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Title: Moving on after a break-up with your familiar living environment. The effect of moving to another degree of urbanization on drug usage

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Inhoudsopgave

ABSTRACT

This thesis researches the effect of a change in someone's urban living environment on the number and types of drugs used by citizens in the Netherlands. The outcomes can be used to develop more targeted approaches to educate citizens about the health risks of drug usage in specific urban living environments. As little earlier research is available about the topic, this thesis contributes to existing literature. It is also socially relevant as the government is spending a lot of money on law enforcement, safety and consequently health care costs. The central research question is: *What is the effect of a change in the degree of urban living environment on the frequency and types of drugs used by citizens in the Netherlands?* This is investigated with data from the LISS panel set of the years 2016 and 2019 in the Netherlands. Moving to a more urbanized area is associated with a decrease in the number of times drugs and legal drugs were used and an increase in the number of illegal drugs used. Moving to a less urbanized area is associated with a decrease in the number of times drugs, legal drugs and illegal drugs were used. These are no causal effects as they were not significantly affected at the 10% significance level by a change in the degree of urbanization of an individual, ceteris paribus. In addition, the results show that respondents living in extremely urban areas used significantly, at a 10% SL, on average 0.416 more times drugs a month than those living in non-urban areas, ceteris paribus. Hence, as there are some limitations to this thesis, the results should be interpreted with caution.

Keywords: risky health behavior, drug usage, urban living environment, relocation

INTRODUCTION

The number of citizens living in urbanized living environments has increased rapidly in the last decades. According to the most recent revision of world urbanization already 55% of the world population lived in urban areas by 2018 (UN, 2019; WHO, 2021). In Europe, this was even 74% at that time. The two largest cities in the Netherlands, Amsterdam and Rotterdam, both have a population of over one million inhabitants (UN, 2019). These increases can be explained by the rapid growth of the overall population and an increased shift of people moving from rural to urban areas (UN, 2019). Migration is supported by seeking a better quality of life in cities, like improved employment opportunities (Lawrence, 2013).

As more people move to cities and live closely together their social context changes. This might cause challenges for maintaining a good quality of the citizens' mental health, physical health and well-being. Urban environments do play an essential role in how the health and wellbeing of people is shaped (Bai et al., 2012). Risky health behaviors like drug use might be closely related to the address density of an individual's living environment (Abraham, 1999). It is assumed that the higher the address density of a place, the higher the level of urbanization.

In the Netherlands, drug use is not uncommon. Almost a quarter of the population, 22.9%, indicate to ever have used cannabis in their lives (RIVM, 2021). This presents that many inhabitants got into contact with drugs ever. Drug use and a person's living environment might be related to each other. Statistics Netherlands (CBS) collects data with the *Gezondheidsenquête* about the health condition of Dutch citizens (RIVM, 2015). Statistics about the populations' drug use, shown by different demographic and socioeconomic characteristics, are presented yearly. For 2019, they presented that the higher the level of urbanization, the more citizens self-reported to have ever used drugs in their lives. 27.8% of the respondents living in 'high urban', 18.4% in 'middle urban' and 16.3% in 'not urban' areas reported having used cannabis (RIVM, 2021; Van Laar et al., 2021). Regarding illegal types of drugs 14.5% of the respondents of the 'high urban', 9.6% of the 'middle urban' and 7.8% of the 'not urban' area reported having used it.

This indicates that the level of urbanization, measured as address density per km^2, might be a determining factor for drug usage. However, as the CBS presents only statistics no causal conclusions can be drawn. This thesis distinguishes from earlier research by investigating the causal effect of the degree of peoples' urban living environment on the frequency and types of drugs used by citizens.

Little research is done on the effect of moving between different levels of urbanized areas on drug usage. An earlier Indonesian study found an increased level of smoking for rural-to-urban migrators with longitudinal data (Lu, 2010). However, little to no recent literature can be found with regards to the moving effect in the Netherlands. As being the first to investigate health differences caused by geographical drift, Verheij et al. (1998) studied urban and rural citizens, and both way movers with Dutch data from the early 1990s. They found that movers (both ways) are healthier than stayers. Only, when they accounted for demographic and socioeconomic characteristics, a contrary result was found. Thus, when controlling for these characteristics, suburbanization cannot explain the bad health of people living in urbanized areas. Most of the health differences are accounted for by the characteristics. Hence, as their investigated data is dated nowadays and only data from one city and its surroundings are researched, new research in another time period and/or region is relevant.

This thesis is scientifically relevant, because in the first place it studies the causal effect of the degree of people's urban living environment on drug usage. Earlier literature only shows associations between the level of urbanization and drug use. Secondly, it researches the effect of a change of urban living environment on drug usage. More citizens move to more urbanized areas in the Netherlands (UN, 2019). The outcome of this effect allows us to learn about the development of the population's national drug usage. More insights in urban-rural health differences can be gained and used to design policies to create more awareness about the health risks of drug usage among certain groups of citizens.

This thesis is socially relevant, because it helps to gather more information about possible differences between different urbanized areas. A more elaborated scale will be studied than Statistics Netherlands did for their associations, namely five instead of three categories. Different policies can be designed for each level of urbanization to tackle the health risk problem as efficiently as possible. The outcomes can be used to develop more targeted approaches to educate citizens in specific urban living environments. When providing information about the health risks of drug use, people are discouraged to use them. This can be done in multiple ways, for instance, information sessions at schools for youngsters might be effective. Health education in schools is a good tool in the prevention and reduction of adolescent health problems (Hawkins & Catalano, 1990). Other means are for instance flyers at local shops or campaigns.

This thesis is socially relevant as well, because reducing drug usage might reduce related costs with regards to, among others: prevention, safety, and heavy users' health care costs. Based on more

elaborated information about the usage among different levels of urbanization, policies can be designed to tackle (heavy) drug usage more efficiently.

According to the Netherlands Country Drug Report 2019, 1.4% of the adults were high-risk cannabis users in 2016 (European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), 2019b). The prevalence rates of crack cocaine use ranged between 1.6-2.2 per 1000 inhabitants in 2013. It presents that every high-risk drug user is still one too many. Research shows that chronic drug users consume significantly more emergency and inpatient care than non-drug users. The excess of their total health care costs is generated to about $1000 relatively compared to non-drug users in the US (French et al., 2000). Thus, a reduction of high-risk users will lower health care costs. These costs are mostly funded by society as a whole in the Netherlands. Consequently, diminishing these is of social relevance.

Additionally, a reduction in drug usage can also result in fewer disturbances at public places, nightlife, less vandalism, or other negative externalities. 4% of the Dutch population reported that they experienced a lot of nuisances from drug usage and drug trafficking in 2019 (CBS, 2020). Fewer disturbances will reduce social costs as well. Economic costs of drug abuse in the US with relation to criminal justice, private safety and social welfare administration show an increase of 11 million US$ over six-year time to 32 million in 1998 (Cartwright, 2008).

The most recent estimation available on public expenditures on total drug-related actions in the Netherlands is dated. It assessed the expenditures at 0.5% of 2003's gross domestic product of 454.3 billion euros, accounting for roughly 227 million euros (EMCDDA, 2019b; CBS, 2004). 2% is used for prevention, most of it is for law enforcement and the remainder for treatment and harm reduction (EMCDDA, 2019b). More recent data reported that the total public expenditures in Belgium were estimated at 470 million euros in 2015 (EMCDDA, 2019a). Thus, the consequences of (heavy) drug use may cause a need for high expenses for society as a whole. Reducing these costs is of social relevance.

The central research question of this thesis is:

"What is the effect of a change in the degree of urban living environment on the frequency and types of drugs used by citizens in the Netherlands?"

Based on earlier literature it is expected that age and income will play a determining role as mechanisms. As it seems that the frequency of use might depend on the age of the respondents (Lambert et al., 2007; Coomber et al., 2011; Rhew et al., 2011). Also, the age of onset is influenced by

urban characteristics (Palali & Van Ours, 2015). Or on the other hand, age did not seem to play a role in the effect of urbanization on illicit drug usage (Abraham, 1999). This thesis will control for that to determine whether an effect can be found. Income is expected to play a role, as on the one hand it might be related to educational attainment and may lead to less drugs being used. On the other hand, a higher usage level might be caused by more spare money (Patrick et al., 2012). Thus, the role this variable plays is interested. Controlling for demographic and socioeconomic characteristics is interesting as these might play a determining role on the results like in the study of Verheij et al. (1998).

In order to answer the question, the Ordinary Least Squared (OLS) method will be used to conduct multiple linear regression analyses with Dutch data of the Longitudinal Internet Studies for the Social Sciences (LISS) panel set.

The study is structured as follows: first, a description of existing literature is provided, the shortcomings of it and the hypotheses are presented. Then, the context of drug policy in the Netherlands is discussed and compared with the policy in the United States (US) – which is the main context studied in earlier literature. Furthermore, the dataset and methodology of the study are described. These are followed by the results of the analyses. A summary of the study is given in the conclusion. Lastly, the limitations and recommendations for further research are described in the discussion.

THEORETICAL FRAMEWORK

The theoretical framework will present earlier Dutch and American empirical evidence on the topic. American research is investigated as well, because a lot of literature about the topic is available. Also, even though the drug policies in both countries differ, the US might give an indication for research as both countries are Western. These differences are presented to shed light on the usefulness of earlier American literature. Additionally, the historical background of the drug policy and the current context in the Netherlands are presented.

