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Physical exercise versus shorter life expectancy? An investigation into preferences for physical activity using a stated preference approach

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Highlights

- We investigate preferences of engaging in physical activity among less physically active individuals
- Preferences are elicited using a stated preference approach
- We find that perceived negative quality of life impact of physical activity is an important barrier of not attending physical activity
- Furthermore, long-term health effects do not seem to work as motivation for engaging in physical activity
- Our study provides valuable input to policies intended to motivate inactive individuals

Abstract

The positive life-prolonging effect of physical activity is often used as a promotion argument to motivate people to change their behaviour. Yet the decision of investing in health by exercising depends not only on

the potential health effect but also on the costs of physical activity including time costs and the individual's (dis)utility of performing physical activity. The objective of this study was to investigate the trade-off between costs and benefits of engaging in physical activity. A web-based stated preference experiment was conducted to elicit individual preferences for physical activity among a representative sample of the Danish population, 18-60 years of age, categorised as moderately physically active or physically inactive. The results of the study suggest that perceived negative quality of life impact of physical activity is an important predictor of the choice of not attending physical activity, and hence should be acknowledged as a barrier to engaging in physical activity. Furthermore, we find time costs to have a significant impact on stated uptake. For individuals categorised as moderately active, the marginal health effect of physical activity is significant but minor. For inactive individuals, this effect is insignificant suggesting that information on long-term health effects does not work as motivation for engaging in exercise for this group. Instead, focus should be on reducing the perceived disutility of physical activity.

Keywords: Physical activity; health behaviour; perceived quality of life impact; stated preferences; willingness-to-pay

Introduction

Physical inactivity is a risk factor for a number of health problems, including obesity, coronary heart disease and stroke, diabetes, hypertension, colon cancer, breast cancer and depression [1]. Despite the well-recognised benefits of physical activity (PA), 31.1% of the world's population does not meet the minimum recommendation, with the highest rates of physical inactivity observed in high-income countries [2]. As a consequence, physical inactivity is a major public health problem and an economic burden on society.

Over the past decades, researchers from various science fields have endeavoured to understand and identify factors associated with the choice of whether to engage in PA. However, the focus of research differs across the health and social science fields [3]. The health behaviour approach has been to investigate the correlates and determinants of PA. This literature has been extensively reviewed [2, 4, 5], and a consistent correlation has been found between PA and individual-level factors, such as age, sex, health status, self-efficacy, education level and previous PA. Likewise, physical and social environments are important determinants of PA [5]. The psychology literature has also addressed the problem by focusing on different personal and environmental barriers to engaging in PA [6]. Many of these relations have also been presented in the economic literature linking such observations to neoclassical economic theory [7, 8]. Central to the neoclassical perspective is the assumption that individuals are rational and maximize utility. This means that the individual is regarded as having well-defined and consistent preferences, and will allocate his or her income and time to maximize lifetime utility. If individuals do exhibit rational behaviour, the choice to engage in PA depends on whether the perceived present value of benefits (health and non-health) offsets the associated opportunity costs (monetary costs and time) and process (dis)utility of doing PA. Especially the time costs of PA versus other activities of daily life and the investment aspect of PA in future health have been a major focus in the economic literature. Empirical studies have shown that the demand for PA is a negative function of cost [9, 10], with time costs representing an important determinant of exercise patterns [11]. Finally, a few studies have investigated predictors of willingness to pay (WTP) of health improvement for physical activity [12, 13].

The public health literature has mainly focused on the benefits of PA in the form of gained life years and quality of life (QoL), with less emphasis on the costs of performing PA. Such costs include time costs as well as the potential (dis)utility associated with performing the PA *per se*. Investing in health by exercising may give rise to either positive or negative process utility depending on the individual's enjoyment of performing PA. To fully understand how individuals can be encouraged to increase their PA levels, it is not sufficient to identify the environmental and socioeconomic barriers to PA, which until now has been the

primary focus of the literature. To guide policy, it is important to gain a better understanding of individuals' utility function (i.e. the determinants of the utility function) and to understand exactly how individuals trade off PA with health benefits, and how time preferences affect choices. Moreover, to provide effective targeted prevention programmes, it is important to identify sub-groups which have different preference structures and thus differ in their underlying motivations. A positive correlation between enjoyment of PA or related activities and time spent on PA has been found in numerous studies [6, 10, 14, 15]. In a recent systematic review, Devereux-Fitzgerald et al. [16] found fun and enjoyment of social interaction to be a primary motivation for PA among older adults.

