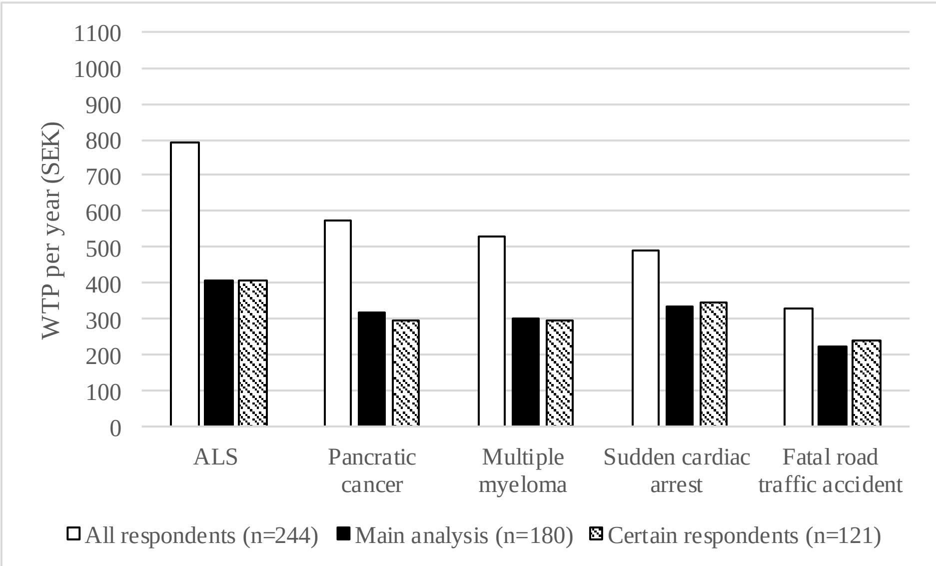


Fig. 4b WTP for a risk reduction of 5 per 100,000

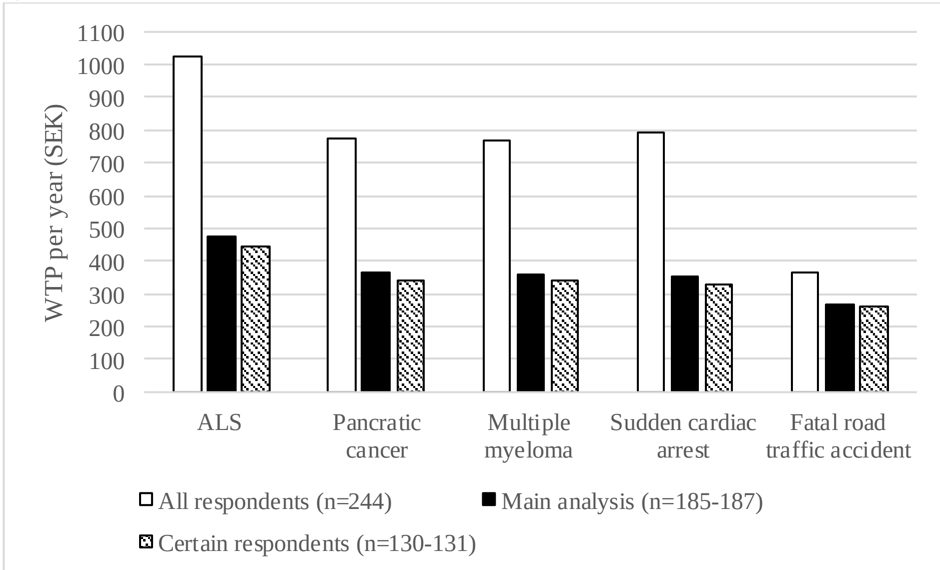


Fig. 4d WTP for a risk elimination of 5 per 100,000

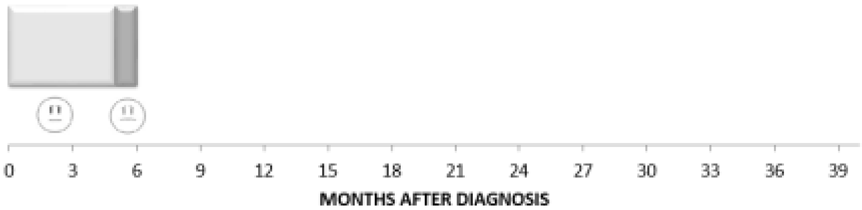
Appendix 1

Health risk 1: Pancreatic Cancer

When pancreatic cancer develops, it causes symptoms such as jaundice (the eyes and skin stained yellow and the urine becomes dark), abdominal pain radiating to the back, loss of appetite, weight loss, nausea, fatigue, irritability and depression. These symptoms usually become worse as the disease progresses.

After a while you become so weak that you have to stay in bed or sit in a wheelchair the majority of the day and you are unable to care for yourself. In most cases, treatment will not affect disease course and you only live for <u>about 6 months after diagnosis</u>.

The causes of the disease are not clear. Tobacco smoking, type 2 diabetes and chronic inflammation of the pancreas is considered to be linked to the disease.