EMPIRICAL EVIDENCE

The distance to the nearest cannabis shop matters for the age of onset of cannabis use by youngsters (Palali & Van Ours, 2015). They investigated this effect with data from 2008 of the Dutch LISS panel set. They found that the onset age is lower for respondents living within a radius of 20 kilometers from a municipality with a cannabis shop than for those living more than 20 km away from a municipality with a cannabis shop. Palali and Van Ours (2015) also concluded that coffee shops are not randomly distributed across the country. By 2007, the two Dutch cities Amsterdam and Rotterdam contained more than 60 shops each, which was the highest number for a municipality at that time. There are more shops located in larger municipalities. With the outcomes they presented that the size of the municipality, measured as its population, is highly significant for the number of cannabis shops in the municipality.

The expectation follows that there are more coffee shops in more urbanized areas, as it is assumed that larger cities do have a higher degree of urbanization. This might result in more drugs being used among citizens living in more urbanized areas. This can be caused by lower transaction costs when a coffee shop is nearer, which lowers the threshold for people living in more urbanized areas to try out drugs (Palali & Van Ours, 2015). American urban residents self-reported to be more often approached for illicit drug purchases than rural residents (James et al., 2002). This suggest that they might be more likely to try drugs out as they are confronted with it more often. Another reason can be that citizens watch others using drugs daily. For instance, if they smell cannabis being smoked when walking the streets. This may lead them to think subconsciously that the negative health effects and risks are overrated. Being exposed to risky health behavior may lead to underestimate the negative health effects of it. Pollack et al. (2005) showed that being exposed to the availability of alcohol can influence its use among young people and also affect rates of alcohol-related injury. In conclusion, based on these studies, it is expected that the usage of (illicit) drugs are higher in more urbanized areas.

Another result of the study conducted by Palali and Van Ours (2015), is that it can follow from the analysis that when youngsters move from areas without a cannabis shop in the radius of 20 km to areas with one, their age of onset of cannabis use can be influenced by this. Hence, if they had never used cannabis before moving, they are more likely to start using it after they relocated. Considering there are more shops in more urbanized areas, an outcome indicating that young respondents who moved to a more urbanized living environment start using cannabis earlier in life might not be surprising. Thus, the number of times drugs are used by them might increase.

The idea that the abundance of coffee shops in more urbanized areas is associated with more usage among nightlife visitors is refuted by Wouters et al. (2012). Their study done among nightlife visitors in the Netherlands showed that the prevalence of cannabis use or intensity of use was not linked to the proximity to a shop. Additionally, hard drug usage was neither directly linked to the proximity of the shops. It did not matter if a respondent went out close to a coffee shop or not, the use and intensity of hard drugs were comparable at places with a high or low proximity to a coffee shop.

Urbanization is positively related to drug prevalence rates based on a national household survey in the Netherlands in 1997 (Abraham, 1999). This study states that illicit drug use was higher among respondents from living areas with a higher address density. The differences in usage between different degrees of urbanized living environments could not be explained by gender or age. This is partly in line with an American study by Gfroerer et al. (2007). They researched past month illicit drug usage and concluded that adults living in rural areas had lower usage rates than those who lived in urban areas. Past year illicit drug use was similar among adults in all types of urban living environments. Only ecstasy usage was higher in the highest levels of urbanization compared to the lowest.

When people use soft drugs, they may be more likely to try out hard drugs as well. The study of Wouters et al. (2012) presented that first use of cannabis under 13 years old is an important predictor of later hard drug usage. A study among high school students in Amsterdam found that in almost all cases youngsters who had ever used the party drug ecstasy had experiences with other drugs like cannabis as well (Dijkshoorn et al., 2017). Drugs like ecstasy and cocaine are regularly used in combination with other drugs (Van Laar et al., 2021). This might result that people try out multiple drugs or are more likely to try out other types of drugs when they are already using drugs.

A slightly different result was found when the behavior of young American teenagers was researched. Youngsters between 12 and 17 years old from the same data sample investigated in the research of Gfroerer et al. (2007) are studied separately in the research of Lambert et al. (2008). They reported

that respondents living in urban areas were less likely to be involved in illicit drug use than the respondents living in rural areas. This is supported by a study that investigated American and Australian teenagers of 12 till 15 years old on multiple risky health behaviors (Coomber et al., 2011). The results present that those living in rural areas used significantly more cannabis than those living in urban areas. This outcome is in line with a study that researched youngsters living in three different urbanized living environments in the US (Rhew et al., 2011). They found that the prevalence of illicit drug use among high school-aged respondents was higher for those living on farms in comparison with those living in towns. This is in contrast with research done by Cronk and Sarvela (1997), who investigated differences between urban and rural living environments on past month drug use trends for over fifteen years among high school students in the US. They showed that the usage changed in that timespan. Overall substance use declined and, at the end of the study in 1992 the usage rates were comparable for urban and rural students.

Hence, as the teenagers who participated into these aforementioned studies were young and the studies are a bit dated as well, the samples used might not be representative enough for Dutch adults nowadays. In contrast, Abraham (1999) and Gfroerer et al. (2007) researched the effect of urbanization on adults' drug usage. That is why the expectations are mainly based on these two researches. When investigating the studies of Palali and Van Ours (2015) and James et al. (2002) it is expected that adults living in more urbanized areas are more likely to try out and use drugs more frequently. To verify earlier research done with more recent Dutch data and to determine whether the earlier described associations of Statistics Netherlands might be causal effects, the first hypothesis follows:

The higher the degree of someone's urban living environment, the more frequently drugs and more different types of drugs someone uses, when investigating citizens in the Netherlands.

It is expected that when someone moves to a more urbanized area, his or her drug usage and the number of types of drugs increases based on the study of Palali and Van Ours (2015). Based on this expectation the second and also the last hypothesis follows:

When someone moves from a less urbanized living environment to a more urbanized living environment in the Netherlands, drugs will be used more frequently, and more different types of drugs will be used. An opposite effect is expected to be found for respondents moving from a more urbanized living environment to a less urbanized living environment.

Reasons for people to move are according to a British study by Coulter and Scott (2015) that people are more likely to move for 'targeted' than for 'diffuse' reasons. The first one relates to educational or job opportunities and the latter to reasons like area characteristics, as nicer weather for instance. The ties someone has with work and family, more 'targeted' reasons, are determining factors in the decision of whether to move or stay in a specific area, as stated by Fischer and Malmberg (2001). In addition, they report that age-specific migration patterns are mainly influenced by the distribution of life projects like going to college, moving in together, or becoming parents. Based on this, it is expected that respondents are more likely to move due to 'targeted' reasons. As moving for job opportunities is also correlated with factors like income and income might influence one's drug usage as well, this variable will be controlled for.

Relocating might also influence the frequency and types of drugs someone uses, as already described. The study by Palali and Van Ours (2015) indicated that the distance to a cannabis shop matters for the onset age of cannabis use. In addition, according to Abraham (1999) urbanization affects drug usage level and thus a relocation might as well.

CONTEXT OF DRUG POLICY

The Dutch drug policy context will be presented to inform the reader, as this specific policy distinguishes itself from those in other countries. A comparison with the American policy context is made to shed light on the differences and to show the usefulness of taking earlier research from the US into account. As a lot of earlier literature described is American.

Historical introduction of the Netherlands

The first two laws regarding the sale of soft drugs in the Netherlands were introduced in the early 1900s. At first, the cannabis market was mostly underground. Later, the government tolerated house dealers in youth centers. In 1976 one main Opium Law was designed. This law separated soft and hard drugs by making two lists. List I presents the hard drugs and List II the soft drugs (Opiumwet, 1928; Rijksoverheid, 2021). For the latter, the health risks involved are only a few, if any, unlike the risks that may occur from the use of hard drugs (Van Solinge, 1999). This distinction is made to be able to address different legalization for both types. When users can buy soft drugs in the coffee shop, they will not get into contact with hard drugs and the crime scene of it. This is one of the main intentions that caused the creation of the quasi-legalized policy. Along with this act, coffee shops were introduced. Coffee shops can be preferred to the illegal market by the government, because they provide a legal and reliable source of soft drugs (Wouters et al., 2012). In the absence of a shop, individuals may buy cannabis mostly via friends or dealers. However, this practice is illegal.

The Dutch system is well-known for its tolerated policy regarding the use of soft drugs. While the use of hard drugs is illegal, the use of soft drugs is quasi-legalized (Palali & Van Ours, 2015). The use of soft drugs is not considered an offense and having drugs in your possession is a misdemeanor up until 5 grams of cannabis (Openbaar Ministerie, 2021). However, carrying a higher amount of cannabis is considered a criminal offense (Palali & Van Ours, 2015; Korf, 2002). You are allowed to buy only small quantities of the soft drug cannabis, either prepared in a so-called space cake, pre-rolled in a joint or in absolute quantities.

Selling drugs is officially a crime, but the sale of soft drugs is regulated. Small-scale dealing is not prosecuted if coffee shops take certain rules into account (Korf, 2002). The shops are nowadays only allowed to sell to Dutch residents above the age of 18 with a maximum of 5 grams of soft drugs per day per person. The sale of hard drugs is prohibited (Rijksoverheid, 2021). The street scene may make it look like selling is legalized to citizens in the country and may make hard drugs more accessible, although this is not the case (Korf, 2002). The fact that soft drugs can be bought at coffee shops is common knowledge.

At the same time, the production and supply of soft drugs to coffee shops is illegal (Korf, 2019; Rijksoverheid, 2021). This inconsistency has been ignored for a long time. The debate about the regulation of supply to create a closed circuit is still going on. In November 2019 the Senate approved the bill which makes the cannabis legalization experiment possible (Rijksoverheid, 2019). The experiment will be done in ten municipalities to determine whether legalization of supply, making purchases, and selling cannabis are desirable by the government (Rijksoverheid, 2021).

