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Risk and time preferences in individuals with lifestyle-related and non-lifestyle-related cardiovascular diseases: a pilot study

Nadja Kairies-Schwarz ,[1,2] Irene Mussio ,[3] Natalia Bulla-Holthaus,[1,4] Esther Wankmüller,[5] Georg Wolff ,[6,7] Veronika Gontscharuk,[1] Yvonne Heinen,[6] Stefan Perings,[6] Maximilian Brockmeyer,[6] Malte Kelm ,[6,8] Andrea Icks[1,2]

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For numbered affiliations see end of article.

Correspondence to
Professor Nadja Kairies-Schwarz;
nadja.kairies-schwarz@hhu.de

ABSTRACT

Objectives To (1) pilot a study of behavioural characterisation based on risk and time preferences in clinically well-characterised individuals, (2) assess the distribution of preferences in this population and (3) explore differences in preferences between individuals with 'lifestyle-related' (LS) and 'non-lifestyle-related' (NLS) cardiovascular diseases.

Design Cross-sectional study with an economic online experiment to collect risk and time preferences, a detailed clinical characterisation and a sociodemographic and lifestyle survey. A definition of LS and NLS groups was developed.

Setting Specialist outpatient clinics of the clinic for cardiology and pneumology of the University Hospital Düsseldorf and patients from a cardiology practice in Düsseldorf.

Participants A total of 74 individuals with cardiovascular diseases.

Outcomes Risk and time preferences.

Results The implementation of the study process, including participant recruitment and data collection, ran smoothly. The medical checklist, the survey and the time preference instrument were well received. However, the conceptual understanding of the risk preference instrument resulted in inconsistent choices for many participants (47%). The remaining individuals were more risk averse (27%) than risk seeking (16%) and risk neutral (10%). Individuals in our sample were also more impatient (49%) than patient (42%). The participant classification showed that 65% belonged to the LS group, 19% to the NLS group and 16% could not be assigned (unclear allocation to lifestyle (ULS) group). Excluding the ULS group, we show that individuals in the LS group were more risk seeking, and unexpectedly, more patient than those in the NLS group.

Conclusions The process of the pilot study and its results can be used as a basis for the design of the main study. The differences in risk and time preferences between the LS and NLS groups provide us with a novel hypothesis for unhealthy behaviours: individuals never give up a bad habit, they simply postpone the latter, which can be tested alongside other additional research questions.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The interdisciplinary study allows for a combination of methods yielding a broad behavioural, lifestyle and clinical characterisation of the study population.
⇒ The study process, including recruitment of participants and data collection, is implementable.
⇒ The use of multiple data collection methods from different disciplines allows for an in-depth exploration of the differences in risk and time preferences between 'lifestyle-related' and 'non-lifestyle-related' disease groups.
⇒ The instrument for collecting risk preferences is cognitively demanding.
⇒ The pilot was conducted only in specialised care, probably resulting in a selected group of participants.

BACKGROUND

Cardiovascular diseases constitute a global health concern, being the number one cause of death (about 31% worldwide and 45% in Europe[1]). Cardiovascular disease yields challenges at the individual and societal levels. Patients are often faced with long-term treatment and care and suffer productivity losses due to increasing morbidity and mortality.[2 3] Moreover, total healthcare costs in the European Union (EU) due to cardiovascular diseases amount up to €210 billion per year.[3] Early diagnosis and suitable treatment strategies are hence of crucial relevance.

Some cardiovascular diseases are not preventable, for example, congenital heart defects. However, most are preventable: there are risk factors that cannot be influenced (such as age, gender, genetic predisposition), but several risk factors can be influenced or changed by the individuals themselves. Cardiovascular diseases are often related to today's lifestyle in industrialised countries, that is, tobacco and alcohol consumption, lack of exercise, poor diet, and stress increase

the likelihood of developing cardiovascular disease. These factors can also affect both morbidity and mortality in patients with established cardiovascular disease.[4–11] Nevertheless, these risk factors are highly behavioural and can thus be modified or influenced.[12 13] Medical guidelines and healthcare programmes propose adequate self-management and lifestyle changes such as increases in physical activity, smoking cessation and adherence to medication.[14 15]

However, up to 60% of patients lack adherence to medical guideline recommendations. Patients with coronary heart disease (CHD), for example, insufficiently follow physical activity recommendations[16–18] or show a lack of self-management.[19] A potential solution is patient-centered medicine, which acknowledges patient preferences and characteristics to better understand patient behaviour and opportunities to yield positive long-term effects.