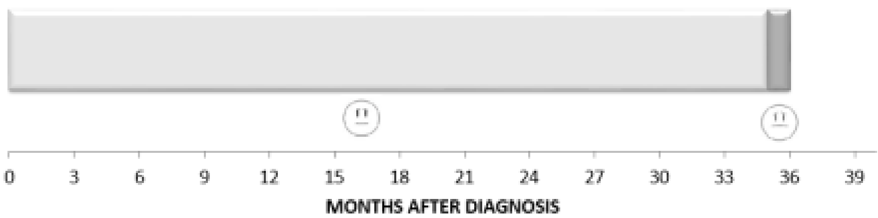


Health risk 2: Cancer of the plasma cells/Multiple myeloma

When cancer of the plasma cells/multiple myeloma develops, it causes symptoms like bone pain, broken bones (fractures), sciatica pain of a pinched nerve root, fatigue, risk of infections of the upper respiratory system and kidney damage. These symptoms usually become worse as the disease progresses.

After a while you become so weak that you have to stay in bed or sit in a wheelchair the majority of the day and you are unable to care for yourself. In some cases, treatment with radiation, chemotherapy and other drugs can help slow the progression of the disease but may also cause side effects such as pain, nausea, vomiting, diarrhea, and hair loss. Even with treatment most patients only survive for about 36 months (3 years) after diagnosis.

The causes of cancer of the plasma cells/multiple myeloma are unknown.

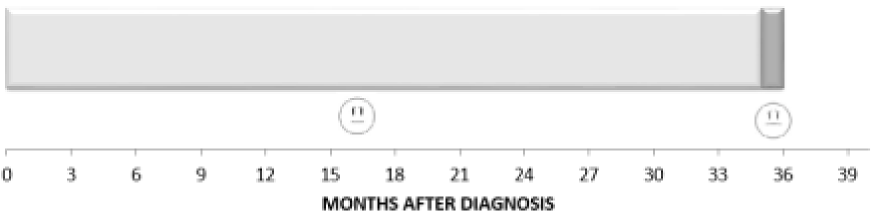


Health risk 3: Amyotrophic lateral sclerosis (ALS)

ALS is a paralytic disease caused by the disintegration of the nerve cells in the brain and spinal cord that activates the willfully controlled muscles. The weakness usually begin in a foot or a hand. The paralysis spreads, to finally affect the respiratory muscles. However, functions such as touch, sight, hearing and ability to hold tight are not affected. Some may experience poor memory functions.

After a while you become so weak that you have to stay in bed or sit in a wheelchair the majority of the day and you are unable to care for yourself. Anyone who has ALS will eventually get respiratory failure and die. It usually occurs within about 36 months (3 years) after diagnosis.

It is not known why the disease occurs. Heredity is found in about one in ten who get the disease.



Health risk 4: Fatal road traffic accident

In most cases, a person who is involved in a fatal traffic accident ends up with immediate loss of consciousness followed by death.

About a third are single vehicle accidents (e.g. car driving off the road), about a third is a collision between two motor vehicles and about a third are cyclists or pedestrians who are hit.

Health risk 5: Sudden cardiac arrest

Sudden cardiac arrest is when the heart suddenly stops for an unexpected reason. The person who experience this becomes immediately unconscious and then stops breathing. The only treatment that can help is cardiopulmonary resuscitation (CPR) and the shock from a defibrillator. Only 5% of those affected survive.

Sudden cardiac arrest is often the result of a known heart disease but may also be due to an unknown heart condition who are not diagnosed or given any prior symptoms.

Appendix 2

MEN, 10-year risk (per 100,000)

Age	Pancreatic Cancer[a]	Cancer of the plasma cells/Multiple Myeloma[b]	Amyotrophic lateral sclerosis (ALS)[c]	Fatal road traffic accident[d]	Sudden cardiac arrest[e]
50-54	156	90	24	42	1628
55-59	252	154	48	43	2234
60-64	408	231	83	48	3071
65-69	569	323	108	66	4254
70-74	641	433	130	100	5500

[a]The National Board of Health and Welfare (NBHW), Cancer Registry, Diagnosis 157, Number of new cases of cancer per 100 000 persons in 2014.
[b]NBHW, Cancer Registry, Diagnosis 203, Number of new cases of cancer per 100 000 persons in 2014.
[c]NBHW, Cause of Death Registry, G12, Number of deaths per 100 000 persons in 2014.
[d]NBHW, Cause of Death Registry, V01-V79, Number of deaths per 100,000 persons in 2014.
[e]The Swedish Heart-and Lung-Rescue Registry, Annual Report 2014.

WOMEN, 10-year risk (per 100,000)

Age	Pancreatic Cancer[a]	Cancer of the plasma cells/Multiple Myeloma[b]	Amyotrophic lateral sclerosis (ALS)[c]	Fatal road traffic accident[d]	Sudden cardiac arrest[e]
50-54	135	70	39	14	531
55-59	222	103	61	10	707
60-64	363	143	86	13	1046
65-69	522	192	105	20	1631
70-74	578	261	112	35	2234

[a]The National Board of Health and Welfare (NBHW), Cancer Registry, Diagnosis 157, Number of new cases of cancer per 100 000 persons in 2014.
[b]NBHW, Cancer Registry, Diagnosis 203, Number of new cases of cancer per 100 000 persons in 2014.
[c]NBHW, Cause of Death Registry, G12, Number of deaths per 100 000 persons in 2014.
[d]NBHW, Cause of Death Registry, V01-V79, Number of deaths per 100,000 persons in 2014.
[e]The Swedish Heart-and Lung-Rescue Registry, Annual Report 2014.

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