Difference between Dutch and USA drug policy

In the USA the laws regarding medical and recreational drug use differ per state. By July 1st, 2021, eighteen states and the District of Columbia legalized recreational marijuana for adults aged 21 years and older (NORML, 2021). It is legalized to possess up to 1.5 ounces in public and have 5 ounces at home. Public policy that regulates marijuana instead of criminalizing it, is more popular. That is why more states follow, the social basis seems to be broad enough.

Due to many American influences on Western society, among others via film and music, the outcomes, influences, and lessons of American empirical research might be somewhat adaptable in the Netherlands context. This can be supported with the idea that countries that are not systematically different from the US are expected to have comparable observations and outcomes regarding the relation between urbanization and drug use (Galea et al., 2005). The Netherlands, as a western

country, can be considered to be not systematically different and thus some results from earlier literature, like for instance the study of James et al. (2002), might be comparable.

DATA

DESCRIPTION OF THE DATASET

The data used for this thesis are from the Longitudinal Internet Studies for the Social Sciences (LISS) panel set. The LISS panel collects data from the Dutch population and is in full operation since October 2007 (CentERdata, 2021). It investigates all kinds of subjects that influence the daily lives of citizens. The data are used for scientific, societal, and policy-relevant research. The panel is based on a true probability sample of households drawn from the population register by the CBS. This means that every Dutch household has the same probability of being invited by CentERdata to participate in the research. It is not possible to sign up for the panel yourself. Therefore, the data present a representative group of the population considering people with all kinds of backgrounds and from all levels of society. Respondents are at least 16 years old. Those with no computer and internet connection are provided with one to be able to participate. The LISS panel contains data from about 5,000 households and around 7,500 individuals all over the Netherlands. The panel members can answer short online questionnaires monthly and are paid for each completed questionnaire.

SELECTION OF THE SAMPLE

To be able to determine whether a respondent moved to another degree of urbanization, data from the background variables of the LISS panel set from November 2016 and November 2019 will be researched. To determine the effect on drug usage, data from November 2019 will be investigated. The year 2019 is chosen because it is the most recent point in time at which the COVID-19 pandemic did not play a role in the Netherlands yet and, consequently the results will not be influenced by this exceptional situation.

The timeline of three years is kept short, because it is expected that a new living environment influences someone's health behavior already in the short term. Strong evidence of independent neighborhood effects on health outcomes that can develop relatively quickly, such as health-related behaviors, are found (Ellen et al., 2001). Thus, when someone relocates, it is expected that the new neighborhood might influence someone's health, especially conditions that are most immediately responsive to influences, like drug use, in the short term. It is not expected that the effects of moving to another area kick in just after multiple years. That is why 2016 – three years before the outcomes are observed – is chosen.

The moving groups are investigated prior to the analysis whether they are large enough to be informative, and this is the case. The groups also do not differ too much in characteristics beforehand

based on the results of t-tests, which will be presented later on, to be able to draw conclusions based on it. Thus, the timespan of three years seems reliable enough.

METHODOLOGY

SPECIFICATION OF THE MODEL

First, the inclusion of the control variables will be discussed. Their inclusion is motivated by links to previous literature. Then, the regression analyses that will be used for both hypotheses are mathematically specified.

Inclusion of control variables

In all regressions, control variables are included. These are someone's age, gender, number of children, level of education, personal net monthly income, and origin, as these might influence both the outcome variable and people's decision where to settle down or their moving behavior. This is motivated by literature. They are included to create an outcome as unbiased as possible.

Age and gender are included to verify the conclusions based on the research of Cronk and Sarvela (1997), Abraham (1999) and Palali & Van Ours (2015). In this thesis, gender is expected not to significantly impact drug usage. Research by Cronk and Sarvela (1997) stated that the found trends were similar for both sexes. In addition, Abraham (1999) concluded that the differences in usage between different degrees of urbanized living environments could not be explained by gender and age. In contrast, Palali and Van Ours (2015) found that women start using cannabis at a later age than men. It is not expected that this variable does influence moving behavior, however, it is included to verify the earlier findings.

Someone's age might influence someone's drug usage. The studies of Lambert et al. (2008), Coomber et al. (2011) and Rhew et al. (2011), presented different outcomes regarding the relation of urbanization and drug use for young teenagers than the study of Gfroerer et al. (2007) found among adults. Young people might want to explore more and try new things out with their friends. Individuals can also affect each other's preferences directly (Manski, 2000). Thus, individuals who use drugs may affect others directly to start using drugs as well. Also, someone's age might be a reason to migrate to a more urbanized living environment, for example when attending a college or university located in a city (Fischer & Malmberg, 2001). In addition, age, gender and migrant status are stated to be determining in the decision for people to move, as concluded by De Groot et al. (2011).

The number of children an individual has might affect his drug usage. Individuals might feel more responsible if they do have (more) children and consequently might use fewer drugs. If and how many children someone has might also partly affect the neighborhood someone settles down. In the stage

of child-rearing, people consider characteristics of neighborhoods like safety and the presence of green space, playgrounds and schools important (Bootsma, 1998). Individuals without children are less restricted by this. Financial possibilities do play a role as well. Someone's preference, as well as their household or housing trajectory, are triggers in the decision of relocating and where (Mulder & Hooimeijer, 1999).

Origin is included to validate a statement of Palali and Van Ours (2015), namely migrant status was insignificant in their study. Someone's origin is often related to someone's religion. People from different origins might have different religions and, consequently another view or opinion on drug use. Also, citizens with the same origins, religions or interests may grow close to each other and spend time in for instance communities. Strong communities with a high proportion of drug users, make it more likely that people will influence each other to use drugs, because people meet often and may in this way influence each other's behavior (Flowerdew et al., 2008). Thus, people in communities might have a large influence on each other. Just like someone's social network might encourage or discourage drug use (Galea et al., 2005). In addition, people who know one person who uses cannabis are significantly more likely to start using cannabis earlier on in their lives compared to people who do not know any users. Citizens who know several others who use it, are even more likely to start using cannabis early in life themselves (Palali & Van Ours, 2015). Bloomfield and Stock (2013) stated that gender and religious affiliation might affect someone's drug use. In addition, someone's origin might play a role in the decision where to settle down. Therefore, I will control for this indicator.

Someone's level of education and personal net monthly income are also included. These might relate in the first place. With a higher educational attainment, the chance of earning more is higher, which partly determines the number of affordable houses and, thus might be correlated to the probability of moving. Income conditions if someone actually relocates (Mulder & Hooimeijer, 1999). How much someone earns partly determines the neighborhood and the kind of house someone lives in. When earning more, one can afford a more expensive house in a more expensive neighborhood. These two factors might also be related to drug use. Higher educated individuals might be more aware of the health risks occurring with drug use and use drugs less frequently than less educated. An additional year of education is associated with a 0.1 percentage point lower probability of having used marijuana in the past year by an individual according to the research of Cutler and Lleras-Muney (2010). They also investigated the effect with income added. An additional year caused a 0.2 percentage point lower probability of having used marijuana in the past year. In contrast, Patrick et al. (2012) found that respondents in the highest income group used significantly more drugs in the past year compared to respondents in lower income groups. Earning more money might on the one hand be affected by a

higher education and, thus negatively influence one's drug usage. On the other hand, earning more can also cause that people have more spare money to spend on, for instance, drugs. I include net monthly income and educational attainment to verify these indicators.

Specification of the first model

The approach of this thesis will be empirical. To answer the first hypothesis, considering what the effect is of different degrees of urban living environment on the frequency and types of drugs used in 2019, multiple regressions will be conducted. The results of the analyses will be compared to investigate whether the level of urbanization affects drug use.

The first regression estimates the effect of the degree of urbanization on the total number of times drugs were used last month by the respondents. The second and third regressions estimate the effect on the number of times legal and illegal drugs were used respectively. The following formula presents the regression function for a certain individual i with the variable of interest, with 'not urban' taken as the reference category, and all control variables included. Y_i presents the outcome variable: the total number of times drugs were used or separated to the types; legal and illegal drugs.

$$Y_i = \beta_0 + \beta_1 * Extremely\ urban_i + \beta_2 * Very\ urban_i + \beta_3 * Moderately\ urban_i + \beta_4 * Slightly\ urban_i + \beta_5 * Gender_i + \beta_6 * Age_i + \beta_7 * Children_i + \beta_8 * Income_i + \beta_9 * vmbo_i + \beta_{10} * havo\ vwo_i + \beta_{11} * mbo_i + \beta_{12} * hbo_i + \beta_{13} * wo_i + \beta_{14} * first\ gen.,Western_i + \beta_{15} * first\ gen.,non\ western_i + \beta_{16} * second\ gen.,Western_i + \beta_{17} * second\ gen.,non\ western_i + \varepsilon_i$$

Specification of the second model

In the second hypothesis, the effect of moving on the frequency and types of drugs used will be investigated. First, a categoric variable, separating three groups is created: respondents who did not move to another degree of urbanization, those who moved to a more urbanized area, and those who moved to a less urbanized area. All measured between November 2016 and 2019. The difference in how many levels of urbanization a respondent moved is not taken into account. A difference in the effect is not expected to be relatively large when someone moves an extra degree compared to someone else, regarding the fact that there are just five categories.

