Association Between Life Satisfaction and Smoking Behavior in the Netherlands: During the Covid-19 Pandemic

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Master thesis

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Abstract

The Dutch government is aiming at a smoke-free generation in 2040 by implementing new policies. The smoking rate is not decreasing enough to reach this target. This study looks at the association between smoking behavior and life satisfaction to find ways to influence smokers to quit. This study aims to assess what the association is between life satisfaction and smoking behavior in the Netherlands. It will also look into the effect of the Covid-19 pandemic on smoking behavior and the effect that age has on the relationship between life satisfaction and smoking behavior.

Data from the LISS-panel is used to conduct a fixed effects regression analysis. The results show that there is no significant association between life satisfaction and smoking behavior in any of the cases. This is contradictory to past research, which all found a significant negative association. The only significant associations are between the control variables anxiety and exercise, and smoking behavior. Both have a negative association with smoking behavior. The effect of exercise on smoking behavior is the strongest for people aged 65 and older. Based on these results, the policy recommendation is to stimulate exercise, which can lead to a healthier lifestyle and reduce the number of cigarettes people smoke.

Table of contents

Introduction

22.2% Of the Dutch adult population smoked in 2020, which is about 3.87 million Dutch citizens. This has to be 0% by the year 2040 (MacroTrends, 2023). Smoking has gotten a lot of attention from national governments in the last decades, because it has a big negative impact on the private health of citizens. On top of that, smoking bears a big social cost. A study done in the United States shows that, in 2018, the social cost of smoking was 240 billion dollars in direct costs. The indirect cost, however, like lost productivity and premature death, was 372 billion dollars (Centers for disease control and prevention, 2022). These social costs are a big burden for the government.

The Dutch government has implemented multiple smoking policies over the years to decrease the smoking rate and lower the social cost. The smoking rate has decreased by roughly 10% since the year 2000, but it is not decreasing enough to reach the target of a smoke-free generation by the year 2040 (MacroTrends, 2023). The government raised the taxes on cigarettes in April 2023 and will do so again in April 2024. This will be on top of the other measures the government has taken over the last decades. These measures include, for example: less availability of tabacco, neutral packaging, ban of flavored cigarettes, less places where you are allowed to smoke and the provision of free quit-smoking programs (Ministerie van Volksgezondheid, Welzijn en Sport, 2023).

The measures the government has already taken are not yielding the desired results. This is why it is interesting to look at the relationship between life satisfaction and smoking. This study will try to provide insight into smoking behavior with the use of life satisfaction by building on the existing literature and providing new data. With this new insight, a policy proposal is drafted which might help the Dutch government to find other ways to influence smoking behavior and stimulate smokers to quit.

A lot of research has been done into the relationship between smoking behavior and life satisfaction and numerous studies have found a relationship between the two. Grant et al. (2009) found an association between life satisfaction and smoking behavior, where people with lower life satisfaction are more inactive and smoke more. Taheri et al. (2014) support this finding and also found a connection between personal life distress and smoking more. Other studies, however, only found an association for certain aspects. Shahab and West (2012) only found an association when someone was depressed or had anxiety, not for other aspects of self-reported health. Another important aspect of self-reported health is exercise. Smoking has an influence on your lungs and makes exercising more difficult (USA Department of Health and Human Services, n.d.), while exercise can be beneficial in decreasing cigarette cravings (Conway & Cronan, 1992). Sran et al. (2021) and An et al. (2020) also found an association between being active and having higher life satisfaction.

A lot of studies looking into the relationship between life satisfaction and smoking behavior have looked only at a certain part of the population. Xie et al. (2022) takes a broader view and comes to the conclusion that there is a difference in the association between life satisfaction and smoking behavior for different age groups. They found that when emotional and social support are taken into account, only smokers aged 18-34 and 65+ are influenced by this. This means that age plays a role, which is interesting to include in this study.

As shown above, not everyone agrees about the association between life satisfaction and smoking behavior and the factors that influence this relationship. Especially during the last couple of years, a lot has changed. The Covid-19 pandemic started, which can also have an impact on people's behavior. The influence of the pandemic on the association between life satisfaction and smoking behavior has not yet been studied thoroughly in the Netherlands. On top of that, most studies looking at the relationship between life satisfaction and smoking behavior conduct cross-sectional research instead of panel research, see for example Grant et al. (2009). These studies look at a comparison between countries or only look at respondents

within a country for one moment in time. Most of these studies are conducted in other countries, which might not be a good representation for behavior in the Netherlands.

Even if these studies look at the Netherlands, most of these studies base their variable 'life satisfaction' on one or at most two survey questions, while Huebner (1991) created the Student Life Satisfaction Scale which is based on nine survey questions. He only created this scale for students aged 7 to 14, but this study uses a similar scale for the whole smoking population. Thus, this study can provide new knowledge about the relationship between life satisfaction and smoking behavior and provide insight into the smoking behavior of the whole population, instead of only part of it. Based on this the following research question has been drafted:

To what extent is life satisfaction associated with smoking behavior in the Netherlands?

This question will be answered with data from the LISS Panel (Centerdata, n.d.). This Panel has a household survey that contains data from a very big part of the Dutch population. This dataset can provide data about smoking habits in the Netherlands for the last fifteen years. This data can show changes (or no changes) in smoking behavior in the period of 2017 to 2022 to include the changes in behavior because of the Covid-19 pandemic. With use of a fixed effects framework, the changes in smoking behavior will be studied in relation to life satisfaction.

This paper first explains smoking behavior on the basis of Hedonism and the Prospect theory and formulates the hypotheses. Next, the research design is presented in which it is specified how the smoking behavior will be measured with the use of a fixed effects regression analysis. In the next chapter, the results and analysis will be discussed. At the end, the conclusion, recommendation and limitations will be discussed.

Theoretical framework

The Dutch government is aiming at a smoke-free generation in the year 2040. The government wants to reach a smoke-free generation, because smoking is the main cause of bad health in the Netherlands. In 2019 alone roughly 10.000 Dutch citizens died from lung cancer (Integraal kankercentrum Nederland, 2019).

The Tobacco Act was implemented in 2002, which was one of the first big smoking legislation changes that has been introduced. The Tobacco Act banned smoking in government buildings and public transport. Over the years more policy changes took place. Examples of these policy changes are increases in excise duties, neutral cigarette packages and bans of smoking in public places. All of these changes were implemented to incentivize people to stop smoking and to reach a smoke-free generation in 2040 (Toebes & Bontema, 2016).

The Dutch government has different options to reach a smoke-free generation; price increases, neutral packages and limiting the number of selling points (Toebes & Bontema, 2016). However, this is focused on the cigarettes themselves and not the characteristics of smokers. By looking at their characteristics, there might be other ways smokers can be stimulated to quit.