From a behavioural economics perspective, risk and time preferences are two factors which play a central role in health-related decisions and influence adherence to medical guidelines (with the aim of behaviour change). Evidence from clinical studies shows that risk seeking and impatient individuals with cardiovascular diseases behave in a less preventive manner. These patients also have poorer medication or therapy adherence.[20–22] Moreover, there are positive associations between risk tolerance and poorly performing clinical parameters.[23] Unfortunately, there are no studies with a comprehensive and interdisciplinary set of data (including clinical measures, lifestyle measures and individual, behavioural measures) allowing for a characterisation of patients to improve treatment outcomes, and in particular a distinction between those patients with lifestyle-related (LS) diseases. The latter is an interesting question that has not yet been investigated, although risk and time preferences have been shown to be associated with LS behaviours[24–28] and lifestyle in turn is associated with a number of cardiovascular diseases, but not all. This raises the question of whether risk and time preferences differ between patients with more LS diseases and those with more non-LS (NLS) diseases.

To fill this gap in the literature, we designed an interdisciplinary study to (1) pilot a behavioural characterisation based on risk and time preferences in clinically, well-characterised individuals, (2) assess the distribution of preferences in this population and (3) explore differences in preferences between individuals with LS and NLS cardiovascular diseases. All results will inform the main study about the design and implementation of experimental economic methods in the study population and the categorisation of disease groups.

METHODS

Trial design

This interdisciplinary project was a cross-sectional observational study combined with an integrated behavioural economic online experiment.

Testing the implementation of the study process and instruments

To inform the main study, this pilot study intended to test the implementation of the study process and instruments. This included the recruitment of participants, data collection procedures and instruments used to collect preferences, sociodemographic, lifestyle and clinical data.

Participants and recruitment

Our pilot study sample included adults (18 years or over) with a primary diagnosis of cardiovascular disease who were being treated in the cardiological outpatient clinic of the University Hospital Düsseldorf (UKD) and in the MVZ Cardio Centrum Düsseldorf GmbH (cardiological practice) in Düsseldorf and who had a regular appointment at the time of the survey. Further inclusion criteria were proficiency in the German language as well as mental and physical fitness to participate in the study. To obtain a sufficiently heterogeneous group of participants, the aim was to recruit N=18 patients from each of the following areas: ‘general cardiology and angiology’, ‘rhythmology’, ‘heart failure’ and ‘structural heart diseases’. Once we reached this number of subjects, no further subjects were recruited from the respective area. Recruitment and data collection took place during April–November 2021.

Procedures and data collection

The protocol and the way participants were addressed during the study were standardised. Appropriate material to prepare and train the medical staff was developed. On the day of their regular medical appointment, potential participants were identified by the medical staff of the respective medical facility. Those who expressed interest were informed in detail about the study by the study team. If individuals were willing to participate, the declaration of informed consent and, if applicable, the consent to blood collection were signed by the participants.

At UKD, participants had to wait after the physician–patient conversation before the start of their medical examination. During this time, the computer-aided, economic online experiment, including the online questionnaire, was carried out (on a tablet). At the MVZ Cardio Centrum Düsseldorf GmbH (cardiological practice), the medical examination took place directly after the physician–patient conversation and before the computer-aided, economic online experiment, including the online questionnaire, was carried out (on a tablet). Interested participants were given detailed oral and written explanations by the study staff before participating.

After successful completion of the economic online experiment, the participants filled out a payment receipt (ie, he or she gives their first and last name, private address, telephone number and bank details), so that a money transfer could be made via the UKD finance department. The amount and time of the payment depended on the decisions made by the participant during the economic online experiment and were noted by the study team in the presence of the participant on a

receipt. The participants were then given the paper form of the self-completed questionnaire in a stamped return envelope addressed to UKD (to be filled out at home). It was briefly explained that the questionnaire should be returned (within 14 days). The elicitation of variables in the online questionnaire allowed us—in the event that the self-completed questionnaire in paper form was not returned—to evaluate at least a few parameters. The economic experiment lasted between 30 and 60 min. On average, and consistent with procedures in economic experiments, a participant received about €19.40 for the elicitation of risk and time preferences. For risk preferences, for each of the 10 choices, 1 of those choices was randomly selected for payment. Similarly, for time preferences, for the 50 decisions, 1 of those decisions was randomly selected for payment.

With participant consent, the treating physicians also filled out a checklist for (main) diagnoses of cardiovascular diseases, therapy based on cardiovascular (main) diagnoses, medication and physical examinations. Laboratory values were either taken out of the patient's file or a study-related blood sample was taken on the same day if no current data on laboratory values were contained in the patient's file or they were not collected within the planned/regular examination or treatment appointment.