PA is not purely a consumption good yielding utility now but also an investment in maintaining or increasing health status in future years [17]. This may explain why some people who do *not* enjoy PA still choose to participate in PA. These individuals may value their health highly and have time preferences that involve low discounting of future events [18]. Conversely, for some people the future health effects do not compensate for the disutility associated with PA, either because the disutility of PA is high or the present value of health effects are negligible either due to low importance being attached to future health, or as a consequence of high discounting of future events. In the latter instance, promotional efforts focusing on future health effects may fail.

The objective of this study is to investigate the trade-off between the (dis)utility associated with PA and the health benefits of PA among a representative sample of physically inactive and moderately physically active individuals. The (dis)utility associated with PA is characterized by the opportunity costs associated with time spent on PA and the process (dis)utility of PA, whereas the benefits are measured in terms of extended life expectancy. To the authors' knowledge, disclosing individuals' trade-off between effort invested at present time and future pay-offs in the form of increased life-expectancy has not been a focus in previous literature.

- We aim to investigate the following three research questions. Do individuals associate positive or negative quality of life impact of performing PA? And which personal characteristics are associated with the quality of life impact of PA?
- To what extent does the quality of life impact of PA influence the choice to engage in PA? How do individuals trade off time, quality of life impact of PA and health benefits when choosing to engage or not to engage in PA? And do these preferences differ across respondents who are characterized as inactive and moderately active, respectively?
- Are individuals willing to pay to participate in a PA programme and if so how much? And how do individuals value the same health benefits when the only cost imposed is monetary and does not involve other opportunity costs or process (dis)utility?

Methods

We applied a stated preference (SP) experiment to investigate preferences for PA among those members of the public who are physically inactive/moderately active. The SP approach enables us to decipher determinants of and possible barriers to the choice of (not) attending PA programmes. By presenting individuals with hypothetical choice scenarios, we can systematically elicit the implicit trade-off between benefits and costs associated with PA among physically inactive individuals, thus providing information on the preference structure that is otherwise not accessible using observed market data.

The questionnaire

The survey was conducted as a web-based chained questionnaire sent out by an independent marketing research agency (The Nielsen Company) in June 2010 to a representative sample of the Danish population 18 to 60 years of age. The +60-year olds were excluded from this study, to make the stated increases in life

expectancy realistic for all respondents. Respondents received no direct monetary compensation for their participation. Instead they earned points that could be used to buy gifts at the agency's online store. The questionnaire consisted of five parts. An illustrative overview of the survey design is provided in Appendix 1.

Part 1: General socio-demographic questions. Part 2: Question on self-reported PA level (see Appendix 2 in the online appendices). The question is taken directly from the National Longitudinal Survey on Health and Sickness used to monitor Danish citizens' PA level [19]. This question enabled us to categorize individuals according to national guidelines and was applied as a screening instrument to identify less physically active individuals. Only respondents who were defined as being moderately active or physically inactive ($n=1,607$ out of 2,658) were included in the rest of the survey, whereas the physically active were excluded from further participation. Part 3: Questions about respondents' height and weight (to calculate BMI), self-perceived health risk and self-perceived health status including QoL. The section on self-perceived health status was not used directly in the empirical analyses, but used as a warm-up task to engage the respondents in assessing their current QoL given their current life-style. Part 4: The stated preference choice task. In the first choice task (SP1), respondents were offered a hypothetical membership by their municipality to a local sports centre, which would enable them to engage in various types of PA programmes. It was explicitly stated that the membership offer was conditional on spending a specific number of hours per week doing PA at the centre. To minimise the costs of engagement, respondents were told that the membership was free and that the centre was located very close to their home. The SP1 was formulated as a binary discrete choice question (yes/no response), i.e. acceptance or rejection of the free membership. Different PA scenarios were presented to respondents through a systematic variation in the presentation of the costs and benefits of the programme; 1) time spent on exercise, described in terms of minimum number of hours per week required to obtain the free membership, and 2) the size of the expected health effect, described as the increase in life expectancy resulting from following the PA programme. Each of the dimensions was assigned three levels (2, 6, 10 hours per week/2, 12, 48 months