2.1 Literature study

A lot of studies looking into smoking behavior find a link with life satisfaction and happiness. Grant et al. (2009) conducted cross-country research in 21 countries spread over four continents. They researched students aged 17 to 30. They found that students who are dissatisfied with life are more inactive, which means they work less, engage in less activities and smoke more. Taheri et al. (2014) support this claim. They conducted a cross-sectional study of health professional students at the Mashhad University of Medical Sciences in Iran. In 17.6% of the cases, the most important reason to keep smoking was personal life distress.

Both of these studies only looked at students. By only including students, a big part of the target population is not taken into account.

Xie et al. (2022) also found data in the United States pleading in favor of a link between life satisfaction and smoking behavior, especially for respondents aged 18 to 34. The results were not significant for the groups with respondents older than 34. They have lower life satisfaction if they smoke than the non-smokers in these age groups do. The dependent variable in the studies by Grant et al. (2009) and Xie et al. (2022) is only based on one question, while Huebner (1991) used 9 indicators for life satisfaction. He created the Students Life Satisfaction Scale, which bases life satisfaction on 9 different indicators. While the scale is made for students, it provides the same results as for adults. This should provide more information about life satisfaction for the target population of this study than the indicator used by Grant et al. (2009) and Xie et al. (2022).

Xie et al. (2022) also found a connection with having social and emotional support. More smokers than non-smokers reported low social and emotional support. The authors argue that more social and emotional support can help with smoking cessation by reducing stress caused by the smoking cessation, stress buffering. The study shows that ex-smokers and non-smokers were more satisfied with life than smokers. Smokers also had lower social and emotional support. This conclusion, however, can only be drawn for smokers aged 18-34 and 65+. The results for the other age groups are not significant.

While the studies by Taheri et al. (2014) and Xie et al. (2022) showed an association between life satisfaction and smoking behavior, Shahab and West (2012) do not fully agree with this point of view. They conducted cross-sectional research in England in which they only found an association between smoking and life satisfaction when the reason for smoking was depression or anxiety. In all other cases smokers were just as happy as non-smokers. This study shows a clear correlation between life satisfaction and smoking behavior for depression and

anxiety. However, there is no control group in which the respondents have depression and anxiety symptoms but do not smoke. Therefore, it is possible there is a reporting bias which would require more research. Shahab and West (2012) did use a more extensive scale for life satisfaction than the studies mentioned above, it is however still limited to two indicators.

The contradictions between the studies show that there might be other factors influencing the relationship between life satisfaction and smoking behavior. Income might be an important factor. Jarvis (2004) looks at the reasons as to why people smoke, and he found evidence that since the 1970s the percentage of smokers who have stopped smoking in the United Kingdom rose from 25% to almost 60% for the whole population. When looking at the poorest groups it was only 10%, which is the same as it was in the 1970s. Poorer smokers in general smoke 1,5 times as many cigarettes as the most affluent and are more dependent on nicotine, which is why there is a smaller percentage of people that stop smoking.

As already mentioned, Shahab and West (2012) only found an association between smoking and life satisfaction for depression and anxiety. 20.4% Of the sample indicated that the most important reason for smoking was to help them feel less anxious and for 11.2% of the respondents the most important reason was to feel less depressed. The study showed that the people who reported these reasons for smoking have a lower life satisfaction (relatively −14% & -43% for anxiety and depression). These two reasons are the only two with statistically significant results (respectively <0,05 and <0,001). Factors such as weight control or stress control are not significant in this study.

Based on this, self-reported health can be an important influence in the relationship between smoking and life satisfaction. As Prus (2011) shows in his study about self-reported health across the US and Canada, people who smoke and people who report low life satisfaction have poorer health than those who do not report this. 15.4% of the current smoking population report poor health, while only 8% of non-smokers report poor health. Of the people that report

they were satisfied with life only 8.6% reported poor health, while 23.2% of people who were not satisfied with life reported bad health.

This makes clear that self-reported health can be an important factor in the relationship between smoking behavior and life satisfaction, because the study by Prus (2011) shows that there is a link between the three factors. His study had a response rate of only 66 percent in Canada and just 50 percent in the United States. This might have left out relevant respondents. He did, however, check if his key characteristics, such as age distribution, were similar to national health surveys, which was indeed the case.

As a lot of people use exercise to create better mental health, Sran et al. (2021) found that people who exercise are 3.10 percentage points more satisfied with life than people who do not exercise. They conducted an experimental study which only consisted of 60 participants, which they followed for four months. This is a very small sample and not very representative of the full population. They did use a Subjective Health Scale, which has four indicators. This is more extensive than the other studies. The significance of the correlation is high, but because they found a very small difference in happiness scores for people who exercise and people who do not, it is negligible.

An et al. (2020) conducted a cross-sectional study in a city in Taiwan which had 2345 respondents. This study came to the same conclusion as Sran et al. (2021): active respondents had higher life satisfaction. Moderate activity resulted in a life satisfaction score which was 0.12 higher than low-activity, for high-activity this was 0.19. Both of these results are significant.

Looking at the connection of exercise and smoking, research shows that exercising is more difficult for smokers than for non-smokers. This is because smoking decreases your lung capacity and narrows your arteries, which decreases blood flow and increases your heart rate. Because exercise is more challenging for smokers, they do it less. In an attempt to quit smoking,

exercising can be very beneficial. It can reduce cigarette cravings and reduce stress (USA Department of Health and Human Services, n.d.; Conway & Cronan, 1992).

As mentioned above, exercise can reduce stress and cigarette cravings. Stress itself is an important factor in smoking behavior and a lot of smokers reason that smoking reduces their stress. However, Parrott (1999) argues with results of multiple studies done by other researchers that smokers have higher levels of stress, which increases even more when they have a regular smoking pattern. These stress levels also decrease when they stop smoking. So, smoking eventually only increases stress.

Most studies use self-reported health, which is a subjective measure. Richards et al. (2011) draw the same conclusions but based on biological measures. This study looks at the neural circuits of chronic smokers. Changes in the neural circuit result in less reward signals from the brain and it increases activity in the part of the brain related to stress. The reason smokers keep smoking is because nicotine gives the reward signals they miss out on when they do not smoke. This is very strong evidence for the results found in the studies that use self-reported health as a variable.

Lastly, a work-life balance is also important. Research done by Kouvonen et al. (2004) shows that people who have an imbalance between work effort and reward are mostly smokers. A high workload and stress in the workplace lead to increased smoking behavior. On top of that, the workplace environment is also important for smoking behavior. When health and work-life balance are important to the employer, employees are smoking less than when it is the opposite. So, work can influence smoking behavior as well. This study had 46190 respondents scattered throughout Finland. It included public sector employees aged 17 to 65. The respondents are a good representation of the eligible population. The eligible population only existed of public sector workers, which means it was not very representable for the full working population. Kouvonen et al. (2004) state that the association between work stress and

smoking is in line with previous studies. They also mention that there are studies that find no association between the two, but the authors argue that a potential reason for this is a small sample size in almost all of these studies, which decreases the likelihood of finding significant associations.