LS and NLS cardiovascular diseases

Based on a comprehensive literature review concerning the aetiology of cardiovascular diseases, we developed two groups of cardiovascular diseases: a LS group and a NLS group (see online supplemental appendix A for a detailed description of the classification and its development process). Based on the cardiovascular diagnoses, participants were assigned to one of these groups. They were assigned to the LS group if they had a coronary artery disease, a peripheral arterial disease, a cerebral arterial disease or atrial fibrillation (AF). A participant was assigned to the NLS group if there is no diagnosis listed under LS diseases and the person has congenital heart, inflammatory diseases such as pericarditis/myocarditis, inflammatory cardiomyopathies, rheumatic heart diseases or a hypertrophic cardiomyopathy. The remaining participants, for example, those with a diagnosis not listed under LS diseases, a disease with a very heterogeneous aetiology, or with an unclear data situation with regard to the connections to LS aspects and the disease or the diagnosis was not specified so that the aetiology/data situation could not be assessed were assigned to a group 'unclear allocation to lifestyle' (ULS) (see online supplemental appendix A, table A.2 for a full description of each category).

Outcomes and other variables

Risk and time preferences

Collection of individual preferences (online)

Using an economic online experiment, we collected data on risk preferences based on the approach of Holt and Laury[29] and Binswanger.[30] This is an experimental measure of risk aversion using a multiple price list (MPL) design, where decisions are set out on a table and vary slightly as the individual goes through the list. We collected data on time preferences using the approach of Coller and Williams,[31] also based on the MPL design. The added pictorial representation of the time tasks—pie charts and calendar—is based on Harrison *et al*[32] and serves as a decision-making aid for individuals. The prevalent use of the MPL method allows us to compare risk attitudes across different environments and individuals.[33] Online supplemental appendix B contains detailed descriptions of both sets of tasks, including the elicitation of preferences. The tasks were followed by a short online questionnaire.

Further measures

Collection of sociodemographic and lifestyle measures and medical history (self-reported)

The economic online experiment also included a questionnaire with a number of variables to describe the study population, and which may be associated with preferences in the main study: demographics (age, gender, nationality, country of birth, education, marital status), lifestyle measures as physical activity, smoking behaviour, self-control and clinical variables (height, weight, diabetes, cancer, heart attack, stroke, asthma, depression, hospitalisation within the last 12 months, family history of diabetes and heart disease). Online supplemental appendix C, table C.1 presents the variables together with the associated validated instruments and instruments from population-based studies.

The self-reported, paper-based questionnaire was more extensive than the online questionnaire and contained questions on demographics (age, gender, nationality, country of birth, education, marital status, fellow human beings, employment, household income), health-related quality of life, well-being, participation and information preferences, health-related locus of control, depression and anxiety, Big Five personality traits, social integration, physical activity, smoking, self-control, type D personality and medical service utilisation. The variables of the self-completed questionnaire together with the corresponding validated instruments and instruments from population-based studies are summarised in online supplemental appendix C, table C.1.

Collection of clinical variables (medical, physician completed)

The clinical variables served to create a clinical profile to characterise the study population. For this purpose, the treating physician filled out a checklist. We included various cardiovascular measures: arterial hypertension, high-grade heart valve stenosis/regurgitation, heart failure (including classification according to left ventricular ejection fraction), CHD, peripheral and cerebral arterial occlusive diseases, cardiac arrhythmias and AF, cardiomyopathies, congenital diseases (heart defects, others) and rheumatic heart disease. The checklist also included cardiovascular events (myocardial infarction,

stroke) and prior acute cardiovascular diseases (myocarditis). With regard to concomitant diseases, chronic kidney failure, including its stage, and chronic obstructive pulmonary disease were recorded. Current symptoms were described using established classification systems like New York Heart Association (NYHA) Functional Classification, Canadian Cardiovascular Society grading of angina pectoris (CCS), European Heart Rhythm Association score of AF (EHRA) and Fontaine classification for peripheral arterial disease. Invasive surgical, interventional and pacemaker therapy and current drug therapies based on cardiovascular diagnoses were incorporated. Relevant cardiovascular drugs (beta blockers, ACE inhibitors/sartans, neprilysin inhibitors, diuretics, aldosterone antagonists, calcium antagonists) and antithrombotic drugs (oral anticoagulation, platelet function inhibitors) were recorded. The presence of antihyperglycaemic therapy was registered as well (see online supplemental appendix C, table C.1 for full table of questions and clinical parameters).

Analyses

Sample size calculation for preference assessment

The sample size for the pilot study was determined based on a significance value of 0.05 and a power value of 0.80. Since the prior literature on risk and time preferences does not provide much information on how the sample size for experiments was constructed,[34 35] we assumed the minimal difference that would occur between two people is a change in one row in each MPL task (which has 10 rows total). Therefore, we wanted to find at least a difference of one-row switch in both the risk aversion and time preferences tasks (either a higher or lower row). This sample size calculation resulted in a case number of N=74 participants.

Statistical analysis

Sample description

The quantitative data were analysed, including visual aids, such as graphs. All participants were used for the statistical analysis. Statistical tests were performed based on the classifications defined in the next sections. The analysis was done in Stata V.18 (StataCorp) and SAS software, V.9.4 (SAS Institute).