increase in life expectancy), which gave a full set of 9 PA scenarios. The levels were carefully chosen to secure trade-offs between the two attributes while being relevant and realistic¹. Each respondent was randomized to only one discrete choice scenario. To check for any potential framing effect, i.e. any impact of the way the time and effect information was presented, three splits were included: duration of period with physical activity was presented as either 5 or 10 years, the change in life expectancy due to PA was framed as a gain or a loss, and as being a certain or an uncertain benefit.

Subsequently, respondents were asked to indicate their perception of QoL with and without the PA programme measured on a VAS scale ranging from 1 to 10, with 1 representing very poor QoL and 10 representing very good QoL. The VAS item has previously been used to measure the enjoyment of exercise [25]. In our analysis we focus on the difference in QoL incurred by PA measured as the difference $\Delta QoL = QoL_{with} - QoL_{without}$ at the individual level (range 9 to -9).

To elicit a monetary value of the PA programme, respondents who consented to the free membership in SP1 were subsequently asked to state their monthly WTP for that membership (SP2). Respondents were presented with a closed ended dichotomous choice question (seven bids ranging from 50 – 5,000 DKK, 1 Euro = 7.46 DKK). This was followed by an open-ended WTP question, in which respondents were asked to indicate their maximum WTP using a payment card with 16 bid options with an exponential increasing scale ranging from 0 to 10,000 DKK and above. The closed-ended question format with follow-up was in the

¹ The levels of the two attributes were chosen in accordance with national recommendations and the evidence within the field. Our choice of gains in life expectancy (LE) rests on estimates from Danish cohort studies [20-22] and a modelling study [23]. According to Sørensen et al. [23], an inactive 30-year-old individual can gain 3.2-4.7 years if staying moderately physically active for the rest of his/her life. Similarly, a recent review [24] found regular physical activity over lifetime to be associated with an increase in LE of between 0.4-4.2 years. The Danish Ministry of Health recommends that individuals are active at least ½ hour a day and engage in intensive physical activity at least 20 min*2 a week (corresponding to a moderate PA level). As we in our survey chose a time span of 5/10 years (and not lifetime) we chose to operate with 2, 6 and 10 hours of training per week (corresponding to low, moderate and high PA levels) to signify the trade-off needed to obtain the full benefits of PA (an increase in life expectancy of 2,12 or 48 months).

present study preferred to an open-ended WTP question, since respondent may in the case of the latter anchor their response to existing prices of memberships to fitness clubs. Furthermore, to investigate the preferences for the health benefit in a different context where less effort is required to obtain increases in life-expectancy, all respondents faced a final SP task (SP3). Here respondents were asked to state their monthly WTP for a pill (preventive medication) with the same health effect as offered in SP2. The two-part WTP question in SP3 was identical to that applied in the SP2 question. Comparing SP2 to SP3 thus provide us with additional relevant information on the magnitude of perceived effort and dis-utility associated with engaging in PA relative to taking a pill. It was explicitly stated that the pill had no adverse effects and was to be taken daily for 5 years². The PA and pill scenarios (SP2 and SP3) were presented as mutually exclusive scenarios. As a follow-up to each WTP questions, respondents were asked to rate their certainty in their answers to the WTP questions [26].

A translated version of the stated preference questions as presented to the respondents can be found in the online Appendix 3.

Part 5: The final part of the questionnaire contained a series of questions regarding respondents' attitude to PA. These questions were included to support (and potentially provide further explanation of) the findings from the SP analysis.