The Covid-19 pandemic could also influence the relationship between life satisfaction and smoking behavior. In January of 2020 the Covid-19 pandemic reached the Netherlands. A lot of people got infected or were scared of getting infected. Patanavich and Glantz (2020) found that smoking cigarettes resulted in more serious Covid-19 symptoms and worse health than for people who did not smoke. 29.8% Of respondents with a history of smoking experienced a progression of the Covid-19 virus and sickness, while this was only 17.6% for non-smokers. This research included 19 different countries and looked at 907 different studies. The downside to this study is that the researchers used data from other studies. Not every study separated smokers and ex-smokers, which might have biased the outcome of Patanavich and Glantz' (2020) study. However, without this bias the difference between smokers and non-smokers might be even bigger. Ex-smokers have less chance of progressing sickness, because their lungs have recovered, which might only underestimate the percentage of smokers with progression of Covid-19.

This increase in health risks was spread over the news and Elling et al. (2020) researched the reactions of smokers on the news that they had more Covid-19 related risks. They found that 67.7% of smokers were not influenced by the news about the risks and kept smoking. A part of the smoking population in the Netherlands quit smoking (18.5%) because of the risks related to Covid-19. But a small group of smokers started smoking more (13.8%) because of the stress related to the Covid-19 risks (Tetik et al., 2020). The sample was small (340 respondents) and only smokers who were willing to quit smoking within five years were included. This means that it is not a great representation of the smoking population. On the contrary, Almeda and Gómez-Gómez (2022) conducted research including 58052 participants

extracted from 11 different publications from the USA, Asia and Europe. They found that the fear of the health risks related to Covid-19 had the upper hand and most people quit smoking during the pandemic.

2.2 Conceptualization

To accurately measure life satisfaction and smoking behavior, it has to be clear what those terms contain. Life satisfaction especially is a very broad and vague term and can be explained in different ways. Diener et al. (2002) describe life satisfaction as 'a person's cognitive and affective evaluation of his or her life'. The OECD is a little more specific and adds that this rating should not be based on current feelings, it should only be based on the evaluation of their life as a whole (OECD, n.d). Happiness and life satisfaction are difficult to distinguish, but for the present study the description the OECD uses to describe life satisfaction is used, which means that happiness will not be measured. Badri et al. (2022) describe it as "happiness and satisfaction are distinct constructs, as happiness is a momentary experience that arises spontaneously, while life satisfaction is a long-term feeling based on achieving life-long goals" (p. 3575).

A lot of studies base life satisfaction on multiple indicators. The Student Life Satisfaction Scale used by Huebner (1991) exists of 9 factors: 'I like the way things are going for me', 'my life is going well', 'my life is just right', 'I would like to change many things in my life', 'I wish I had a different kind of life', 'I have a good life', 'I feel good about what's happening to me', I have what I want in life' and 'my life is better than most kids'. This scale is broadly used with modifications to fit to the data that is used. This scale is also the basis for the present study.

Smoking behavior can be interpreted differently. In the encyclopedia of behavioral medicine smoking behavior is described as, for example, how deeply smokers inhale, and their puffing style (Baker & Webb Hooper, 2013). When talking about smoking behavior in

behavioral economic studies, a couple of things can be meant by this. It can be about smoking initiation, smoking cessation and smoking intensity (Hammond, 2005). The present study looks at smoking intensity by studying the number of cigarettes smoked in the years 2017 until 2022. This means that initiation and cessation will not be measured directly, but indirectly through the number of cigarettes smoked in those years and the increases or decreases. It will be measured to see if life satisfaction influences the number of cigarettes smoked. The factors that might influence this relationship are more straightforward and will be explained later on in the operationalization.

2.3 Theory

There are two theories that can describe the relationship between life satisfaction and smoking behavior, which are Hedonism and the Prospect theory. The relationship will be first be explained with the use of Hedonism and supplemented with the Prospect theory.

Hedonism looks at the balance between pleasure and pain. The theory itself can be explained in different ways based on the type of philosophy you reason from. Morally, Hedonism is explained as a view in which life is good when it is pleasurable. From the viewpoint of psychology, humans act in a certain way because they are pleasure seekers (Veenhoven, 2003). Ruut Veenhoven uses the term 'a good life' for: "A way of life in which pleasure plays an important role" (2003, p. 437). Hedonism can be seen as a way of life resulting in living well and enjoying life or it can result in a life with addiction, irresponsibility or egoism. This already shows some contradictions within the theory. Hedonism explains that pleasure compensates for pain, but there are multiple critiques of the theory showing that a Hedonistic lifestyle is not always the best way to live. Firstly, Hedonism is bad for the environment because it leads to overconsumption and blindness to danger, because it only pays attention to the pleasures of life (Veenhoven, 2003).

Secondly, Hedonism is bad for individuals, because it is focused on present happiness, which can be at the expense of long-term happiness. As mentioned above, it can lead to overconsumption, which can lead to bad health in the future. Overconsumption can for example be drinking too much alcohol, binge-eating or smoking. This can also lead to addiction, because pleasure slowly decreases, leading to seeking more pleasure. This can lead to short term happiness, but future health losses (Veenhoven, 2003). On the other hand, smoking results in pleasure in the moment and can reduce pain or stress. This is in line with the heart of Hedonism, because the pleasure of smoking is greater than the stress the individual is experiencing.

The theory of Hedonism is two-sided, which means that the explanation of the link between smoking and life satisfaction is two-sided as well. Smoking can result in short term pleasure, which means that smokers might be happier and more satisfied with their life than non-smokers. This can contribute to being able to cope with stress and problems better, which results in a more positive view of life and more life satisfaction (Iversen and Erwin, 1997). The other side argues that the pain of smoking in the future can lead to future health problems and decrease overall life satisfaction. Habituation reduced the pleasures of addiction as well, which means that smoking will not result in as much pleasure anymore. Both of these arguments show that when getting older or smoking for a longer period of time, the pleasures are less prominent, and the pain is more present. This results in less life satisfaction, because smoking will not relieve the stress as it used to or make you feel as good.

Another theory that can be used to describe this relationship is the prospect theory. The prospect theory is drawn up by Daniel Kahneman and Amos Tversky (1979) as a reaction on the expected utility theory. The expected utility theory looks at the risks for every decision. Kahneman and Tversky state that the outcomes that have a high certainty of taking place are outweighing outcomes that have more uncertainty, which leads to risk aversion. The prospect theory looks at gains and losses, not at utility. Utility only takes the outcomes into account, while the prospect theory also takes the process into account. So, when evaluating choices, it

looks at what it might give you in the process, without only paying attention to the outcome. An example might be temperature. The temperature outside can be rewarded differently for different people, based on the temperature they were previously in. This is not taken into account with the expected utility theory (Kahneman & Tversky, 1979).

When this is applied to smoking and life satisfaction, people who are not satisfied with life value the present gains from smoking very highly, because it functions as stress relief and gives pleasure. The gains later on in life from not smoking are smaller compared to the gains now. They experience greater losses now if they decide not to smoke than they will later on in life because of worse health later on in life. This is different from people who are satisfied with life, because the present gains from smoking are lower, because they are in a better place in their life, they do not rely on smoking to feel pleasure, which is why the gains from smoking now are not as high and the losses later on in life in regard to health are valued higher. Thus, applying this theory to the relationship between life satisfaction and smoking behavior shows that people who are not satisfied with their life value their present gains from smoking higher than the health losses later on in life, which is less the case with people who are satisfied with life.