Risk and time preferences

We categorised participant behaviour based on the decisions made in the risk and time preferences tasks. Table 1 summarises the classifications based on the row where participants switch. As an example, for the case of risk preferences, we classified participants as risk seeking if they switch from option A to option B once before the 5th row (out of 10) of an MPL task. For the case of time preferences, patient individuals switch from option A to option B once before or exactly at the 6th row (out of 10) of the time MPL. To check the robustness of our results, we also applied two other methods for classifying risk preferences, as proposed by Engel and Kirchkamp.[36]

Table 1 Criteria for classifying risk preferences

Criteria for classifying risk preferences, adapted from Charness *et al* and Holt and Laury[29 33]

Risk preferences	Switching row from option A → option B Row	Decision 10	Number of safe choices (option A)
Risk seeking	Before the 5th row	option B	0–3
Risk neutral	In the 5th row		4
Risk averse	After the 5th row		5–9
Inconsistent—multiple row switches	2+ switching points		
Inconsistent—lack of understanding		option A	
Criteria for classifying time preferences			
Time preferences	**Switching row from 'smaller sooner' (option A) to 'larger later' (option B)**		
Patient	Before or in the 6th row		
Impatient	After the 6th row		
	No switch		
Inconsistent	2+ switching points		

The description of the methods and the corresponding analyses can be found in online supplemental appendix D. The results of the two classification methods showed no significant differences. Hence, we concluded that our results are robust.

RESULTS

Performance of study procedures and instruments

No major problems arose regarding the implementation of the study process. Although we did not specifically test this point, the combination of the components of the economic online experiment and the clinical data collection was successfully implemented in each of its stages in the clinical environment. The pilot study was perceived useful and satisfactory by the individuals responsible for the recruitment, as procedures were adapted to the conditions of the medical facilities (ie, the UKD cardiology outpatient clinic and the cardiology practice). Moreover, the (digital) data collection ran smoothly. Only individual challenges, for example, when handling the notebook mouse by the participants, occurred. These were reduced with the support of the study staff and data was successfully collated.

However, general challenges arose regarding the conceptual understanding of the survey of risk preferences (see the 'Risk preferences' section). In addition, the study was useful in understanding a potential source of self-reported bias, as the processing of the physical

Table 2 Pilot sample breakdown by clinical, lifestyle and socioeconomic characteristics, all participants (N=74)

Clinical and lifestyle characteristics				
	Total	LS	NLS	ULS
Systolic blood pressure (15 missings), mean±SD, median (Q1–Q3)	129.8±19.6, 130 (115–145)	132.7±20.5, 132.5 (120–149)	119±15.5, 119.5 (113–130)	129.2±16.7, 137 (115–141)
Diastolic blood pressure (15 missings), mean±SD, median (Q1–Q3)	78.6±10.3, 79 (70–88)	77.8±9.9, 78.5 (69.5–86.5)	80.4±10.9, 80 (70–90)	79.9±12.3, 78 (75–91)
Cardiovascular diagnoses, N (%)				
CHD	36 (48.6)	36 (100)		
Heart valve regurgitation/stenosis	24 (32.4)	18 (75)	3 (12.5)	3 (12.5)
Cardiac arrhythmias, others	19 (25.7)	10 (52.6)	4 (21.1)	5 (26.3)
Atrial fibrillation	18 (24.3)	18 (100)		
Congenital heart defects	12 (16.2)	1 (8.3)	9 (75)	2 (16.7)
Cerebral arterial disease	12 (16.2)	12 (100)		
Inflammatory cardiomyopathy	6 (8.1)	2 (33.3)	4 (66.7)	
Heart failure	41 (55.4)	32 (78)	5 (12.2)	4 (9.8)
Clinical characteristics, N (%)				
Former myocardial infarction	17 (23.0)	17 (100)		
Arterial hypertension	53 (71.6)	39 (73.6)	7 (13.2)	7 (13.2)
Diabetes mellitus	14 (18.9)	12 (85.7)	2 (14.3)	.
Chronic kidney disease	15 (20.3)	12 (80)	.	3 (20)
Former stroke/TIA	11 (14.9)	3 (27.27)	6 (54.55)	2 (18.18)
NYHA/EHRA/CCS stages >1 (6 missings)	38 (51.3)	30 (78.95)	3 (7.89)	5 (13.16)
Current drug therapy, N (%)				
ACE inhibitor/AT-1 antagonist	55 (74.3)	40 (72.73)	9 (16.36)	6 (10.91)
Beta blockers	46 (62.2)	36 (78.3)	7 (15.2)	3 (6.5)
Diuretic	29 (39.2)	23 (79.3)	2 (6.9)	4 (13.8)
Calcium antagonist	16 (21.6)	13 (81.3)		3 (18.8)
Aldosterone antagonist	14 (18.9)	10 (71.4)	3 (21.4)	1 (7.1)
Oral anticoagulation	31 (41.9)	25 (80.6)	5 (16.1)	1 (3.2)
Platelet aggregation inhibition	31 (41.9)	21 (67.7)	5 (16.1)	5 (16.1)
Statins	42 (56.8)	33 (78.6)	5 (11.9)	4 (9.5)
Smoking status, N (%)				
Never smoked	37 (50.0)	22 (59.46)	9 (24.32)	6 (16.22)
Former	26 (35.1)	18 (69.24)	4 (15.38)	4 (15.38)