A cross-sectional study will be done to research the effect of moving to a different degree of urban living environment in the timeline, compared to respondents who stayed in the same level of urbanization, on the frequency and types of drugs used last month by citizens. The results of the three

analyses will be compared to investigate whether drug use is affected by a change in the level of urbanization.

The following formula presents the regression function for a certain individual i with the variable of interest, with 'not urban' taken as the reference category, and all control variables included. Y_i presents the outcome variable: the total number of times drugs were used or separated to the types; legal and illegal drugs.

$$Y_i = \beta_0 + \beta_1 * Moved\ less\ urban_i + \beta_2 * Moved\ more\ urban_i + \beta_3 * Gender_i + \beta_4 * Age_i + \beta_5 * Children_i + \beta_6 * Income_i + \beta_7 * vmbo_i + \beta_8 * havo\ vwo_i + \beta_9 * mbo_i + \beta_{10} * hbo_i + \beta_{11} * wo_i + \beta_{12} * first\ gen., Western_i + \beta_{13} * first\ gen., non\ western_i + \beta_{14} * second\ gen., Western_i + \beta_{15} * second\ gen., non\ western_i + \varepsilon_i$$

SPECIFICATION OF THE VARIABLES

Dependent variables

The dependent variable *Drugs* was created which indicates the summation of the number of times drugs were used last month in 2019. The variable *Legal* is made, indicating the summation of the number of times legal drugs were used last month in 2019. Among legal drugs belong sedatives (as valium) and soft drugs (as hashish and marijuana). The last dependent variable is the created one *Illegal,* indicating the summation of the number of times illegal drugs were used last month in 2019. Ecstasy, hallucinogens (as LSD and magic mushrooms) and hard drugs (as stimulants, cocaine and heroin) belong to this group. The last month indicates October 2019.

When someone indicated not to have used drugs, the questions regarding the amounts of all types of drugs used were not asked and consequently reported as missing. These are renumbered to zero. In addition, two observations were dropped from the dataset due to missing values.

Independent variables

The variable of interest of the first hypothesis is the categoric variable *Urban*, indicating the degree of urbanization based on surrounding address density per km^2. The answer possibilities are [extremely urban, very urban, moderately urban, slightly urban, not urban], with densities of respectively: 2500 or more; 1500 to 2500; 1000 to 1500; 500 to 1000; less than 500 addresses per km^2. The category 'not urban' will be used as reference category.

The created variable of interest of the second hypothesis is *Diff_urban* and presents if a respondent moved to another degree of urbanization between November 2016 and November 2019. Three groups are identified; respondents who moved to a more urbanized area (MU), those who did not move to another degree of urban living environment, and lastly those who moved to a less urbanized area (LU), presented with [1; 0; -1] respectively. The group 'who did not move' will be used as the base category.

The first control variable is the binary variable *Male* with answer possibilities [0; 1], indicating a female with 0 and a male with 1. The respondent's age is presented with the continuous variable *Age*. *Children* indicates the number of children someone has. Originally this was a nine-scale categoric variable in rising order with the highest possibility of having nine or more children. In the sample there were no respondents with more than six children, thus it is interpreted as a continuous variable. The continuous variable *Income* presents someone's personal net monthly income in 1,000 euros. If a respondent did not indicate a net income, it was estimated based on their gross income by the researchers of LISS. One observation of 133,537 is dropped because when investigating the income distribution in the Netherlands of 2019, very few people belong to the highest category till 100,000 a month (CBS, 2021). The chance that this observation represents a true value is unlikely.

Education presents the current level of education in CBS-categories [primary school (basisschool); intermediate secondary education (vmbo); higher secondary education (havo/vwo); intermediate vocational education (mbo); higher vocational education (hbo); university (wo)]. The category 'primary school' will be used as base category. The last control variable is the categoric *Origin* with answer possibilities [Dutch origin; first generation foreign, Western background; first generation foreign, non-western background; second generation foreign, Western background; second generation foreign, non-western background]. 'Dutch origin' will be used as reference category.

DESCRIPTIVE STATISTICS

Only respondents who filled out all four surveys, regarding the background characteristics in 2016 and 2019 as well as their health condition at both times, are investigated. This results in a total sample of 3,410 respondents. The descriptive statistics of the sample are presented in Table 1. The respondents are on average 57 years old. This is much older when comparing it with statistics of the Dutch population, the average age is namely 42.2 years old (CBS, 2021). This may be caused by the fact that you have to be at least 16 years old to participate into the LISS panel set. The respondents use on average about 0.574 times drugs each month. It is difficult to determine whether this is comparable with the usage pattern of the Dutch population. As the statistics available are only percentages on how many people used drugs last month, and not on how many times (RIVM, 2021). Both genders are

evenly represented. This is comparable with the composition of Dutch inhabitants, as up till the age of 40 there is a little abundance of men and from the age of 60 years onwards there is a little abundance of women (CBS, 2021). It is shown that most respondents belong to the educational groups intermediate secondary and intermediate vocational education and higher vocational education. This is 82.7% of the sample together with higher secondary education. This is comparable with statistics from the Dutch population in 2019; 78.0% (Maslowski, 2020). More than 85% of the respondents do have a Dutch background. This is 75% for the Dutch population (CBS, 2021) and thus, not completely comparable. In addition, it becomes clear that the majority of the respondents did not move to another degree of urbanization, namely 1535. 1037 respondents moved to a less urban area and 838 to a more urban area.

The correlations between all independent variables are tested for and presented in Appendix A. This is done to determine whether there are no variables in the models correlated with each other. The correlation presents how strong a relation between two variables is. If there is a strong correlation, then a trend is detected, and the estimation of the value does not present a clear effect because it captures a part of the effect of another variable. The strongest correlation found is 0.413, between income and gender. This is still considered to be a modest correlation (Taylor, 1990). From 0.680 a correlation is considered to be strong or high.

Table 1: Descriptive Statistics of the control variables

Variable	Obs.	Mean/ Frequency	Std. Dev./ Percent	Min	Max
Age	3410	57.307	16.151	19	95
Children	3410	0.584	0.985	0	6
Income	3410	1,771	1,094	0	10,000
Drugs	3410	0.574	4.512	0	100
Legal	3410	0.535	4.370	0	100
Illegal	3410	0.038	0.803	0	31
Gender					
Female	3410	1777	52.11		
Male	3410	1633	47.89		
Education					
Primary school	3410	184	5.40		
Intermediate sec.	3410	746	21.88		
Higher sec.	3410	324	9.50		
Intermediate voc.	3410	851	24.96		
Higher voc.	3410	899	26.36		
University	3410	406	11.91		
Origin					
Dutch background	3410	2922	85.69		
First gen., Western	3410	120	3.52		
First gen., non-western	3410	126	3.70		
Second gen., Western	3410	175	5.13		
Second gen., non-western	3410	67	1.96		
Difference Urban 2016-2019					
Less urban	3410	1037	30.41		
Not moved	3410	1535	45.01		
More urban	3410	838	24.57		

Notes: This table presents the descriptive statistics of the control variables. For all continuous variables the number of observations, mean, standard deviation (std. dev.), minimum value (min) and maximum value (max) are presented. Age is presented in years, income in euros and the other variables in proportions. For categoric variables the number of observations, frequency and percentage are given.

Comparison moving groups

When investigating the two groups who moved, it becomes clear from Table 1 that they can be considered large enough when a timeline of three years is researched to draw conclusions. To check whether the moving groups differ in characteristics beforehand compared to the group who did not move, t-tests are performed. This is relevant, because if the groups differ on characteristics beforehand, the found result does not present a proper effect due to only a change in urban living environment. In that case, there are other characteristics on which both groups differ, thus these might influence the outcome variable as well. The results are reported in Table 2.

First, the group who moved to a more urbanized area (MU) is compared to the group who did not move. These results are presented in the first three columns of Table 2. The groups are comparable in most characteristics. In the MU group, there are 3.6 percentage point more respondents with a university education than in the group who did not move at a 1% significance level (SL). Regarding the origin of the respondents, the MU group consists of fewer people with a Dutch background, namely 5.5 percentage point, and 1.3 percentage point more people with a first-generation Western and 3 percentage point more with a first-generation non-western origin, as compared to the group who did not move. Significant at a 1%, 10% and 1% SL respectively.

Second, the group who moved to a less urbanized area (LU) is compared to the group who did not move. These results are presented in the last three columns of Table 2. These groups are also comparable in most characteristics. There are only differences regarding the origin of the respondents. The LU group consists of 2.7 percentage point fewer people with a Dutch background and 2.4 percentage point more people with a first-generation non-western background, as compared to the group who did not move. Significant at a 10% and 1% SL respectively.

For both comparisons, it means that different outcomes might be related due to these differences between the groups in advance.