Looking at the literature, people who are satisfied with life value future losses higher than short term gains from smoking, which is also stated in the study by Grant et al. (2009) and Taheri et al. (2014). This leads to the following hypothesis (hypothesis 1):

There is a negative association between life satisfaction and smoking behavior.

This hypothesis states that people who are satisfied with life smoke less than people who are not satisfied with life. But, as shown above, the effect of the Covid-19 pandemic moves two ways, which can also be explained with the use of Hedonism. On the one hand, people experience stress because of the lockdown. This can result in lower life satisfaction compared to before the pandemic. Smokers might have needed those cigarettes more to calm their nerves

and give them some pleasure, which increased their life satisfaction again (Tetik et al., 2020). On the other hand, health risks became more visible, which influenced the perception of life satisfaction and might have changed smoking behavior (Patanavich & Glantz, 2020). As Almeda and Gómez-Gómez (2022) found, more people quit smoking than started smoking. They took a sample from multiple countries and stated that government policy might impact their results on a country level. Based on these findings, the following hypothesis is drafted (hypothesis 2):

> During the Covid-19 pandemic the association effect of life satisfaction and smoking behavior increased.

Xie et al. (2022) have mentioned that the association effect between life satisfaction and smoking behavior is different for different ages. They only found an association between life satisfaction and smoking behavior for people aged 18 to 34. When taking social and emotional support into account it also included people aged 65 and over. Tetik et al. (2020) showed that the average age people stop smoking is 40 years or older. This might provide another focus point for the government. This leads to the last hypothesis (hypothesis 3):

> The association between life satisfaction and smoking behavior is only present for the age groups 18 to 34 and 65 and over.

Research design

This chapter explains how the results are computed to answer the research question. Furthermore, it provides information about the method of data collection using the LISS Panel (Centerdata, n.d.). It shows how the data is analyzed in Stata and why this type of research design fits the research question.

3.1 Method of data collection

The data used for this research was collected from the LISS-panel, which is a longitudinal panel survey of Dutch households. This study will use a quantitative research approach, which makes it possible to capture changes over time for a large group of people.

This dataset consists of a lot of data points, which are collected through online surveys. The LISS-panel consists of data of approximately 5000 Dutch households (*LISS Panel Homepage*, n.d.). It is an unbalanced panel, because not every individual is observed the same number of times (Greene, 2012). This dataset can provide a lot of insight about smoking habits over the past 15 years in the Netherlands. It uses multiple studies focusing on different aspects of the population, such as education, income and political belief. The datasets that will be used in this study are the ones about health, social integration and leisure and personality. These categories provide insight into the aspects that are taken into account when looking at the relationship between life satisfaction and smoking behavior. Also the Core Questionnaire is used to provide the most complete information about income (Centerdata, n.d.). Because this dataset takes a sample from the whole Dutch population (that is older than 16 years old), it creates a valid representation of the smoking habits of the whole population. It also creates an objective measurement; when someone else computes the same research, it will show the same results.

The LISS-panel data is conducted by the foundation Centerdata and the Central Bureau of Statistics (CBS). Centerdata conducts the research, while CBS creates the sample. This

increases validity, because the institutions are not acting in self-interest: the tasks are divided and they aren't government departments, so they don't benefit from certain results. Another reason for conducting a panel study is that most studies looking at the relationship between life satisfaction and smoking behavior conduct a cross-sectional study. Those studies look at respondents at one moment in time. Examples are the studies done by Grant et al. (2009) and Taheri et al. (2014).

Grant et al. (2009) look at the smoking behavior of youth in different countries and how their well-being influences their smoking behavior. A panel study can add to the knowledge about smoking behavior, because it can make the changes visible over time, which a cross-sectional study does not. In this case, it can show changes in smoking behavior that happened because of the Covid-19 pandemic.

3.2 Method of data analysis

For this type of research a choice has to be made between a random effects model and a fixed effects model. The difference between the two models lies in the association with individual fixed effects (α_i). The individual fixed effects are factors which do not change over time and are linked to each individual. A random effects model assumes that the individual fixed effects (α_i) are not associated with the explanatory variables, while a fixed effects model assumes that the individual fixed effects (α_i) are associated with the explanatory variables. Both models have pros and cons. The assumption mentioned above is a pro for using a fixed effects model, because it is a strong assumption, which is hard to be true in most cases. A random effects model however can show the effect of time invariant variables, while the fixed effects model can only include these variables in the error term (Greene, 2012). Because there is no reason to believe there is no association between the included variables and the regressors and there is no controlled environment a fixed effects model seems to fit best (Greene, 2012).

To make sure this is the case, the Hausman test has been executed. The Hausman test checks if there are differences in coefficients between a random effects and a fixed effects regression. The nullhypothesis states that there is no systematic difference in the coefficients in a random effects regressions versus a fixed effects regression. Then, a random effects model is the best option. With the data used in this research, the random and fixed effects estimations provide different coefficients for the independent variables (Table A1). Because the models provide different coefficients and this difference is significant with a p-value of 0.000 (Table 1), the nullhypothesis can be rejected. This means that a fixed effects model is best fitted for this research.

Table 1
Hausman (1978) specification test

	Coef.
Chi-square test value	153.857
P-value	.0000

As mentioned before, there are time and individual fixed effects, which leads to a two-way fixed effects of an unbalanced panel, because not every respondent filled in the questionnaire every year (Greene, 2012). It is also important to look into omitted variable bias, which occurs when some influencing factors are left out of the equation. These factors can influence the dependent variable, while only influence from the included independent variables is measured. This leaves a gap between the true value and the conducted value (deHaan, 2021). This is why a lot of control variables are added. These variables are selected based on outcomes of previous research, which has been discussed in the theoretical framework. By using a fixed effects method, the unobserved time fixed effects are controlled for, which also reduced omitted variable bias.

Heteroskedasticity is also something that has to be checked, because this can make the estimates a lot less precise. The Wald- test shows a probability>chi-square of 0.00 (table 2),

which means that there is a very strong rejection of the null hypothesis that there is no joint significance of the variables. This means there is heteroskedasticity. To control heteroskedasticity the regressions are done with robust fixed effects (Greene, 2012).