Continued

Table 2 Continued

Clinical and lifestyle characteristics				
Current	11 (14.9)	8 (72.73)	1 (9.09)	2 (18.18)
Level of physical activity (15 missings), N (%)				
High	47 (79.7)	29 (61.7)	10 (21.3)	8 (17)
Medium	10 (16.9)	8 (80)		2 (20)
Low	2 (3.4)	1 (50)	1 (50)	.
BMI level (1 missing), N (%)				
Normal (<25)	25 (34.3)	12 (48)	6 (24)	7 (28)
Overweight (25–29.9)	25 (34.2)	18 (72)	5 (20)	2 (8)
Obese (≥30)	23 (31.51)	17 (74)	3 (13)	3 (13)
Socioeconomic characteristics				
Age in years, mean±SD, median (Q1–Q3)	64.6±13.6, 67 (58–75)	69.52±10.14, 70.5 (62–78)	51.5±16.41, 51.5 (46–64)	60.33±11.28, 61.5 (54.5–69.5)
Gender, N (%)				
Female	23 (31.1)	11 (47.8)	7 (30.4)	5 (21.7)
Male	51 (68.9)	37 (72.5)	7 (13.7)	7 (13.7)
Born in, N (%)				
Germany	61 (82.4)	41 (67.2)	11 (18)	9 (14.8)
Abroad	13 (17.6)	7 (53.8)	3 (23.1)	3 (23.1)
Education, N (%)				
Secondary school (general)	27 (36.5)	22 (81.5)	4 (14.8)	1 (3.7)
Secondary school (applied)	19 (25.7)	11 (57.9)	4 (21.1)	4 (21.1)
Vocational school	8 (10.8)	4 (50)		4 (50)
Abitur (school diploma)	17 (23)	10 (58.8)	5 (29.4)	2 (11.8)
No school diploma	2 (2.7)	1 (50)		1 (50)
Other	1 (1.4)		1 (100)	
Partnership status, N (%)				
Living in a partnership	54 (73.0)	34 (63)	9 (16.7)	11 (20.4)
Not in a partnership	20 (27.0)	14 (70)	5 (25)	1 (5)

classification of dyspnoea due to heart failure according to the NYHA; classification of palpitations due to atrial fibrillation according to the EHRA; classification of angina pectoris according to the CSS. There were no patients with NYHA stage 4; NYHA/EHRA/CCS>1 defines subjects with NYHA and/or EHRA and/or CCS>1.
BMI, body mass index; CCS, Canadian Cardiovascular Society; CHD, coronary heart disease; EHRA, European Heart Rhythm Association; LS, lifestyle related; NLS, non-LS; NYHA, New York Heart Association; SD, standard deviation; TIA, transient ischaemic attack; ULS, unclear allocation to lifestyle.

Table 3 Distribution of risk preferences (N and percentage)

Category	Total N (%)	LS N (%)	NLS N (%)	ULS N (%)
Risk seeking	12 (16.2)	10 (20.8)	0 (0.0)	2 (16.7)
Risk neutral	7 (9.5)	4 (8.3)	2 (14.3)	1 (8.3)
Risk averse	20 (27.0)	10 (20.8)	6 (42.9)	4 (33.3)
Inconsistent, multiple row switches	18 (24.3)	12 (25.0)	4 (28.6)	2 (16.7)
Inconsistent, no switches	17 (23.0)	12 (25.0)	2 (14.3)	3 (25.0)

LS, lifestyle related; NLS, non-LS; ULS, unclear allocation to lifestyle.

activity instrument data led to a very high proportion of highly active people. The other variables could be collected without obstacles.

Description of the study population

The medical staff of the two clinical facilities identified and invited N=79 participants for our study based on the inclusion and exclusion criteria. While the study staff was further informing the participants about the study, one participant withdrew without giving a reason. Accordingly, N=78 patients took part in the economic online experiment and the online questionnaire. No other participant was excluded during the economic online experiment. Based on the checklist, clinical variables were collected from these participants. N=60 people returned the paper-based questionnaire. We excluded N=4 participants (of the latter, N=3 had returned the paper questionnaire and N=1 had not), since during ex-post data collection it turned out that: according to the main diagnosis, one patient was a haemato-oncological and not a cardiovascular patient, two did not have current clinical data and one did not yet have a confirmed cardiovascular disease as the main diagnosis. Thus, the final sample consisted of N=74 participants. N=40 participants were assessed at the cardiological outpatient clinic of the UKD and N=34 participants at the MVZ Cardio Centrum Düsseldorf GmbH (cardiological practice).