Analytical strategy

Descriptive statistics were obtained on the full sample. Statistical differences in socio-demographics across sub-groups were analysed using parametric and non-parametric tests. First, we investigate the association between individual characteristics and the impact of QoL on PA (Δ QoL). For this purpose, we conduct a

² There will be adherence costs associated with obtaining the health effect if the pill offer. Compared to the effort and dis-utility associated with the PA programme, we consider these costs minor.

binary logit analysis with the dependent variable = 1 if the QoL impact is negative ($\Delta QoL < 0$) and = 0 if positive or neutral ($\Delta QoL \geq 0$). The individual characteristics included are age, gender, education, income, BMI, self-assessed risk and PA level.

Analysis of preference for engagement in physical activity (SP1)

The analysis of discrete choice data is based on random utility theory assuming utility-maximizing behaviour by the individual [27, 28]. The utility U that individual i obtains from choosing to engage in the PA programme is given by:

$$(1) \quad U_i = V_i + e_i$$

where V_i denotes the deterministic (i.e. observed) part of the utility and e_i the error terms assumed to have a logistic distribution yielding the binary logit specification. Furthermore, V_i is assumed to be linear in parameters with the variables varying over choices according to the following specification

$$(2) \quad V_i = \beta_0 + \beta_1 Time + \beta_2 Effect + \beta_3 \Delta QoL_i + \beta_4 \Delta QoL_i * Time + Z_i$$

where *time* is the time spent on PA, *effect* is the long-term health effect (increase in life expectancy) from doing PA and ΔQoL is the self-reported QoL impact of PA. Furthermore, to control for any effect of presented scenario on the self-reported QoL measure, we also include an interaction between *QoL* and *time*. Finally, Z denotes a vector of individual characteristics. Z variables included are activity level, gender, age, income, education, BMI and self-assessed risk of cancer and cardiovascular disease.

The binary logit model specified in Equation 2 was estimated for the full sample and the two sub-samples defined by activity level (moderately active vs. inactive). To measure the trade-off between costs (time) and benefits (health effect) marginal rates of substitution was estimated as the parameter ratio between time (denominator) and effect (numerator) (20). Furthermore, a binary logit model including interactions terms

was estimated to provide evidence of a statistically significant difference in variables across the two sub-samples.

Analysis of willingness-to-pay for the PA programme (SP2) and pill (SP3)

Mean WTP for a life year gained from the PA programme (SP2) and the pill offer (SP3) were estimated for those who rejected/accepted the PA programme and were inactive/moderately active, respectively. It was assumed that individuals who rejected the PA programme had a WTP for the PA programme of zero. Differences in conditional and unconditional mean WTP were tested using unpaired t-tests.

The primary variables used in the regression analyses are listed in Table 1, including a description of the variables, their definition and the expected sign. All analyses were performed using Stata version 15.1.

[Insert Table 1]

Results

Of the invited panel members, 3,408 persons activated the link of which 2,658 (78 %) completed the questionnaire including the SP tasks. The item response rate was 98% with 2,607 respondents answering the questions relating to physical activity. A list of relevant socio-demographic and physical characteristics for the full sample (pre-selection) ($n=2,607$) and the selected sample ($n=1971$) are shown in the online appendices (Appendix 4). The sample was representative of the Danish adult population (18 to 60 years) with regard to gender, geographic area and marital status. However, the sample was older, more highly educated and more often employed than the general population. As expected the selected segment of the population - those who were inactive or moderately active -was characterized by being older, less educated, more often unemployed, more often female and having a higher BMI.

QoL impact of physical activity

The selected respondents' mean self-reported net QoL impact of PA was 1.7 (SD=2.3), with a median score of 1. The number of positive, zero and negative values were 1,065 (66.3%), 396 (24.6%) and 147 (9.1%), respectively with the majority of individuals reporting a positive valuation. Table 2 shows that inactive respondents were more likely to associate PA with a negative QoL impact relative to those who were moderately active. Moreover, being female and older was associated with a more positive QoL impact of PA, whilst higher education was associated with a more negative impact on QoL of PA. Note, QoL impact of PA and time were not correlated (correlation coefficient -0.09) suggesting that the QoL of PA reflects the individual's perception of a life with/without PA and is not driven by the specific scenario, i.e. the time spent on PA, presented to the respondent.