Table 2
Modified Wald test for groupwise heteroskedasticity in fixed effects regression

	Coef.
Chi-square (3433)	6.5e+39
Prob>chi-square	.0000

The regression for this research is based on an ordinary least squares regression with fixed effects (Wooldridge, 2019, formula 14.22):

$$Y_{it} = \eta_1 + \alpha_2 d2_t + \cdots + \alpha_T dT_t + x_{it}\psi + \alpha_i + u_{it} \qquad (1)$$

The subscripts i and t represent each individual and every time period in the sample. Y_{it} in the formula represents the dependent variables. The dependent variable is 'number of cigarettes smoked per day'. The η_1 is the intercept, which shows the baseline situation in 2017. $\alpha_2 d2_t$ +...+$\alpha_T DT_t$ represent the time dummies. A_2, ..., α_T are the coefficient, which are multiplied by time dummies $d2_t$, ..., DT_t. There are time dummies for every year. The value of time dummy $d2_t$ is equal to 1 for the year 2018 and 0 for the other years, time dummy $d3_t$ is equal to 1 for the year 2019 and 0 for the other years, and so on until the year 2022. These variables show the impact of the time periods on the dependent variable. The term $x_{it}\psi$ captures all of the independent variables in x with their corresponding coefficient captured in the symbol ψ, with its coefficient for time period t and individual i. α_i includes the individual fixed effects. Individual fixed effects are factors which do not change over time and are linked to each individual. The residual u_{it} shows the difference between the expected value predicted by the regression and the revealed value of the dependent variable. It includes time variant factors that are not already included in the regression (Wooldridge, 2019). Two-way fixed effects models control for all differences between individuals that are time-invariant. This is for example gender or age. It cannot be used to research time-invariant factors, because they are fixed per

individual over time. This is why the variables mentioned in the theoretical framework are chosen. These variables are all time inconsistent, which is necessary to conduct a two way fixed effects study.

3.3 Operationalisation

This study looks at association instead of causation, which leads to the absence of a clear dependent and independent variable. Life satisfaction will be considered the main independent variable in the formula, while smoking behavior will be the dependent variable.

'Life satisfaction' describes how satisfied respondents are with their life at that moment. As mentioned in the previous chapter, life satisfaction is not based on one particular survey question. To best grasp every aspect of life satisfaction this variable will consist of six different variables measured: 'how do you feel in general?', 'in most ways my life is close to my ideal', the conditions of my life are excellent', 'I am satisfied with my life', 'I've gotten the things I want in life' and 'if I could live my life over, I would change almost nothing'. All of these variables are measured from a scale of 1 to 7. The mean of these variables is calculated to create the new variable 'life satisfaction', which also has a scale from 1 to 7. A score of 1 meaning being not satisfied at all with life and 7 being completely satisfied.

To measure the change in smoking behavior, the dependent variable is the 'number of cigarettes smoked per day'. This provides more information about the smoking population. This variable has been build by using two different variables. The first variable is 'do you smoke now?' and the second variable is 'how many cigarettes do you smoke per day?'. When respondents answered no to the first variable, this has been implemented in the data from the second variable as 0 cigarettes per day. This way, both smokers, ex-smokers and non-smokers are included. It creates a variable with a continuous scale instead of having a dummy dependent variable. The data provides values between –10 and 2000 cigarettes per day. To give a realistic estimate of the number of cigarettes smoked, outliers below 0 and above 60 cigarettes have

been changed to 'missing values'. The limit has been set to 60 cigarettes, because this was the highest number of cigarettes with more than ten observations, everything above this had less than ten observations. The average number of cigarettes smoked per day is approximately thirteen in 2012 (Ritchie & Roser, 2023). This makes the set limit of 60 cigarettes a reasonable cut-off.

As mentioned earlier in this chapter, the panel variables are 'individuals' and 'year'. The individuals variable is the variable 'nomem_encr' from the LISS panel. The time variable 'year' shows in which year the data was computed, which ranges from 2017 to 2022.

Multiple control variables are added to the equation to include as many factors as possible influencing smoking behavior. These control variables are: 'income', 'depression', 'anxiety', 'self-reported health' 'work' 'stress' and 'exercise'. The first control variable is 'depression'. This variable is measured with the LISS panel personality questionaire on a continuous scale of 1 to 6. Respondents answered '1' if they never felt depressed or gloomy and '6' if they continuously felt depressed or gloomy.

The second control variable is 'anxiety'. This variable is also measured on a continuous scale from 1 to 6. '1' Represents never feeling very anxious and '6' represents continuous feeling very anxious.

The third control variable is ' net income'. This variable is from the variable nettoink_f in the LISS Core Questionnaire, which results in less missing variables than the income variable used in the other LISS panel questionnaires. It shows the current net montly income and the values range from €0 to €232.020. There will not be any cut-offs in regard to income, because students can also fill in the questonnaire and might not have a job, thus not an actual income. The maximum income is difficult to correct, because there are people who earn a lot more than average, which can also give insight into their behavior. To accurately display the

income effect in the regressions, the variable scaled net income is created, which divides the net income by 1000.

The fourth control variable is 'exercise'. This is based on the question: do you practice sports? Because the question can only be answered with yes (1) or no (2) it is a dummy variable.

The fifth control variable is 'self-reported health'. This is measured with the Health questionnaire of the LISS panel. The question the respondents answered is: 'How would you describe your health, generally speaking?'. This variable is measured on a continuous scale from 1 to 5. 1 represents a poor subjective health and 5 represents an excellent subjective health.

The sixth control variable is 'work'. This variable is based on the following questions: 'How satisfied are you with your wages or salary or profit earnings?', 'How satisfied are you with your working hours?', 'How satisfied are you with the type of work that you do?', 'How satisfied are you with the general atmosphere among your colleagues?', 'How satisfied are you with your current work?'. All of the variables are measured on a scale from 0 (not at all satisfied) to 10 (fully satisfied). The variable 'work' is created by taking the mean of the five variables mentioned above. This variable has the same scale of 0 to 10.

The last control variable is 'stress'. This is based on the variable in the personality questionnaire 'I get stressed out easily'. This variable has a scale from 1 to 5. 1 being 'very inaccurate' and 5 being 'very accurate'.

The smoking behavior is measured for the years 2017 until 2022. These years are selected, because they give the best insight into the latest developments in smoking behavior. This means that the Covid-19 crisis is included as well. In January of 2020 the Covid-19 pandemic reached the Netherlands, which means that the years 2020, 2021 and 2022 are considered to be the 'post-covid period' and 2017, 2018 and 2019 as the 'pre-covid period'. These years are changed to the values 1 to 6 representing the years 2017 to 2022. These periods have been selected to test the second hypothesis.

The variable 'age' is added to test the third hypothesis. The values have been corrected for outliers. The ages conducted from the birthyears of the respondents ranged from 16 to 104 years old. Since the legal age to buy cigarettes is 18 years old in the Netherlands, this has been set as the minimum age of respondents. The maximum age has been set at 96 years old, because this is the last value with multiple respondents. Every value above 96 has been changed to missing. This cut-off provides enough respondents with a retirement age but corrects for incorrect data. For testing hypothesis 3, three regressions will be computed. The first one with the whole population, the second one with respondents aged 18 to 34 and the third one with respondents aged 65 and older.

3.4 Multicollinearity

Multicollinearity can be a problem, because independent variables can be correlated. This can give false estimates. To test multicollinearity the Variance Inflation Factor (VIF) is calculated, which can indicate to what extent the value of the dependent variable is influenced because of multicollinearity.