Table 2 presents basic socioeconomic, lifestyle and clinical characteristics of our sample. The breakdown of our sample into the individual subgroups is as follows: LS participants represent 65% (N=48), NLS participants represent 19% (N=14) and ULS participants represent 16% (N=12) of our sample.

Preferences in the study population

Risk preferences

Most participants are risk averse (27%, N=20), followed by risk seeking (16%, N=12) and risk neutral (9.5%, N=7). In addition, more than 40% of participants did not answer the questions consistently, making either no row switches (23%, N=17) or multiple row switches (24%, N=18) in the MPL (see table 3). In online supplemental appendix D, we show that these findings are robust to different non-parametric methods of risk preference classification, as suggested by Engel and Kirchkamp.[36]

Time preferences

Table 4 shows that around half of the participants are impatient, regardless of the time horizon of the task (N=36 on average, 49%). For most tasks, except for the time horizon of 2 weeks, almost half of the participants can be classified as impatient and around 40% as patient. For the 2 weeks time horizon, the pattern is the opposite.

Preferences by lifestyle-based categorisation

Risk preferences

Table 3 shows the distribution of risk preferences split by LS and NLS diseases. There is a higher percentage of LS disease participants who are more risk seeking than NLS disease ones, as only LS participants are risk seeking (LS 21%, N=10 vs NLS 0%, N=0). In addition, a higher percentage of NLS participants are more risk averse compared with LS participants (LS 21%, N=10 vs NLS 43%, N=6).

Time preferences

Figure 1 shows the split of time preferences by time horizon (of the five time preferences tasks) and type of disease. LS disease participants are more patient than NLS disease ones (compared with impatient behaviour), with around half of the participants being patient. For example, for the 2 weeks task, patient LS disease participants account for 54% (N=26) vs 36% (N=5) of NLS disease participants. For the 20 weeks task, patient LS disease participants account for 48% (N=23) vs 29% (N=4) of NLS disease participants.

Table 4 Distribution of time preferences in participant sample by time horizon (N and percentage)

Time horizon in weeks N (%)	2 weeks	4 weeks	8 weeks	16 weeks	20 weeks	Average
Patient	36 (48.6)	30 (40.5)	29 (39.2)	30 (40.5)	32 (43.2)	31.4 (42.4)
Impatient	31 (41.9)	39 (52.7)	38 (51.4)	38 (51.4)	36 (48.6)	36.4 (49.2)
Inconsistent	7 (9.5)	5 (6.8)	7 (9.5)	6 (8.1)	6 (8.1)	6.2 (8.4)

DISCUSSION

Main findings

We find (1) that the implementation of the study process, including the recruitment of participants and data collection, ran smoothly. The main challenge was related to the conceptual understanding of the specific risk preference instrument. We also show (2) that, on aggregate, individuals were more risk averse than risk seeking and more impatient than patient. Lastly, we also find (3) that individuals in the LS group were more willing to take risks and more patient than those in the NLS group.

Interpretations and implications for main study

Study procedure

The pilot project shows that our procedure for recruiting participants in cardiology clinics and the protocol for data collection are manageable and comply with the strict guidelines for data collection in the medical and economic fields.

Instruments

The pilot data show that many individuals are inconsistent when answering the risk preference task. This could happen for various reasons, ranging from lack of comprehension, boredom or not wanting to engage. Age and cognitive status are other potential explanations for inconsistencies and risk seeking profiles, as these two groups are significantly older (around 10 years older) than risk averse and risk neutral groups. The average age for risk averse participants is 58 years old, for risk neutral is 59, for risk seeking is 70, for those inconsistent with no row switches is 67 and for those inconsistent with multiple row switches is 69. Older individuals could have more problems with the cognitively demanding risk preference task and understanding probabilities. For our study population, who is relatively older (65 years on average) than the usual target population in economic experiments (eg, University students), there is evidence that given the demands on memory and learning from an MPL task, the differences in outcomes could be reflecting age-related declines in cognitive abilities.[37] Based on the previous discussion, and in addition to the existing instrument, we will include a new survey instrument to measure risk preferences in the main study (both incentivised and hypothetical). Although all risk measurement instruments have advantages and disadvantages,[33] we will consider the inclusion of general risk preference questions (from DOSPERT[38]) and a less cognitively demanding risk preference measurement task, such as the Gneezy and Potters[39] lottery task or a Balloon Analogue Risk Task.[40] Our MPL is a more complex method to measure attitudes, as it includes trading-off multiple risks involving lotteries and interest rate calculations, instead of a single decision as in, for example, Eckel and Grossman or Gneezy and Potters[39 41] or a simple framework like pumping a balloon or moving boxes.[42]

Moreover, almost half of our sample is impatient regardless of the time horizon of the task. Apart from the behavioural interpretation of the overall high degree of impatience (see next section), another possible explanation for our results could be that our interest rates are too low. This means that the 'larger amount at a later date' likely needs to be larger in order to induce participants to switch options in the time task.