Table 2: Descriptive Statistics Moving Groups

	More Urban	Not moved	Difference	Less Urban	Not moved	Difference
Variable						
Gender	0.474	0.470	-0.003	0.496	0.470	-0.025
			(0.021)			(0.020)
Age	57.952	57.146	-0.806	57.024	57.146	0.122
			(0.707)			(0.640)
Children	0.537	0.599	0.062	0.602	0.599	-0.003
			(0.042)			(0.040)
Income	1,718	1,759	42	1,832	1,759	-73
	[1,023]	[1,107]	(45)	[1,128]	[1,107]	(45)
Level of education						
Primary school	0.042	0.053	0.012	0.065	0.053	-0.011
			(0.009)			(0.010)
Intermediate sec. education	0.228	0.214	-0.014	0.218	0.214	-0.004
			(0.018)			(0.017)
Higher sec. education	0.089	0.101	0.011	0.091	0.101	0.010
			(0.013)			(0.012)
Intermediate voc. education	0.261	0.243	-0.018	0.250	0.243	-0.007
			(0.019)			(0.017)
Higher voc. education	0.285	0.258	-0.027	0.255	0.258	0.003
			(0.019)			(0.018)
University	0.094	0.130	0.036***	0.122	0.130	0.008
			(0.013)			(0.013)
Origin						
Dutch background	0.890	0.835	-0.055***	0.862	0.835	-0.027*
			(0.014)			(0.014)
First gen., Western	0.025	0.038	0.013*	0.040	0.038	-0.002
			(0.007)			(0.008)
First gen., non-western	0.021	0.051	0.030***	0.028	0.051	0.024***
			(0.008)			(0.008)
Second gen., Western	0.041	0.055	0.014	0.055	0.055	-0.000
			(0.009)			(0.009)
Second gen., non-western	0.023	0.021	-0.002	0.015	0.021	0.005
			(0.006)			(0.005)
Observations	838	1,535	2,373	1,037	1,535	2,572

Notes: The first three columns present the group that moved to a more urban area in comparison with the group that did not relocate. The third column presents the differences between those two groups. The fourth till sixth column present the comparison between the group that moved to a less urban area and the group that did not move. The last column presents the differences between those two groups. The coefficients are shown in proportions and the standard errors are presented in parentheses. The standard deviations for income are given in square brackets. *** p<0.01, ** p<0.05, * p<0.1.

ANALYSIS TECHNIQUE

To test the hypotheses, six multiple linear regressions will be conducted with the Ordinary Least Squared (OLS) method. With this, it is possible to research the effect of multiple variables which simultaneously influence the outcome variable. To determine whether the method is applicable, its assumptions are tested.

The first assumption is exogeneity, meaning that the correlation between the variable of interest and the error term is zero. However, this assumption cannot be tested. The chance that both are related is likely as there might be omitted variable in both models. Other factors might relate to moving behavior and drug usage but are not included into the model. This might for instance be religion or frequency of going to bars as going out behavior, as Palali and Van Ours (2015) and Abraham (1999) included those control variables into their analyses respectively. These might be omitted and thus, there might be a case of endogeneity. However, the weaker form, the conditional mean independence assumption, is more likely to hold. In this case, only one of the variables should not be correlated to the error term, the others may.

The second assumption is homoscedasticity; the variance of the error term has to be constant and not depending on any of the independent variables. When investigating the residuals in a scatterplot, it becomes clear that the variances of the error terms do change at different levels of urbanization. These plots are presented in Figure 1 and Figure 2 in Appendix B. To make sure that constant variances apply, heteroskedastic-robust standard errors are used in all regression models.

The third assumption is no perfect multicollinearity. To make sure this one holds, always a dummy of one categoric variable is left out and used as a reference category. In addition, the correlations between all variables are checked for and presented in Appendix A. No variables are strongly correlated and thus the assumption is likely to hold.

The last assumption states that the observations are independent and identically distributed. This holds if a sample is drawn from a simple random sampling. The sample is based on a true probability sample of households, and thus all variables are drawn from the same population and are independent. In addition, large outliers in X and Y are unlikely, because outliers in the dependent and independent variables are excluded from the dataset due to expected measurement errors. Hence, as the sample is one unit of observation over time, panel data of the Netherlands, the assumption does not hold. With panel data, it might be the case that the results of the data depend on earlier results

and thus the estimations are not independent. Concluded, it might be that case that there is autocorrelation, thus this affects the reliability of the results.

If these four assumptions hold, the OLS estimator is unbiased and consistent. However, as the last assumption might not hold, this is might not be the case. The consequences of this are discussed in the discussion.

RESULTS

In this section, the results of the analyses are presented and answers to the hypotheses are formulated.

FIRST HYPOTHESIS

The first hypothesis follows: *The higher the degree of someone's urban living environment, the more frequently drugs and more different types of drugs someone uses, when investigating citizens in the Netherlands.*

To test if this hypothesis holds, three different multiple regressions are conducted. The first one is conducted on the outcome variable *Drugs*. The results are shown in the first column (Model 1) of Table 3. For the category regarding the level of urbanization is 'not urban' used as the reference category. The results show that respondents living in extremely urban areas used significantly, at a 10% SL, on average 0.416 more times drugs a month than those living in non-urban areas, ceteris paribus. The coefficients of the categories 'very urban' and 'moderately urban' show an increase in the number of times drugs were used, ceteris paribus, and 'slightly urban' presents a decrease, ceteris paribus, all compared to the reference category. It shows that these estimates are not significantly affected at the 5% SL by the level of urbanization of an individual, ceteris paribus.

When investigating the estimates of the control variables, it becomes clear that *Age*, *Children* and *Income* do affect someone's drug use, all at a 1% SL. The coefficient of age is – 0.013 and means that the older the respondents were, the less frequently they used drugs with a decrease of 0.013 times with an additional year of age, ceteris paribus. The coefficient of the variable *Children* shows that when a respondent has one additional child, this decreases the number of times drugs were used with 0.286 a month, ceteris paribus. Lastly, the coefficient *Income* presents someone's income in 1,000 euros. Earning for instance an additional €1000 a month affects the number of times drugs were used by a decrease of 0.247, ceteris paribus.

In addition to the results presented in the table, they are visually shown with a coefficient plot (Jann, 2013). In this plot, the coefficients of the variables as well as the corresponding 95% confidence intervals are presented. The plot of the first model is presented in Figure 1.

Table 3: Regression results for the first hypothesis

VARIABLES	Model (1) DRUGS	Model (2) LEGAL	Model (3) ILLEGAL
Degree of urbanization			
Extremely urban	0.416*	0.339	0.077
	(0.245)	(0.218)	(0.067)
Very urban	0.033	0.039	-0.006
	(0.176)	(0.174)	(0.018)
Moderately urban	0.397	0.374	0.023
	(0.284)	(0.279)	(0.051)
Slightly urban	-0.041	-0.022	-0.019
	(0.208)	(0.207)	(0.015)
Male	0.245	0.200	0.044
	(0.170)	(0.161)	(0.034)
Age	-0.013***	-0.011**	-0.002**
	(0.005)	(0.005)	(0.000)
Children	-0.286***	-0.267***	-0.018*
	(0.063)	(0.061)	(0.011)
Income (x 1,000)	-0.247***	-0.220***	-0.027
	(0.077)	(0.074)	(0.017)
Level of education			
Intermediate sec. education	0.623	0.778**	-0.155
	(0.417)	(0.309)	(0.162)
Higher sec. education	-0.117	0.057	-0.174
	(0.367)	(0.223)	(0.169)
Intermediate voc. Education	0.258	0.379	-0.121
	(0.384)	(0.253)	(0.173)
Higher voc. Education	0.157	0.300	-0.143
	(0.367)	(0.231)	(0.166)
University	0.0220	0.126	-0.104
	(0.392)	(0.248)	(0.179)
Origin			
First gen., Western	-0.088	-0.040	-0.048**
	(0.288)	(0.287)	(0.021)
First gen.,	0.355	0.441	-0.086*
non-western	(0.444)	(0.438)	(0.045)

Second gen., Western	-0.046	-0.022	-0.025
	(0.262)	(0.260)	(0.020)
Second gen.,	-0.303	-0.329	0.026
non-western	(0.292)	(0.256)	(0.099)
Constant	1.429***	1.110***	0.319*
	(0.524)	(0.409)	(0.191)
Observations	3,410	3,410	3,410

Notes: This table presents the regressions results on the dependent variables *Drugs* (Model 1), *Legal* (Model 2) and *Illegal* (Model 3). The used reference categories for the categoric variables are for degree of urbanization 'not urban', for level of education 'primary school' and for origin 'Dutch background'. The coefficients are shown in proportions and the robust standard errors are presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

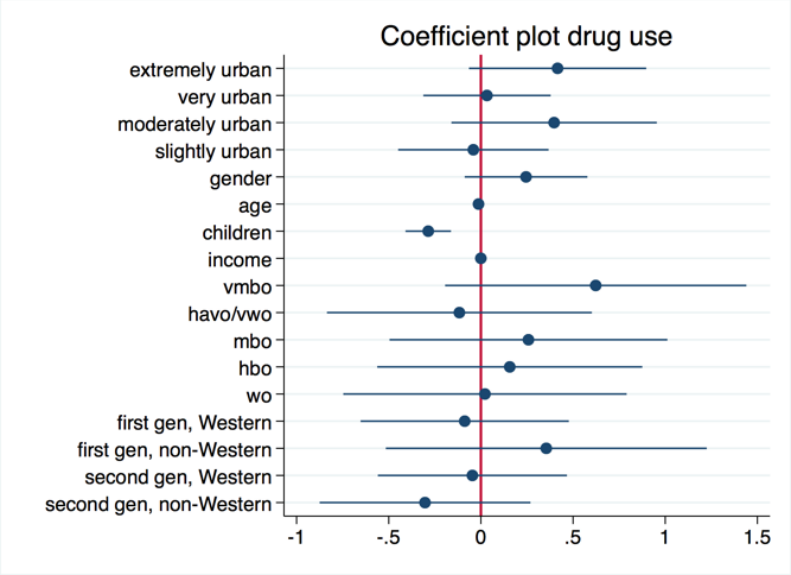

Figure 1: Coefficient plot of drug use

Notes: This coefficient plot presents the results of Model 1 on the number of times drugs were used. It shows for all variables included into the regression the coefficients with a dot and their corresponding 95% confidence interval with a bar. The variables are located at the y-axis, the coefficient interval at the x-axis. The red line, located at 0, can be used to determine whether a coefficient is significant or not. If the dot and bar are fully located at one side of the line, the coefficient is significant at a 95% confidence interval at minimum. The coefficients of the reference categories are excluded.