The VIF has been calculated for the dependent variable (table B1). This table shows a lot of multicollinearities. With a value higher than 5, a variable is too dependent on another variable. Multiple correlation tables have been drafted (table B2, B3 & B4) to remove variables until there is no multicollinearity anymore. The variables work satisfaction, subjective health, stress and depression had to be removed as control variables.

Analysis

This chapter is divided into two parts. In the first part the descriptive statistics are discussed. This is followed by the second part which discusses the regression tables and connects them with the literature review.

4.1 Descriptive statistics

Table 3 shows the means of life satisfaction and number of cigarettes smoked for the researched years.

Table 3
Summary statistics

	N	Mean
2017		
Mean number of cigarettes	7096	2.826
Mean number of cigarettes (excl. 0)	735	11.893
Mean life satisfaction	7096	5.127
2018		
Mean number of cigarettes	6288	2.646
Mean number of cigarettes (excl. 0)	600	12.077
Mean life satisfaction	6288	5.138
2019		
Mean number of cigarettes	5688	2.5
Mean number of cigarettes (excl. 0)	577	11.471
Mean life satisfaction	5688	5.153
2020		
Mean number of cigarettes	6588	2.424
Mean number of cigarettes (excl. 0)	617	11.438
Mean life satisfaction	6588	5.189
2021		
Mean number of cigarettes	5555	2.266
Mean number of cigarettes (excl. 0)	515	11.483
Mean life satisfaction	5555	5.132
2022		
Mean number of cigarettes	6574	2.191
Mean number of cigarettes (excl. 0)	564	11.507
Mean life satisfaction	6574	5.211

The mean number of cigarettes smoked ranges from 2.191 cigarettes per day to 2.826 cigarettes per day. This is a relatively small amount. However, this also includes all of the non-smokers. The mean number of cigarettes (excl. 0) shows the number of cigarettes smoked if

the value 0 is excluded. This immediately shows a much higher value in the number of cigarettes smoked. These values range from 11.471 cigarettes per day to 12.077 cigarettes per day.

Both life satisfaction and number of cigarettes have very small variations over time, which is why it is also displayed in figure 1, 2 and 3. Figure 1 shows the variation of life satisfaction over time. Life satisfaction has increased from 2017 to 2020 (0.06) and had a relatively large decrease (0.057) in 2021 and an even bigger increase after that in 2022 (0.079). This all happened during the Covid-19 pandemic in the Netherlands, which might explain the large decrease in life satisfaction and the increase in 2022 when the pandemic came to an end. The number of cigarettes smoked per day shows an overall decrease (figure 2). From 2019 to 2020 the decrease was a bit less than the years before, but from 2020 to 2021 the decrease was a little steeper. This image becomes very different if the value 0 is not included (figure 3). There is a spike in the number of cigarettes smoked in 2018, with a large decrease from 2018 to 2019. After that, the line is relatively flat, with a slight increase from 2020 onwards.

The number of observations also shows that the number of people who do not smoke is relatively equal over the years. In 2017 there are 6361 (7095-735) people who do not smoke, which is 89.65%. In 2022 this is 6010 (6574-564), which is 91.42%. This is a very small increase in non-smokers.
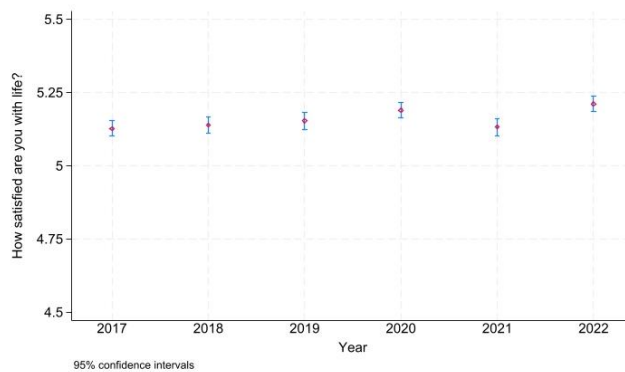
Figure 1
Mean life satisfaction over time

95% confidence intervals

Figure 2
Mean number of cigarettes smoked over time

95% confidence intervals
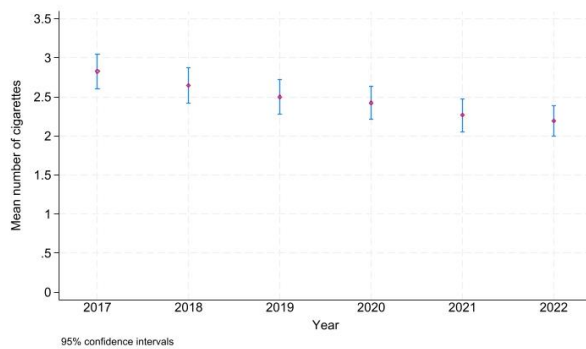
Figure 3
Mean number of cigarettes smoked over time (excluding 0)

95% confidence intervals
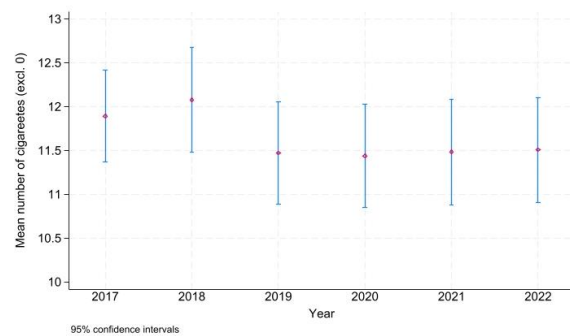
4.2 Regression analysis

As explained in the methods chapter, multiple models have been created to answer the three hypotheses. All of the models use fixed effects regressions, so this will not be mentioned any further in this analysis.

The first model is visible in table 4. This table shows the association between life satisfaction and smoking behavior. Three regressions have been executed. The first regression does not include any control variables, whereas the second and third do. When looking at the association between life satisfaction and smoking behavior, when the life satisfaction score increases with 1, the number of cigarettes smoked does also increase. However, in none of these models the relationship between life satisfaction and smoking behavior is statistically

significant. Model three does include all control variables. This shows that anxiety does have a significant effect ($p<0.05$). When anxiety increases with one factor (on the scale of 1 to 6), the number of cigarettes smoked decreases with .108 (SE = .046). This means that anxious respondents are smoking less than respondents who are less anxious. Exercise also has a significant effect on the number of cigarettes smoked ($p<.1$). People who exercise smoke .161 (SE = .094) less cigarettes per day than people who do not exercise. In all of the models in table 3, a downward trend in number of cigarettes smoked is visible when you look at the years. This effect is the strongest in model 3.

Because the goal of this research is to determine the relationship between life satisfaction and smoking behavior, the within R^2 will be used. This shows how well the variance in smoking behavior per person is explained by the independent variables over time. As more variables have been added, the R^2 increases. The third model has an R^2 of 1%, this means that 1% of the variance in the number of cigarettes that are smoked per day is explained by the independent variables. This is not very much. However, as mentioned in the methods chapter, multiple control variables had to be removed from the regression, because of multicollinearity. With these variables added, the R^2 would be .0198, which would be almost 2% (table C1).