[Insert Table 2]

Preferences for engagement in physical activity (SP1)

Of the 1,604 inactive and moderately active respondents, 915 (57%) accepted the publicly provided free membership. Of these 617 were moderately active, and 298 were inactive, implying that 60% of the moderately active respondents and 52% of the inactive respondents accepted the membership. We observe that acceptance rates decrease with time spent on PA (78%/55%/40%) and increase with increasing health effect (52%/55%/65%)³, a result which suggests that respondents have understood the task at hand. The results of the three binary logit models are presented in Table 3. For the full sample, all three main effects have the expected signs and are significant indicating that they all influence the PA choice. The marginal rate of substitutions show that life expectancy should increase by 17 months before the individual is willing to exercise one more hour a week (MRS=0.059). Furthermore, we see that a respondent who has a QoL of PA that is one unit lower than another respondent should be compensated by

³Frequencies by groups are listed in Appendix 5

an additional lifetime gain of 42 months to reach the same acceptance level (MRS=0.024). Turning to the sub-group analyses, our results reveal that information on gain in life expectancy does not influence the choice of accepting the PA programme among the physically inactive whereas the marginal effect is significant for the moderately active.

[Insert Table 3]

Overall, the results of the interaction model are consistent, with our *a priori* expectations. The result from the extended model confirms the result that the health effect does not influence the physically inactive respondents' choice, as the negative coefficient of the interaction term (Effect x inactive) almost offsets the effect coefficient (0.018 -0.013). For all models, no framing effect was observed in relation to the way the time and effect were presented in the question.

WTP for PA programme (SP2) and pill (SP3)

Of the respondents accepting the free PA programme (SP1) 52% and 53% of the stated a positive WTP for the PA programme (SP2) and the pill offer (SP3), respectively. Physically inactive individuals had a higher probability (29%) of accepting the initial pill bid offer than the moderately active (19%) ($p < 0.001$).

Furthermore, those rejecting the PA programme had a higher probability (26%) of accepting the pill offer than those accepting the PA programme (20%) ($p = 0.005$). Although the association between WTP and the size of the health effect was positive it was statistically insignificant irrespective of whether the scenario was PA or taking a pill programme (results not shown).

Table 4 shows the results from the open ended WTP questions for the PA programme and the pill offer, respectively. Mean WTP (conditional and unconditional) for a one-year gain in life expectancy are reported. Those who initially accepted the free PA offer, were on average willing to pay EUR 819 for the programme with significantly higher mean WTP observed for the moderately active. Interestingly, those respondents who rejected the PA programme were on average willing to pay EUR 5,982 for the pill offer. Conversely,

those who accepted the PA programme, were on average willing to pay more for exercise than for the pill. Inactive respondents were on average willing to pay significantly more for the pill offer than for PA. The same pattern is observed for the moderately active although the effect is insignificant. That preferences differed across those who were moderately active and inactive was clearly reflected in the differences in zero-bids for the PA programme and the pill offer for the two activity groups. Finally, we see a general tendency for conditional WTP to be significantly higher for the pill offer suggesting that the pill offer is considered more attractive.

[Insert Table 4]

Discussion

Our study shows that there is a high degree of variation in the QoL impact of PA and that there is a statistically significant difference in this parameter across inactive and moderately active individuals. This result is consistent with previous studies, where the QoL impact of PA has been found to be highly associated with engagement in PA, e.g. [10, 14, 29]. Furthermore, a larger proportion of men than women associate PA with negative impact on QoL. In addition, age is positively correlated with QoL impact of PA.

Our results indicate that the magnitude of the health effect does not influence the inactive person's choice, and that the health effect only has a minor influence on the moderately active person's choice. Overall, the results suggest that preference structures differ between the two subgroups; for the physically inactive person the short-term consequences of doing PA dominate the long-term consequences of *not* doing PA. The relative importance of time investments in PA and QoL impact of PA, indicated by the estimated marginal rates of substitution, revealed that the latter is the more important driver of choice.