Finally, the results regarding physical activity led to a very high proportion of highly active people, which could be related to an experimenter demand effect or self-report bias. The instrument will be adjusted in the main study.

Results risk and time preferences of lifestyle subgroups: a hypothesis for the main study

We show that participants with LS diseases are more risk seeking as expected, however, unexpectedly, more patient. This provides us with a novel explanation for unhealthy behaviours: individuals never give up a bad habit, they simply postpone the latter. For medical

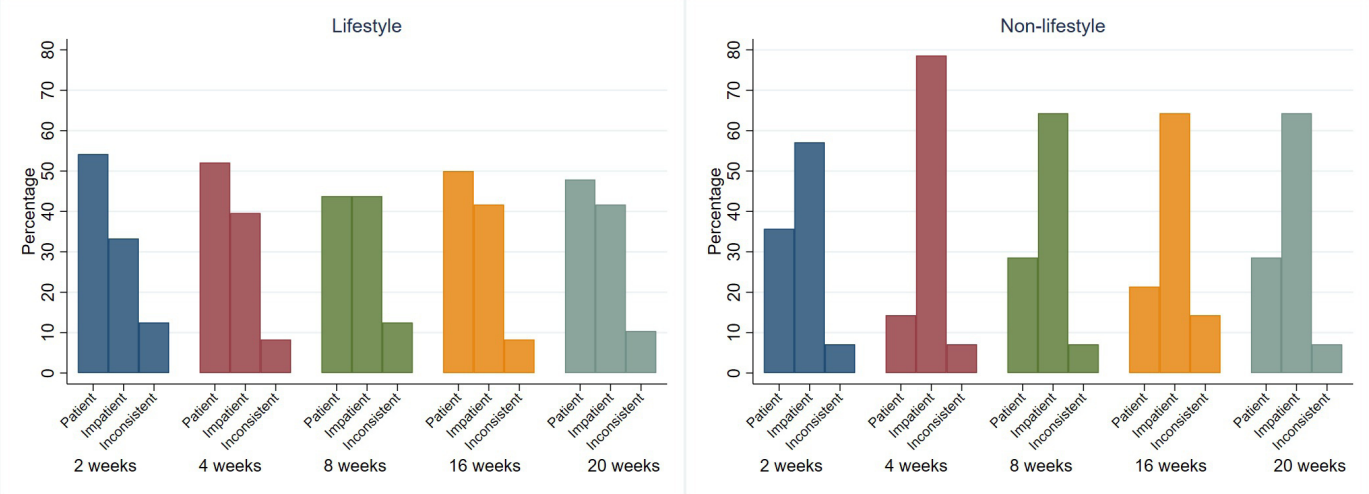

Figure 1 Distribution of time preferences by lifestyle-based categorisation and time horizon of the task (in weeks).

purposes, this means that in practice there is a trade-off between attitudes towards risk and time that should be incorporated when tailoring treatment and check-up frequency for patients. For example, a more risk seeking and 'patient' patient would have a higher chance of skipping taking medication, keeping up with a specific diet, a smoking cessation treatment or even stopping their medical visits to go back to their bad habits in the long term. In terms of medical follow-ups, this could be translated into a higher frequency of medical check-ups for the patient, to make sure that the person follows what is prescribed and prevent cardiovascular disease progression and acute cardiovascular events. Therefore, there is a scope to improve adherence to medical recommendations, especially in the case of LS diseases and to exploit the relationship between individual preferences, clinical parameters and lifestyle (self-management of illnesses).

Classification of groups of LS and NLS cardiovascular diseases

It is not possible to have a clear distinction between LS and NLS cardiovascular diseases. Although a substantial lifestyle component has been shown in the diseases defined as LS, they are not being 'only LS'. The inherent complexity of cardiovascular diseases, influenced by both genetic and lifestyle factors, adds nuances to our findings. A strong genetic influence could be seen, for example, in atherosclerotic CVD (hypercholesterolaemia, etc) but also in AF. Vice versa, the incidence of NLS diseases may be affected by lifestyle factors, too. For the main study, we plan to refine the methods to derive the respective groups. In particular, we intend to include lifestyle factors, and to adjust for other influencing factors in the analyses.