Hypothesis 1 states that there is a negative association between life satisfaction and smoking behavior. The null hypothesis states that there is no association. Based on the results in table 4, the null hypothesis cannot be rejected. The results, however, show a positive association between the two variables, but this is not significant.

Table 4
Association between smoking behavior and life satisfaction

	(1) Number of cigarettes	(2) Number of cigarettes	(3) Number of cigarettes
Life satisfaction	.061	.075	.061
	(.059)	(.061)	(.062)
Scaled net income		.002	.002
		(.002)	(.002)
Anxiety			-.108**
			(.046)
Exercise			-.161*
			(.094)
2017			
2018	-.202***	-.217***	-.228***
	(.068)	(.069)	(.069)
2019	-.352***	-.369***	-.366***
	(.082)	(.082)	(.084)
2020	-.465***	-.496***	-.511***
	(.089)	(.091)	(.092)
2021	-.508***	-.519***	-.543***
	(.091)	(.093)	(.094)
2022	-.61***	-.645***	-.664***
	(.094)	(.094)	(.094)
Constant	2.454***	2.358***	2.717***
	(.306)	(.317)	(.338)
Observations	15576	14835	14460
R-squared	.008	.008	.01

Robust standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1
Note: Scaled net income is the net income divided by 1000.

The second model is visible in table 5. This model looks at the impact of the Covid-19 pandemic on the relationship between life satisfaction and smoking behavior. During and after the Covid-19 pandemic the association between the number of cigarettes smoked and life satisfaction is negative (-.071, SE = .081), while it is positive before the Covid-19 pandemic (.101, SE = .102). This would mean that because of the Covid-19 pandemic people who are

more satisfied with life smoke less. This is the other way around in the period before the pandemic. However, the association is not significant so this conclusion cannot be drawn.

The control variables anxiety and exercise are only significant in the period before the pandemic. People with anxiety smoke less cigarettes (-.161, SE = .066) than people without anxiety. Also exercising is linked to smoking less (-.349, SE = .165). Both with a level of significance of $p<.05$. There is also a difference between the R^2 of model 1 and 2 (table 5).

Table 5
Influence of the Covid-19 pandemic on the relationship between smoking behavior and life satisfaction

	(1)	(2)
	Number of cigarettes before Covid-19	Number of cigarettes during and after Covid-19
Life satisfaction	.101	-.071
	(.102)	(.081)
Scaled net income	0	.003
	(.002)	(.003)
Anxiety	-.161**	-.057
	(.066)	(.065)
Exercise	-.349**	-.02
	(.165)	(.118)
2017		
2018	-.285***	
	(.065)	
2019	-.355***	
	(.084)	
2020		
2021		-.03
		(.052)
2022		-.097
		(.064)
Constant	2.705***	2.725***
	(.524)	(.402)
Observations	7161	7299
R-squared	.01	.001

Robust standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Note: Scaled net income is the net income divided by 1000.

These models were drafted to test hypothesis 2, which states that during the Covid-19 pandemic the association effect of life satisfaction and smoking behavior increased. The null hypothesis cannot be rejected, because the relationship between smoking behavior and life satisfaction is not significant and there is a very low R^2, which means that only 1% (model 1) and 0.1% (model 2) of the variation is explained with the use of this model. On top of that, the hypothesis expected an increase in the association effect, but the effect became negative, while before the pandemic it was positive.

The sixth table shows the relationship between smoking behavior and life satisfaction for different ages. The first model is the same as the third model in table 4. The second model looks at people aged 18 to 34, while the third model looks at people aged 65 and older. The relationship between smoking behavior and life satisfaction is larger in model 2 (.135, SE = .339) than in model 1 and 3. The value in model 3 (.027, SE = .056) is even lower than for all of the respondents together. Interestingly, no values in model 2 are significant. In model 3, however, exercise has a higher significance (p<.01) than in model 1. Which means that people aged 65 and older who exercise also smoke .244 (SE = .094) less cigarettes per day. The R^2 is the same in model 3 as in model 1 (.01), model 2 has an R^2 a little bit higher (.011). Hypothesis 3 states that the association between life satisfaction and smoking behavior is only present for the age groups 18 to 34 and 65 and older. The null hypothesis that the association is the same for every age cannot be rejected.

Table 6
Differences between differences ages on the relationship between smoking behavior and life satisfaction

	(1)	(2)	(3)
	Number of cigarettes	Number of cigarettes for people aged 18 to 34	Number of cigarettes for people aged 65 and older
Life satisfaction	.061	.135	.027
	(.062)	(.339)	(.056)
Scaled net income	.002	-.259	0
	(.002)	(.216)	(0)
Anxiety	-.108**	-.233	-.039
	(.046)	(.182)	(.035)
Exercise	-.161*	-.054	-.244***
	(.094)	(.424)	(.094)
2017			
2018	-.228***	-.456	-.143**
	(.069)	(.346)	(.063)
2019	-.366***	-.023	-.255***
	(.084)	(.378)	(.072)
2020	-.511***	-.206	-.276***
	(.092)	(.394)	(.083)
2021	-.543***	.006	-.31***
	(.094)	(.483)	(.086)
2022	-.664***	-.341	-.415***
	(.094)	(.491)	(.093)
Constant	2.717***	3.648**	1.61***
	(.338)	(1.69)	(.307)
Observations	14460	1400	6621
R-squared	.01	.011	.01

Robust standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1
Note: Scaled net income is the net income divided by 1000.

Conclusion

The Dutch government is trying to reach a smoke-free generation in 2040. It has been trying to decrease the smoking rate with new policies for years. The smoking rate has dropped 10% since 2000. However, more needs to be done to reach a smoke-free generation. The number of cigarettes smoked per day decreased very little from 2017 to 2022, while life satisfaction increased slightly (table 3). This is why the relationship between life satisfaction and smoking behavior has been studied in this thesis. This present study was conducted with a fixed effects regression model with data from the LISS-panel to answer the research question: "To what extent is life satisfaction associated with smoking behavior in the Netherlands?"

There are three hypotheses drawn up to answer the research question. The first hypothesis is: "There is a negative association between life satisfaction and smoking behavior." Based on the two theories, Hedonism and the prospect theory, people who are satisfied with life value future losses higher than present gains from smoking. Grant et al. (2009) and Taheri et al. (2014) found significant data for students supporting this claim. Unfortunately, the regression results are not significant for this association, which means that the null hypothesis cannot be rejected, and it must be assumed that there is no association between life satisfaction and smoking behavior. Having anxiety or exercising is connected to smoking less cigarettes per day, which is in line with previous research done by respectively Shahab and West (2012) and Conway and Cronan (1992). The regression has a very low R^2, which means that the variables used in this research are only explaining 1% of the variance of the number of cigarettes smoked, which is not much.