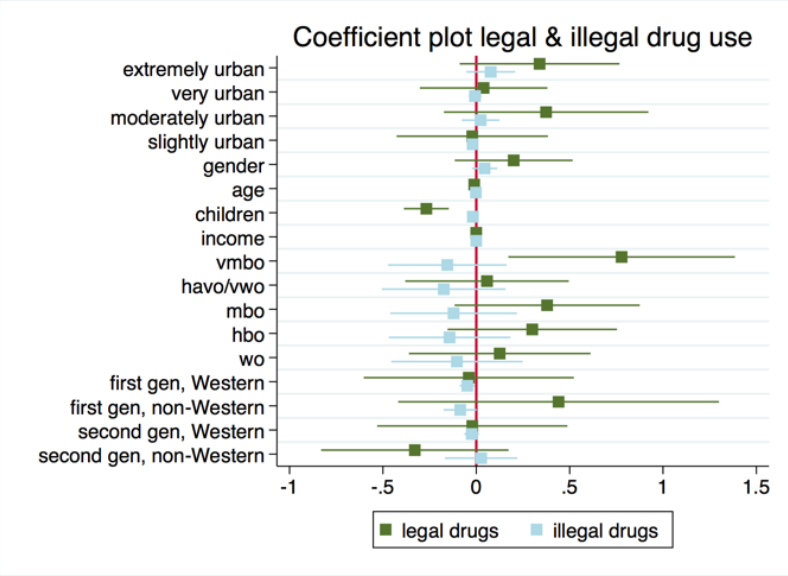

Figure 2: Coefficient plot of legal and illegal drug use

Notes: This coefficient plot shows for all variables included into the regressions on the number of times legal and illegal drugs were used the coefficients with a dot and their corresponding 95% confidence interval with a bar. The variables are located at the y-axis, the coefficient interval at the x-axis. The red line, located at 0, can be used to determine whether a coefficient is significant or not. If the dot and bar are fully located at one side of the line, the coefficient is significant at a 5% significance level at minimum. The coefficients of the reference categories are excluded.

The outcomes of the second regression on the number of times legal drugs and the third regression on the number of times illegal drugs were used are presented in columns (2) and (3) of Table 3 respectively. It shows that the frequency with which legal and illegal drugs were used in 2019 were not significantly affected at the 5% SL by the level of urbanization of an individual, ceteris paribus.

The control variables of Model (2) present comparable results with those of Model (1). The variables *Age*, *Children* and *Income* all do have the same sign as in Model (1) and are significant at a 5%, 1% and 1% SL respectively. The age of the respondent is associated with a decrease of 0.011 times drugs were used a month as someone is one year older, ceteris paribus. An additional child decreases the number of times legal drugs were used by 0.267, ceteris paribus. When someone earns an additional €1000 a month, it affects the number of times drugs were used by a decrease of 0.220, ceteris paribus. The coefficient of intermediate secondary education indicates that when a respondent's education is that compared to 'primary school', the reference category, the number of legal drugs used increases with 0.778 at a 5% SL, ceteris paribus.

The results of the control variables of Model (3) are different compared to the previous models. The coefficients of *Age* and *Children* show that when someone is one year older, a decrease of the used illegal drugs by 0.002 a month, ceteris paribus, is found. An additional child decreases it with 0.018, ceteris paribus. The variables of the categories 'first generation, Western' and 'first generation, non-western' both show a decrease in the number of illegal drugs used a month compared to someone with a 'Dutch background', the base category. A decrease of 0.048 ceteris paribus and 0.086 ceteris paribus a month respectively are found, significant at a 5% and 1% SL respectively.

Figure 2 presents the coefficient plot of legal and illegal times drugs were used combined visually. When comparing the outcomes, it clearly shows that for legal drugs the variable *Children* and for illegal drugs the two variables regarding someone's origin are significant.

Summarizing, a positive effect between living in an 'extremely urban' environment compared to living in a non-urban environment with the number of times drugs were used in 2019 is found. No effects of urbanization with regards to the outcome variables legal nor illegal drugs are found. Some control variables were affected by the outcome variables. Someone's age and the number of children presented negative effects with the times of usage amount in 2019 for all three models. In addition, someone's net monthly income was negatively associated with and highly significant for the outcomes variables *Drugs* and *Legal*.

In conclusion, the first hypothesis can only be partly supported with the results of the analysis. The higher the degree of someone's urban living environment, the more frequently drugs are used only holds for the level 'extremely urban' in comparison to the base category, with regards to Dutch citizens. The more different types of drugs someone uses cannot be supported with the outcomes of the legal and illegal analyses.

SECOND HYPOTHESIS

The second hypothesis follows: *When someone moves from a less urbanized living environment to a more urbanized living environment in the Netherlands, drugs will be used more frequently, and more different types of drugs will be used. An opposite effect is expected to be found for respondents moving from a more urbanized living environment to a less urbanized living environment.*

To test whether the second hypothesis holds, three multiple regressions are conducted. The first regression is conducted on the outcome variable *Drugs*. The results are shown in the first column (Model 1) of Table 4. The used reference category are respondents who 'did not move to another

degree of urbanization'. The two variables indicating the effect of moving to another degree of urban living environment both show that moving to a more or less urbanized area is related to a decrease in the number of drugs used compared to respondents who did not move. However, both estimates do not significantly affect, at a 5% SL, the number of times drugs were used in 2019, ceteris paribus.

When investigating the coefficients of the control variables, comparable results with the outcomes of the first hypothesis are found. Also, the variables *Age*, *Children* and *Income* are significant, all at a SL of 1%. If someone becomes one year older, the overall number of times drugs were used decreases by 0.014 a month, ceteris paribus. An additional child decreases the overall usage with 0.303 drugs a month, ceteris paribus. When someone earns an additional €1000 a month, it affects the number of times drugs were used by a decrease of 0.243, ceteris paribus.

The results are also visually presented in a coefficient plot in Figure 3.

Table 4: Regression results for the second hypothesis

VARIABLES	Model (1) DRUGS	Model (2) LEGAL	Model (3) ILLEGAL
Difference in degree of urbanization			
Moved less urban	-0.242	-0.223	-0.019
	(0.179)	(0.173)	(0.026)
Moved more urban	-0.262	-0.276	0.015
	(0.187)	(0.181)	(0.042)
Male	0.235	0.192	0.043
	(0.169)	(0.160)	(0.034)
Age	-0.014***	-0.011**	-0.002**
	(0.005)	(0.005)	(0.000)
Children	-0.303***	-0.281***	-0.022*
	(0.062)	(0.060)	(0.012)
Income (x 1,000)	-0.243***	-0.217***	-0.026
	(0.074)	(0.072)	(0.016)
Level of education			
Intermediate sec. education	0.604	0.764**	-0.160
	(0.419)	(0.311)	(0.163)
Higher sec. education	-0.130	0.045	-0.175
	(0.363)	(0.221)	(0.167)
Intermediate voc. Education	0.231	0.359	-0.128
	(0.385)	(0.250)	(0.174)
Higher voc. Education	0.140	0.287	-0.147
	(0.365)	(0.230)	(0.165)
University	0.0281	0.126	-0.098
	(0.378)	(0.238)	(0.173)
Origin			
First gen., Western	-0.091	-0.047	-0.044**
	(0.289)	(0.288)	(0.019)
First gen.,	0.413	0.476	-0.064**
non-western	(0.452)	(0.449)	(0.030)
Second gen., Western	-0.030	-0.011	-0.019
	(0.260)	(0.259)	(0.018)
Second gen.,	-0.230	-0.271	0.041
non-western	(0.290)	(0.258)	(0.095)
Constant	1.766***	1.419***	0.347
	(0.589)	(0.450)	(0.223)
Observations	3,410	3,410	3,410

Notes: This table presents the outcomes of the regressions results on the dependent variables *Drugs* (Model 1), *Legal* (Model 2) and *Illegal* (Model 3). The used reference categories for the categoric variables are for the difference in the degree of urbanization 'not moved', for level of education 'primary school' and for origin 'Dutch background'. The coefficients are shown in proportions and the robust standard errors are presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

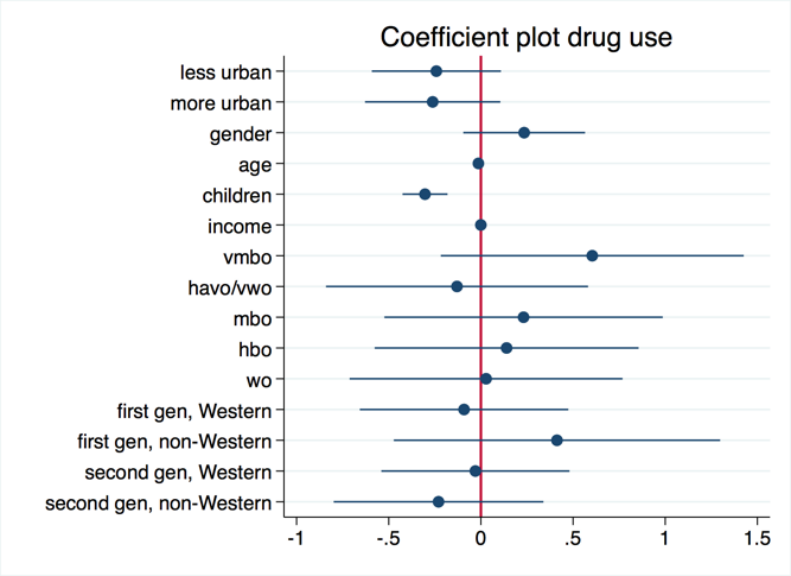

Figure 3: Coefficient plot of drug use

Notes: This coefficient plot presents the results of Model 1 on the number of times drugs were used. It shows for all variables included into the regression the coefficients with a dot and their corresponding 95% confidence interval with a bar. The variables are located at the y-axis, the coefficient interval at the x-axis. The red line, located at 0, can be used to determine whether a coefficient is significant or not. If the dot and bar are fully located at one side of the line, the coefficient is significant at a 95% confidence interval at minimum. The coefficients of the reference categories are excluded.