Limitations

One of the potential limitations of our study is that it was conducted during the COVID-19 pandemic. General safety precautions had to be taken, for example, social distancing, wearing an FFP-2 mask, disinfecting devices. During the pandemic, overall uncertainty was high in terms of risk of infection, timeline of vaccine roll-out and return to 'normality'. This could mean that there is a possibility that our pilot study results are biased, especially in terms of risk preferences. Moreover, the pilot was conducted only in specialised care, probably resulting in a selected group of participants.

Finally, the pilot study with a limited number of participants did not allow to conduct further subgroup or regression analyses that include sociodemographic characteristics, in particular, gender,[43–45] clinical variables and health-related quality of life. However, those variables are available, and we know their distributions. This knowledge can be used for the power calculation of the main study where respective analyses will be performed. First descriptive results for preferences by gender as well as preferences by subgroups described by clinical variables are provided in online supplemental appendices E and F.

CONCLUSION

This study advances the analysis and joint data collection of patient clinical variables, LS and NLS cardiovascular diseases and individual economic preferences. The pilot's implementation of the study process and results can be used as a basis for the main study design. We show that there are differences in risk and time preferences between the LS and NLS groups: participants with LS diseases are more risk seeking as expected, however, unexpectedly, more patient. This provides us with a novel hypothesis for unhealthy behaviours: individuals never give up a bad habit, they simply postpone the latter. For medical purposes, this means that in practice there could be a trade-off between attitudes towards risk and time that should be incorporated when tailoring treatment and check-up frequency for patients.

Author affiliations
[1]Institute for Health Services Research and Health Economics & Centre for Health and Society, Heinrich-Heine-University, Düsseldorf, Germany
[2]German Diabetes Center, Leibniz Center for Diabetes Research, Düsseldorf, Germany
[3]Department of Economics, University of Leeds, Leeds, UK
[4]Health Economics Research Center (CINCH), University of Duisburg-Essen, Essen, Germany
[5]Clinic for Pediatrics 1, UK Essen, University Hospital Essen, Essen, Germany
[6]Division of Cardiology, Pulmonology, and Vascular Medicine, Department of Internal Medicine, Medical Faculty and University Hospital Düsseldorf, Heinrich-Heine-University Düsseldorf, Düsseldorf, Germany
[7]Klinik für Kardiologie, Klinikum Ibbenbüren, Stiftung Mathias Spital Rheine, Ibbenbüren, Germany
[8]Cardiovascular Research Institute Düsseldorf (CARID), Heinrich-Heine-University Düsseldorf, University Hospital Düsseldorf, Düsseldorf, Germany

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Contributors NK-S: study conceptualisation and design, writing–proposal for the ethics committee, writing–original draft, writing–review and editing, interpretation of data, supervision, guarantor; Nadja.Kairies-Schwarz@uni-duesseldorf.de. IM: study conceptualisation and design, writing–original draft, writing–review and editing, analysis and interpretation of data; i.mussio@leeds.ac.uk. NB-H: study conceptualisation and design, writing–proposal for the ethics committee, data collection, data digitisation, writing–original draft, writing–review and editing; Natalia.Bulla@uni-due.de. EW: data collection, data digitisation, writing–review and editing, development/definition of subgroups, design of med. checklist; Esther.Wankmueller@hhu.de. GW: provision of study participants, data collection, writing–review and editing; Georg.Wolff@med.uni-duesseldorf.de. VG: analysis and interpretation of data; Veronika.Gontscharuk@ddz.de. YH: provision of study participants, data collection; Yvonne.Heinen@med.uni-duesseldorf.de. SP: provision of study participants; Stefan.Perings@med.uni-duesseldorf.de. MB: provision of study participants, data collection; Maximilian.Brockmeyer@med.uni-duesseldorf.de. MK: provision of study participants; Malte.Kelm@med.uni-duesseldorf.de. AI: study conceptualisation and design, writing–review and editing; Andrea.Icks@uni-duesseldorf.de. All of the authors approved the final version of the manuscript and agreed with submission for publication.

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Competing interests None declared.

Patient and public involvement The study was discussed with a patient who is a member of our cardio-metabolic health services research group at Heinrich-Heine-University Düsseldorf. The instruments were tested by members of the citizen advisory board of the Institute for Health Services Research and Health Economics at the German Diabetes Center.

Patient consent for publication Not applicable.

Ethics approval The Ethics Committee of the medical faculty at Heinrich-Heine-University Düsseldorf approved the study (Study No.: 2020-1003-other research first voted; 'Risiko- und Zeitpräferenzen bei ambulanten kargiologischen PatientInnen'). Participants gave informed consent to participate in the study before taking part.

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ORCID iDs
Nadja Kairies-Schwarz http://orcid.org/0000-0001-6164-959X
Irene Mussio http://orcid.org/000-0003-3724-9865
Georg Wolff http://orcid.org/0000-0002-1734-6177
Malte Kelm http://orcid.org/0000-0001-5834-2757

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