The second hypothesis states: "During the Covid-19 pandemic the association effect of life satisfaction and smoking behavior increased." Based on the theories, the effect can move two ways. Almeda and Gómez-Gómez (2022) found that more people quit smoking than started smoking during the pandemic, which supports the hypothesis. The regression results show a switch from a positive association to a negative association between life satisfaction and

number of cigarettes smoked. However, both regression results are not significant, which means that the null hypothesis cannot be rejected. It has to be assumed that there is no change in the association effect of life satisfaction and smoking behavior. Anxiety and Exercise had a significant effect on smoking behavior before the Covid-19 pandemic, but it did not have a significant effect during and after the pandemic. The R^2 also decreased from .01 in the first regression to .001 in the second regression. This means that during and after the pandemic factors that were not included became more important in explaining smoking behavior.

The third hypothesis states: "The association between life satisfaction and smoking behavior is only present for the age groups 18 to 34 and 65 and over.". Xie et al. (2022) only found a significant association between life satisfaction and smoking behavior for people aged 18 to 34. When looking at the link with social and emotional support the effect was also significant for people aged 65 and older. The regression results show no significant associations for any part of the regression, which means that this null hypothesis can also not be rejected. There is no difference in association between life satisfaction and smoking behavior for different age groups. Where anxiety and exercise show a significant association with smoking behavior in the overall regression, when it is split into age groups, anxiety is not significant anymore and exercise is only significant for people aged 65 and older. The R^2 is again 0.1, so only a very small part of the variance in smoking behavior is explained by the variables.

To answer the research question, to no extent is life satisfaction associated with smoking behavior. This is contrary to the previous research on this subject.

5.1 Policy recommendation

The only statistically significant associations are between smoking behavior and anxiety and exercise. Anxiety is difficult to change to influence smoking behavior, but exercise is not. The Dutch government has been campaigning over the years to get people to exercise more. In a collaboration of multiple ministries, there has been a multi-year plan drafted to get

more people moving. This plan mentions a collaboration of sports and care facilities to help elderly people to stay active (Werkgroep Bewegen het Nieuwe Normaal, 2021).

These types of plans can help decrease the number of cigarettes that people smoke by stimulating them to start training and live a healthier lifestyle. This healthier lifestyle can also help to treat anxiety. Studies show that exercise can help prevent anxiety attacks and regulate your emotions better (Xiao, 2020; Ratey, 2019). This can help decrease the number of cigarettes smoked as well. The policy recommendation based on this research is investing money in exercise and promotion of exercise to stimulate a healthy lifestyle and decrease smoking.

5.2 Limitations and future research

This study contributes to the expansion of scientific literature looking into smoking behavior. The previous research discussed earlier all showed a significant effect between life satisfaction and smoking behavior. But, as already mentioned in the literature study, Grant et al. (2009) and Taheri et al. (2014) only included students, which can result in different outcomes than when the complete population is taken into account. Xie et al. (2022) did look at all ages and also only found a significant association for people aged 18 to 34, which means that these studies might have a limited contribution. This study uses the Students Life Satisfaction Scale from Huebner (1991) as a basis for the regressions, while most studies only use one indicator for life satisfaction. This can influence results by not including all aspects of life satisfaction. This may result in false positives, while this study shows there is no association between life satisfaction and smoking behavior.

This study can also have different results, because of its own limitations. This study uses a very broad life satisfaction variable, which makes it hard to add control variables that do not result in multicollinearity. This results in a very low R^2, which makes it hard to prove the hypotheses. It is more difficult to get a high R^2 in this type of research, because it is all

based on human behavior, which isn't always rational. For new research, a more specific independent variable might be better to get greater results. It is also advisable to check for more control variables that might be added to get a better picture of the factors that influence smoking behavior.

It might also be interesting to look more into the relationship between smoking behavior and exercising and having an active lifestyle, because that was one of the variables that had a statistically significant relationship with smoking behavior.

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Appendix A Hausman test coefficients

Table A1

Hausman (1978) specification test coefficients

	Coefficients			
	Fe (b)	Re (B)	Difference (b-B)	Squared std. Err.
Life satisfaction	.0428	-.1439	.1868	.0203
Anxiety	-.0914	-.0327	-.0587	.0133
Net income	-7.98e-07	-5.91e-06	5.11e-06	3.54e-06
Exercise	-.1157	-.3835	.2678	.0327

Appendix B Multicollinearity

Table B1
Variance inflation factors (VIF)

Variables	VIF (1)	VIF (2)	VIF (3)
(1) Work satisfaction	35.78		
(2) Life satisfaction	35.72	17.67	4.60
(3) Subjective health	20.76	17.46	
(4) Anxiety	9.15	3.73	3.65
(5) Stress	8.32		
(6) Depression	8.03		
(7) Income	4.91	1.30	1.30
(8) Exercise	2.32	2.02	1.95
Mean VIF	15.62	8.44	2.88

Table B2
Matrix of correlations (1)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Number of cigarettes	1.000								
(2) Life satisfaction	-0.063	1.000							
(3) Depression	0.008	-0.414	1.000						
(4) Anxiety	0.017	-0.298	0.580	1.000					
(5) Net income	-0.073	0.125	-0.112	-0.117	1.000				
(6) Exercise	-0.186	0.115	-0.027	0.026	0.096	1.000			
(7) Subjective health	-0.085	0.324	-0.272	-0.233	0.101	0.190	1.000		
(8) Work	-0.053	0.396	-0.203	-0.164	0.182	0.057	0.180	1.000	
(9) Stress	-0.004	-0.227	0.349	0.425	-0.172	-0.001	-0.164	-0.171	1.000

Table B3
Matrix of correlations (2)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Number of cigarettes	1.000					
(2) Life satisfaction	-0.109	1.000				
(3) Anxiety	0.052	-0.355	1.000			
(4) Net income	-0.032	0.040	-0.036	1.000		
(5) Exercise	-0.134	0.126	-0.014	0.031	1.000	
(6) Subjective health	-0.069	0.385	-0.258	0.020	0.211	1.000

Table B4

Matrix of correlations (3)

Variables	(1)	(2)	(3)	(4)	(5)
(1) Number of cigarettes	1.000				
(2) Life satisfaction	-0.109	1.000			
(3) Anxiety	0.052	-0.355	1.000		
(4) Net income	-0.032	0.040	-0.036	1.000	
(5) Exercise	-0.134	0.126	-0.014	0.031	1.000

Appendix C Regression with multicollinearity

Table C1

Regression with all control variables

	(1) Number of cigarettes smoked per day
Life satisfaction	.097
	(.109)
Scaled net income	.014
	(.109)
Anxiety	-.18*
	(.099)
Exercise	-.043
	(.168)
Work	.084
	(.064)
Depression	-.156*
	(.083)
Subjective health	.126
	(.12)
Stress	-.111
	(.095)
2018	
2019	-.41**
	(.164)
2020	-.626***
	(.166)
2021	-.556***
	(.173)
2022	-.802***
	(.18)
2017	2.507***
	(.913)
Observations	4983
R-squared	.0198

Robust standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1*

Note: Scaled net income is the net income divided by 1000