That there is a marked difference in preferences across those who accept and reject the PA programme is demonstrated by the large difference in WTP. The difference of EUR 6,119 is a conservative estimate, since

the estimate is based on the assumption that those who reject the PA programme have zero WTP, albeit these individuals are likely to demand compensation. The high mean WTP for the pill among those who reject the exercise membership (EUR 5,982) confirms that avoidance of PA markedly increases the perceived net benefits of the intervention. Interestingly, inactive individuals have a significantly lower zero-bid rate for the pill and a significantly higher WTP for the associated health effect, despite the fact that they are generally insensitive to the size of the health gain, when making their choice in SP1 and when expressing WTP for PA (SP2). Our result suggests that this group do value the health effects, but suppress these positive valuations when effort (time and disutility) is required to obtain them. The pattern for those who are moderately active is more heterogeneous, as the proportion of respondents expressing a WTP of zero is higher for the pill than for the PA programme, whereas the mean conditional WTP is higher for the pill.

It is worth noting that the estimated WTP for a life year is very low. The value of a life year has been estimated to be in the range of EUR 16,000 to EUR 30,000 [30]. Studies that directly compare prevention to treatment programmes have shown a preference for prevention over treatment. However, both Corso et al. [31] and Meertens et al. [32] show that when preference elicitation is conducted without directly comparing prevention and treatment, respondents were far more willing to pay for treatment than for prevention. Meertens et al. [32] explain these opposite findings by different psychological mechanisms relating to urgency and certainty with respect to pay-off. Only prevention activities were evaluated in this study, which can explain the low estimated WTP. More importantly, time preferences are also likely to play a significant role, thereby reducing the present value of future health effects. The low values suggest that time preferences may impact on the valuations of preventive programmes, thus affecting the engagement rates. As an illustration, discounting the health effects of 2, 12 and 48 months by a 3% discount rate will for a respondent with average age result in discounted gains in life expectancy at the age of 80 of 0.8, 4.7, and 9.3 months respectively.

It is likely that the health effect, both due to the size and the possible high discounting of the gain in life expectancy, was considered minor by respondents relative to the high time costs here and now needed to obtain the effect. The setting we have presented is however very realistic, as preventive measures often require a high level of consistent effort in the present, whereas relative modest benefits are reaped in the far future. In the present study, we present SP scenarios with a maximum gain in life-expectancy of 4 years. This was deemed realistic, since, on average, those who are physically inactive die 5-6 years earlier than people who are physically active [33]. However, further research applying a broader range of possible effect sizes could be interesting in order to investigate whether the range of the effect offered was too narrow to capture the physically inactive persons' preferences. In a recent choice experiment, Ozdemir et al (2017) investigate the impact of financial rewards on stated PA uptake among active and insufficiently active full-time employees. Besides the financial reward, the choice experiment also included attributes for the time spent on PA (ranging from 1 to 3.5 hours) and an enrolment fee. As expected the authors find that the uptake rate increases considerably with increasing reward. Moreover, they find average uptake rates to vary between 39%-68% depending on the programme on offer, which corresponds well with our findings (57% for the entire sample).

Understanding what drives individuals' choice of PA is valuable, since it generates a deeper understanding of behavioural determinants of health. Such knowledge is important for the planning of health promotion activities intended to attract and motivate individuals to become more physically active. In theory, such choices could be observed in the real market, but since the market does not offer perfect information and mobility, a SP study is a more useful method to investigate how individuals' trade off the (negative) QoL impact of PA and the health benefits of PA. Accordingly, the SP study allow us to isolate the impact of the health benefit and time investments associated with PA, which would be difficult in a real-life setting. In a recent review, SP methods were found to proficiently capture individuals' perceived health benefits of PA in recreational urban spaces thereby providing insights on the impact on different policies on engagement

in PA (Lynch et al. 2018). In the formulation of our PA programme, we included an array of different sport activities to minimize rejection due to type of activity on offer, and ensure generalisability.

Our model is based on a neoclassical demand model, which means that we assume that preferences are stable and known with adequate precision to make decisions unambiguous. These assumptions have frequently been questioned [34], and there is a growing body of evidence supporting the tenet that preferences are often constructed and change as individuals acquire more information and personal experience [35, 36]. Since most people have experience with PA, we believe that the choice patterns we have elicited are relatively stable and based on well-formed preferences.