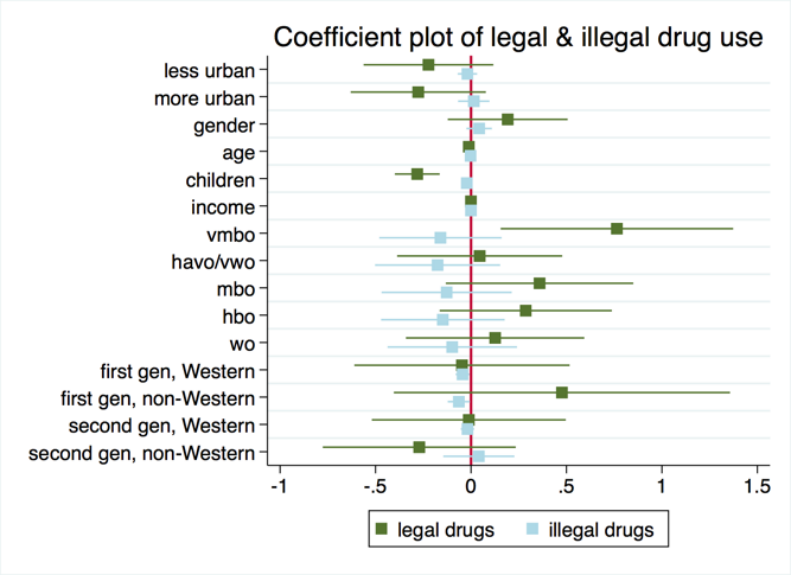

Figure 4: Coefficient plot of legal and illegal drug use

Notes: This coefficient plot shows for all variables included into the regressions on the number of times legal and illegal drugs were used the coefficients with a dot and their corresponding 95% confidence interval with a bar. The variables are located at the y-axis, the coefficient interval at the x-axis. The red line, located at 0, can be used to determine whether a coefficient is significant or not. If the dot and bar are fully located at one side of the line, the coefficient is significant at a 5% significance level at minimum. The coefficients of the reference categories are excluded.

The outcomes of the second regression on the number of times legal drugs and the third regression on the number of times illegal drugs were used are presented in columns (2) and (3) of Table 4 respectively. It shows that for the legal model, the effect of a change in urban living environment decreases the number of times legal drugs were used relatively more than illegal drugs. For legal, the decrease in times used when moving to a more urban area is 0.223 ceteris paribus, compared to 0.019 for illegal drugs, ceteris paribus. When moving to a less urbanized area a comparable gap is found, namely for legal the decrease in times used is 0.276 a month, ceteris paribus, and for illegal an increase of 0.015, ceteris paribus is found. However, it shows that the number of times legal and illegal drugs were used in 2019 were not significantly affected at the 5% SL by a change in the level of urbanization of an individual, ceteris paribus.

The control variables of Model (2) present comparable results with those of Model (2) for hypothesis 1. The variables *Age*, *Children* and *Income* all do have negative signs and are significant at a 5%, 1% and 1% SL respectively. The age of the respondents affects the number of times drugs were used with a decrease of 0.011 a month, ceteris paribus, as someone is one year older. An additional child decreases the number of times legal drugs were used by 0.281, ceteris paribus. The number of times drugs were used is affected by a decrease of 0.217 a month ceteris paribus, when someone earns an additional €1000 a month. The coefficient of intermediate secondary education indicates that when a respondent's highest education is that compared to primary school, the base category, the number of times legal drugs were used increases with 0.764 at a 5% SL, ceteris paribus.

The results of the control variables of Model (3) are comparable to the results of Model (3) of hypothesis 1. The coefficients of *Age* and *Children* show that when someone is one year older, a decrease of the number of times illegal drugs were used by 0.002 a month is found, ceteris paribus. An additional child decreases it with 0.022, ceteris paribus. The variables of the categories 'first generation, Western' and 'first generation, non-western' both show a decrease in the number of times illegal drugs were used a month compared to someone with a 'Dutch background', the reference category. A decrease of 0.044 ceteris paribus and 0.064 ceteris paribus a month respectively are found, both significant at a 5% SL.

Figure 4 presents the coefficients of Model (2) and (3) visually. When comparing the outcomes, it clearly shows that for legal drugs the variable children and for illegal drugs the two variables regarding someone's origin significantly affect drug use.

Summarizing, moving to a more urbanized area is associated with a decrease in the number of times drugs and legal drugs were used. It is associated with an increase in the number of illegal drugs were used. Moving to a less urbanized area is associated with a decrease in the number of times drugs, legal drugs and illegal drugs were used. Hence, the number of times drugs, legal drugs and illegal drugs were used in 2019 were not significantly affected at the 10% significance level by a change in the level of urbanization of an individual, ceteris paribus. Thus, no causal effect of a change in the degree of urban living environment on the frequency and types of drugs used by citizens in the Netherlands can be drawn on these outcomes. However, the outcome variables were affected by some control variables. Someone's age and the number of children presented effects with the number of times drugs were used in 2019 for all three models. In addition, someone's net monthly income was negatively associated with and highly significant for the outcomes variables *Drugs* and *Legal*.

In conclusion, relocating to another degree of urban living environment does not causally affect one's drug usage for the respondents in this sample. Thus, the second hypothesis cannot be supported with the results of the analyses.

CONCLUSION

The central research question of this thesis is: *What is the effect of a change in the degree of urban living environment on the frequency and types of drugs used by citizens in the Netherlands?* Multiple regression analyses are conducted with the OLS method to investigate this.

The results present that moving to a more urbanized area is associated with a decrease in the number of times drugs and legal drugs were used. It is associated with an increase in the number of illegal drugs were used. Moving to a less urbanized area is associated with a decrease in the number of times drugs, legal drugs and illegal drugs were used. Hence, the number of times drugs, legal drugs and illegal drugs were used in 2019 were not significantly affected at the 10% significance level by a change in the level of urbanization of an individual, ceteris paribus. Thus, no causal effect of a change in the degree of urban living environment on the amount and types of drugs used by citizens in the Netherlands can be drawn on these outcomes.

The effect of a change to more urban areas on the total number of times drugs and legal drugs were used in 2019, were both negative. This was not an expected based on earlier research of Abraham (1999) and Palali and Van Ours (2015). A relocation to a more urbanized area for the total number of times illegal drugs were used in 2019, the effect was positive. This association was expected based on the studies of Palali and Van Ours (2015), James et al. (2002), Pollack et al. (2005), Gfroerer et al. (2007) and Wouters et al. (2012). On the same literature the results were based regarding the negative effect of a change to less urban areas on the total number of times drugs, legal drugs and illegal drugs were used in 2019. This result was expected.

Regarding the first hypothesis about the higher someone's urban living environment is, the more frequently drugs and more different types of drugs someone used is only partially supported with the found results. The results show that respondents living in extremely urban areas used significantly, at a 10% SL, on average 0.416 more times drugs a month than those living in non-urban areas, ceteris paribus. Individuals use drugs more frequently in this higher degree of urbanized area, compared to the reference group. However, no effect is found that they also use more different types of drugs.

When comparing the outcomes with earlier research, the expectation that the higher the level of urbanization the more often drugs were used, was based on research of Abraham (1999) and Palali

and Van Ours (2015). This cannot be fully proven, neither be rejected. The expectation that more different types of drugs would be used, was based on research done by Dijkshoorn et al. (2017) and Van Laar et al. (2021). The results of this thesis are not in line with the findings in these earlier studies.

The number of times drugs were used in 2019 was affected by the control variables regarding someone's age, number of children and income. They all presented a decrease of the number of times used, ceteris paribus, and all significant at a 1% significance level. This was expected for age, based on research of De Groot (2011), and for income based on the study of Cutler and Lleras-Muney (2010). Based on the latter study, a positive effect was expected for education, but was not found. That no significant differences between both genders were found, is in line with the research of Cronk and Sarvela (1997). However, that origin was not affected is in contrast with the expectation based on the study of Palali and Van Ours (2015).

Regarding the second hypothesis about a change in someone's urban living environment to a more urbanized area positively affects the frequency drugs are used and that more different types of drugs are not supported with the found results. The number of times drugs, legal and illegal drugs were used in 2019 were not significantly affected at the 10% significance level by a change in the degree of urbanization of an individual between 2016 and 2019, ceteris paribus. The number of times drugs and legal drugs were used in 2019 was affected by the control variables regarding someone's age, number of children and income. They all presented a decrease of the number of times used, ceteris paribus, and all significant at a 1% significance level. These expectations are comparable with those of the control variables of the first hypothesis.