The sample was more highly educated and has a higher employment rate than the general Danish adult population (18 to 60 years). It is however, unclear, whether this affects our results since the selected group (those who are physically inactive or moderately active) may be representative of the corresponding - less physically active - adult population with respect to socio-demographics.

In recent years, a branch of literature has emerged focusing on the health impact of time inconsistent preferences [37]. According to this literature, some individuals who are present biased neglect the consequences of future consumption and overweigh the benefits of present consumption in a dynamically inconsistent way [38, 39]. In terms of decisions to invest in PA, this implies that individuals will tend to sign up for memberships to e.g. gyms with unrealistic expectations about their exercise levels [40]. Transferred to our setting, respondents who were identified to have a positive net utility of PA, might procrastinate or not be able to act out their decision to engage in PA. As for other sources of hypothetical bias, this will cause a wedge between stated and revealed behaviour. Accordingly, our results should not be interpreted as estimates of expected actual uptake rates but rather as insight into understanding the heterogeneity in perceived barriers to considering engaging in PA.

Policy implications

Research into correlates or determinants of PA behaviour has burgeoned in the last two decades. An important contribution of our study to the field of PA behaviour is the result that the preference structures differ between the physically inactive and the moderately active. We found that the long-term health effect had no influence on inactive individuals' choice to engage in PA, suggesting that promotional campaigns on the health benefits of exercising is likely to have little impact on the behaviour of this group. This finding is in line with Devereux-Fitzgerald et al. (2016) who also find that long-term health effects do not work as motivation for getting physically inactive individuals engaged in exercise.

One important policy implication of the study is that perceived negative QoL impact of PA should be acknowledged as an actual – and perhaps the most important – barrier to engagement in PA. Those who are physically inactive, and who often express a high negative impact on QoL of PA, are willing to pay a non-negligible amount for a pill that can prolong life, suggesting that this group does value health and is willing to incur costs, monetary as well as adherence costs, to improve their health prospects. Moreover, time appears to be less of a constraint. To the extent that some individuals are willing to engage time and money to ensure future health, but face a significant barrier in terms of the physical effort required, one should focus on making physical activity more attractive for this sub-group. This could for example be done via the social aspects related to many physically activities or active transportation. The latter will not only increase the PA level but in some cases, result in saved travel costs and time.

Physically inactive individuals use more health care services than active people [41, 42]. In a collectively funded health insurance system, these costs will be financed by all taxpayers. Such externalities justify more paternalistic societal measures for ensuring citizens' engagement in physical exercise, as such behaviour may generate societal benefits beyond those experienced by the individual. Previous studies have found that financial rewards increase (stated) participation in PA programmes [43, 44]. Incentive schemes may prove particularly useful for engaging present biased individuals in PA programmes. More

studies are clearly warranted that apply behavioural economics to increase our understanding of how to overcome barriers to behavioural change relating to physical exercise.

Conflicts of interest

The authors have no conflicts of interest to declare

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Table 1. Description of variables used in the regression models and hypothesised impact

Variable	Description	PA programme	Pill offer
Dependent variables			
Choice of PA	=1 if PA programme is accepted; else=0		
Choice of pill	=1 if pill is accepted; else=0		
Explanatory variables			
<i>Effect</i>	2, 12 or 48 months increase in life expectancy	+	+
<i>Time</i>	Time spent on PA; 2, 6, 10 hours per week	÷	n.a.
ΔQoL	QoL impact of PA. Measured as $QoL_{with} - QoL_{without}$	+	n.a.
<i>Price</i>	Price of PA/pill offer; 0, 50, 150, 200, 300, 400, 500, 750, 1,000, 1,500, 2,000, 3,000, 5,000, 10,000, more than 10.000 DKK (EUR 1 = DKK 7.46)	÷	÷
Interaction terms			
<i>Effect x inactive</i>	Inactive=1, moderately active=0	÷	n.a.
<i>Time x inactive</i>	Inactive=1, moderately active=0	÷	n.a.
<i>QoL x inactive</i>	Inactive=1, moderately active=0	+	n.a.