In conclusion, when comparing the outcomes with earlier research of Gfroerer et al. (2007) the legal model did not show the expected results, the illegal model did. The legal model showed a decrease in the number of times legal drugs were used for both moving groups. The illegal model showed a decrease for the LU group and an increase for the MU group. However, as these results were not significant at a 10% significance level, thus they do not show a causal effect.

DISCUSSION

There are multiple limitations of this thesis that will be discussed. After that, recommendations for further research are given.

The first limitation is the internal validity of the thesis. The sample might not be representative enough for the Dutch population, based on the characteristics of the population from, among others, Statistic Netherlands (2021). Especially age and origin of the respondents differed with the averages of the population. Thus, the statistical inferences about causal effects might not be representative enough for the Dutch population and setting studied.

Another shortcoming that limits the reliability of the study is the fact that there can still be omitted variable bias (OVB). Possible omitted variables are, as described earlier in the part about the analysis technique, religion and frequency of going to bars. OVB affects the internal validity of the study as well, as not all variables that affect the outcome variables are possibly included into the research. The results can thus be biased.

It is not likely that the study is external valid for other countries, as the Dutch drug policy is exceptional. As for instance, it is quite easy to buy soft drugs in the Netherlands, the results of the number of times drugs are used by the Dutch population cannot be compared with the situation in other countries.

Another limitation is that not all assumptions of the analysis technique might hold. There might be a case of autocorrelation. As panel data is used and the variables regarding drug usage might depend on those of earlier years. This causes for less reliable analysis results.

Another shortcoming of the thesis is that the functional form of the effect of someone's living environment on drug use is assumed to be linear. However, this is not completely the case as presented in Figure 3 in Appendix B. This will limit the reliability of the results as not the most applicable analysis technique is used.

In addition, the t-test results presented that the two moving groups differed on a couple of characteristics in advance from the group who did not moved. For both comparisons, it means that different outcomes might have been related due to these differences between the groups in advance. The group who relocated to more urban areas was less comparable with the group who stayed than the group who moved to less urban areas, namely the first one differed on three instead of two

characteristics. Hence, as differences in these characteristics beforehand might have influenced the results, these outcomes are not fully reliable.

Another limitation is that the data is self-reported. It might be that not all respondents filled out the answers as truthfully as possible, although they completed the questionnaires online and are less prone to giving socially desired answers to an interviewer. It can still be the case that people are ashamed to answer truthful or underestimate their personal circumstances or the possible negative health effects, especially with a more sensitive topic as drug use. However, a good thing about the data is that there are no differences in sampling methods or sample size. The same respondents filled out all surveys about the types of drugs.

Also, a shortcoming of this study is that little earlier literature about this topic for the Netherlands was available. American research was used to base expectations on. However, it made it difficult to shed expectations for the Netherlands as not all literature from the US was as usable. As there are only few Dutch studies on this topic, this also shows the contribution of this thesis to literature.

The last limitation is that it might be the case that the effect of relocation on drug usage is not yet visible in the outcomes for respondents who just have moved before November 2019. This limits the reliability of the results. It might be interesting to investigate whether moving affects the subsequent month's drug usage instead of last month's usage. This is possibly a first recommendation for further research.

Another recommendation for further research is to compare people who moved to a more or less urbanized area with others who stayed in that specific degree of urbanization. Instead of comparing them with all respondents in the sample who did not relocate.

In addition, a recommendation is to use a more suitable analysis technique to validate the functional form of the estimated effect and study if the results are consistent with the results of this study. One might use for instance a function with interaction effects to determine the non-linear effect. A more applicable method would give more reliable results.

Another idea for further research is based on the earlier research of Abraham (1999). It stated that more youngsters living in urbanized areas did not simply affect higher drug used rates in those areas, there had to be other factors that play a role. It might be explained by their so-called 'lifestyle', the frequency with which people visit discotheques, bars, and clubs. This might be correlated with the

number of drugs used and with the population density in a place. Further research can investigate the role of this effect on drug usage in the Netherlands. This can be done by adding a variable that measures the frequency of going out to the model, as described before with regards to omitted variable bias.

The last recommendation is based on the American study of Boardman et al. (2001). They found a positive relationship between disadvantages in a neighborhood and drug use. It might be interesting to study the effect of neighborhood disadvantages in different types of urbanized areas. The outcomes can be used for the creation of even more effective policies in different neighborhoods to prevent more vulnerable people from using drugs extensively via for instance, providing local information by flyers in supermarkets.

The results of this thesis can be used in practice. As more insights in urban-rural health differences can be gained and used to design policies to create more awareness about the health risks of drug usage among certain groups of citizens. As the results for 'extremely urban' areas are different compared to 'not urban' areas, different policies might be more effective to prevent health problems related to drug use. Encouraging citizens to use drugs less often or not even start at all, can be done in multiple ways, like information sessions at schools, flyers in the neighborhood, or local campaigns. When fewer drugs are used, this will result in fewer health-related problems and less nuisance to third parties, with lower social costs as result.

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Appendix A

Table 1: Correlations between the variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Male	1.000							
(2) Age	0.093***	1.000						
(3) Children	-0.027	-0.409***	1.000					
(4) Urban	0.030*	0.064***	0.092***	1.000				
(5) Income	0.413***	0.002	-0.025	-0.037**	1.000			
(6) Education	0.077***	-0.268***	0.101***	-0.075***	0.412***	1.000		
(7) Origin	-0.001	-0.097***	0.045***	-0.140***	-0.007	0.020	1.000	
(8) Drugs	-0.004	-0.010	-0.048***	-0.028*	-0.059***	-0.041**	0.001	1.000

Notes: This table presents the correlations between all variables in a matrix. The variables are presented in the first column and indicated with a number. The same numbers are presented in the first row. Each cell indicates the correlation between two variables. The correlation of a variable with itself is always equal to 1.000. *** p<0.01, ** p<0.05, * p<0.1.

Appendix B

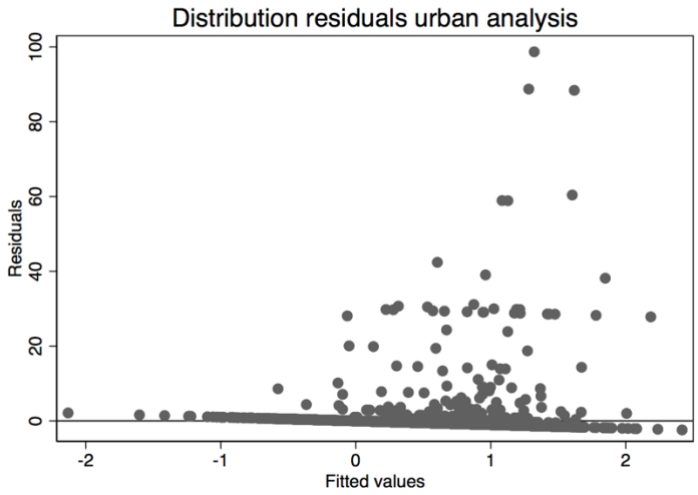

Figure 1: Distribution residuals of the urban analysis
Notes: This scatterplot shows the distribution of the residuals of the analysis done on with *Urban* as variable of interest.

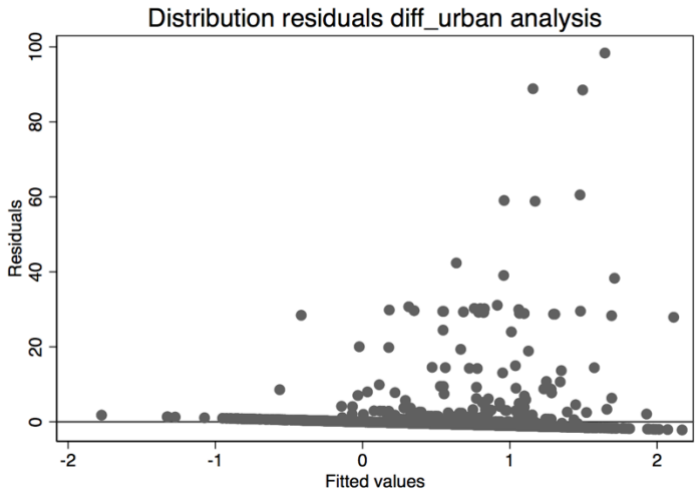

Figure 2: Distribution residuals of the difference in urban analysis
Notes: This scatterplot shows the distribution of the residuals of the analysis done on with *Diff_Urban* as variable of interest.

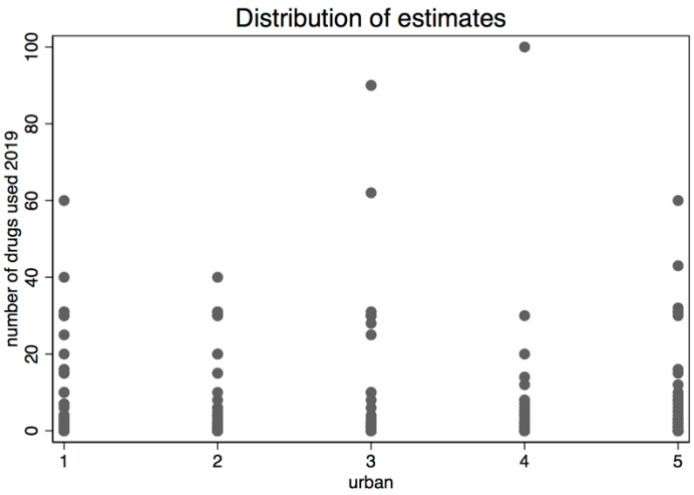

Figure 3: Distribution of the estimates to show the form
Notes: This scatterplot shows the form of the estimates of the analysis done on *Urban*.