Notes. Correlation between time and QoL impact of PA is estimated to -0.008 suggesting that there is problem with multicollinearity.

Table 2. The association between individual characteristics and negative QoL impact of physical activity. Results from binary logit regression.

Variable	Coefficient	(SE)
Inactive (vs. moderately active)	.527***	(.181)
Female (vs. male)	-.490***	(.183)
Age	-.024***	(.0087)
Education		
Lower education	.341	(.377)
Lower secondary education	Ref	
Higher secondary education ¹	.473**	(.196)
Income		
Low-income	-.330	(.239)
Middle-income	Ref	
High-income	.224	(.204)
Body Mass Index (BMI)		
Underweight ²	-.663	(1.05)
Normal weight	Ref	
Overweight ³	.315	(.206)
Obese ⁴	-.043	(.254)
High self-assessed risk ⁵	.255	(.219)
Constant	-1.78***	.416
Pseudo R2	0.04	
N	1595	

Notes. Significance levels *** p<0.01, ** p<0.05, * p<0.1

¹ 3 years or more; ² BMI < 18.5 kg/m²; ³ 25 kg/m² ≤ BMI < 30 kg/m²; ⁴ BMI ≥ 30 kg/m²; ⁵ self-assessed risk for cancer and cardiovascular disease

Table 3. Analysis of accepting the PA programme (SP2). Results from binary logit regressions.

	<i>Full sample</i>	<i>Moderately active</i>	<i>Inactive</i>	<i>Full sample with interactions</i>
	Coefficient	Coefficient	Coefficient	Coefficient
<i>Effect</i>	.0129***	.0182***	.0062	.018***
<i>Time</i>	-.219***	-.258***	-.174***	-.255***
ΔQoL	.5288***	.491***	.656***	.481***
$\Delta QoL \times Time$.0053	.014	.0031	0.011
<i>Constant</i>	1.708***	1.829***	1.34***	1.87***
<i>Effect x inactive</i>				-.0127*
<i>Time x inactive</i>				.0838*
<i>QoL x inactive</i>				.171**
Controls ¹	Yes	Yes ²	Yes ²	Yes ³
MRS: <i>Effect/Time</i>	-.059	-.070	-.036	-
[95% CI]	[-.090; -.027]	[-.10; -.036]	[-.10; .029]	
MRS: <i>Effect/ΔQoL</i>	.024	.037	.0095	-
[95% CI]	[.012; .037]	[.019; .055]	[-.0074; .026]	
MRS: <i>Time/ΔQoL</i>	-2.41	-1.90	-3.76	-
[95% CI]	[-2.96; -1.87]	[-2.40; -1.40]	[-5.37; -2.14]	
Log-likelihood	-834.7	-522.3	-302.9	-828.4
Pseudo R2	0.23	0.24	0.23	0.24
N	1591	1022	569	1591

Notes. Significance levels *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

¹ Same variables as in Table 2: PA level, age, gender, education, income, BMI, self-assessed risk ² PA level not included

Table 4. Mean WTP and conditional WTP for a life year gained. Numbers presented in Euros. Responses from open ended WTP. Zero bid rate in parenthesis.

	PA programme	Pill offer	
	WTP/conditional WTP	WTP/conditional WTP	<i>t-test</i>
Reject PA programme	0 ^a /n.a.	5,982/10,786	p<0.01/n.a
Accept PA programme	6,119/6,691	4,567/8,861	p=0.15/p=0.27
<i>t-test</i>	p<0.01/n.a.	p=0.29/p=0.44	
Inactive	2,899/6,097	5,166/8,458	p<0.01/p=0.026
Moderately active	3,812/6,979	5,191/10,598	P=0.19/p=0.087
<i>t-test</i>	p=0.028/p=0.24	p=0.98/p=0.34	
Full sample	3,486	5,182	0.018

Notes: Exchange rate 1 Euro = 7.46 DKK

^aImputed (assuming that individuals who reject the PA programme have a zero WTP)