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IZA DP No. 14490

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ABSTRACT

Older Adult Health Following Greater Access to Secondary Health Care: Evidence from Bus Service Introductions to Arab Towns in Israel*

How much can socioeconomically-based health disparities be attributed to differential access to secondary and specialist health care? We evaluate this question in the context of Arab-Jewish health disparities in Israel while exploiting the introduction of public transportation to Arab communities. Primary care health services are readily available within Arab towns and the introduction of bus services increased residents' access to secondary health services that are almost exclusively available only outside their towns. In the short term older adults reported higher probabilities of being diagnosed with common health conditions, such as heart problems or high cholesterol, and rare health conditions. In the longer term – more than two years following the initial introduction of public transportation to one's town – there were reductions in overweight and mostly null effects on diagnosis-based health conditions. Coupled with an analysis on mortality rates, our results suggest that the higher rates of chronic conditions in the short term are due to higher diagnosis rates rather than health deterioration. However, this effect is weaker in the long run when the benefits of greater access to health care facilities offset the higher diagnosis rates.

JEL Classification: I12, I14, R4

Keywords: public transportation, health disparities, health care access, secondary health care

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1 Introduction

Health inequality based on socioeconomic status has been widely documented. This is true for birth outcomes, morbidity, chronic conditions, and life expectancy (Case et al. (2002); Chetty et al. (2016); Currie and Hyson (1999); National Center for Health Statistics (1998); Marmot et al. (1991)). Numerous causes for these health disparities have been investigated, including poor access to health care, financial constraints, environmental differences, differential access to information, and behavioral factors.[1]

In this study, we investigate how increased access to secondary and specialty health care facilities and professionals affects older adult health outcomes within disadvantaged communities. Disadvantaged populations often have less access to health care facilities than their more advantaged counterparts. This is largely owing to lower insurance coverage, limited knowledge of available medical options, or less access to health care facilities or professionals within geographic proximity.[2] Furthermore, there is growing evidence of a strong correlation between locality of residence and health outcomes, with residents from less advantageous localities experiencing more chronic conditions and premature mortality (Cullen et al. (2012); Polyakova and Hua (2019)). Nevertheless, there is limited research on the effects of decreased health care services in disadvantaged communities on health outcomes. In fact, the underlying mechanisms for geographic health disparities documented have hardly been investigated, and the role of reduced health care supply in generating these differences, among a myriad of other possible channels, has not received much attention.[3]

In Israel, the Arab minority is socioeconomically disadvantaged for the most part. Most Arab towns are segregated and peripheral communities, although all basic health services, such as primary care doctors, are available within them as part of Israel's national health insurance coverage. For secondary health care services, including specialized physicians or equipment, travel to a larger (Jewish) town or city is needed. Health disparities between the Arab and Jewish populations are significant, with almost a three-year gap in life expectancy at birth and a much higher prevalence of various chronic conditions, including overweight and diabetes (Chernochovaky et al. (2017)). A reform that was announced in 2007 to introduce bus lines to Arab towns is thus an opportunity to evaluate changes in the health of older adults within socioeconomically disadvantaged communities that experienced increased access to secondary health care services.

[1] See Adler and Newman (2002) for a summary of all these factors. Currie (2011) provides an overview of health disparities at birth and their causes. Chen et al. (2019) present evidence that greater access to medical information through doctors within the family improves health outcomes. Evidence on differentials in health behaviors can be found in Rehm et al. (2016) concerning dietary intake and in Hiscock et al. (2012) concerning smoking. Cutler and Lleras-Muney (2010) rule out numerous behavioral factors, such as discounting or the value of the future in the education-health gradient, but show that knowledge and measures of cognitive ability have a large role.

[2] See for example Hing and Hsiao (2014) who report a smaller supply of physicians in rural areas in the U.S., which generally have higher rates of poverty and lower income per capita. Brown et al. (2016) report lower availability of primary care doctors in census tracts in Philadelphia with higher shares of African-Americans. Isabel and Paula (2010) document geographic disparities in physician density in Portugal that appear to be driven by geographic income inequality.

[3] There are a few studies establishing an association between decreased health care professionals' local supply and adverse health conditions, such as hypertension, cancer and heart disease (Okuyama et al. (2019); Shi et al. (2005)). However, to the best of our knowledge, there is no study that causally establishes a relationship between health care supply shortages and health conditions while specifically evaluating the role of these shortages on socioeconomically-based health disparities.

Our study exploits the staggered introduction of public transportation bus lines to Arab towns in Israel, while utilizing data on health outcomes covering Arab households in four annual cross sectional surveys - two survey years before the initial introduction of public transportation in our sample of towns, and two survey years up to six years following it. We combine this data with detailed bus schedule information from Israel's Ministry of Transportation (MOT) in order to match each survey respondent with a measure of the bus frequency in their town over the year preceding their interview date. We focus on older adult health outcomes as increased access to secondary health care services at these ages (50-75) can have a profound effect on treatment and diagnosis of various health conditions that begin to prevail at this age.

Our findings suggest that some of the Arab-Jewish health disparities in Israel may partially be attributed to reduced access to health care facilities and professionals. Within two years following the introduction of public transportation to Arab towns, there was increased diagnosis rates of common health conditions such as high cholesterol and heart problems, in addition to increased diagnosis rates of rare health conditions. We also find greater reporting of suffering from a chronic condition in general. More than two years since the initial introduction of public transportation to Arab towns, there were improved health outcomes in terms of overweight and no increased rates of reporting chronic conditions, common health conditions, or rare health conditions.

We interpret greater reporting of some conditions among survey respondents in the short term as indicative of increased diagnosis rates rather than a deterioration in health in response to public transportation penetration. This is corroborated by the null effects we find in the long term, thus indicating that something is offsetting the increased diagnosis rates several years after the initial introduction of bus lines. The main candidate for this is improved health - health improvements with respect to chronic conditions should not be observed in the short term, as the effects of greater access to secondary health care on chronic conditions should not be immediate. Our hypothesis is further supported by our analysis of the effect of public transportation penetration on mortality. We do not find greater mortality in response to public transportation expansion, and if anything, our analysis suggests a decrease in mortality rates in the long term.

Our regression specifications address the potential endogeneity of bus line introduction timings and intensities by including town fixed effects that control for time-invariant town characteristics that are correlated with town-level bus intensity measures or the timing of public transportation penetration. We further include in our regression specifications subdistrict-year fixed effects that control for time-variant shocks that are mutual to clusters of towns in close proximity to each other. Thus, our identification relies on the assumption that our bus intensity measures are exogenous to our outcomes of interest, conditional on fixed effects. We establish this further by showing that time-varying town characteristics are not correlated with bus intensity measures over time, while controlling for town and year fixed effects.

Within the economics literature, our work is related to several studies on the health effects of proximity to health care services, including hospitals and emergency departments (Buchmueller et al. (2006); Currie and Reagan (2003); Gujral and Basu (2019); Shen and Hsia (2016)). This study complements these important aspects of health care access and supply by evaluating the lack of secondary health care services within disadvantaged communities.[4] It also relates to the effects of lack of health insurance coverage on health outcomes.[5] A study closely-related to ours is Aggarwal (2021), which specifically discusses supply constraints of health care facilities in rural India. Aggarwal (2021) evaluates a reform that increased access to health care services through the construction of roads that connected villages in India to larger towns or cities. Her focus is on access to reproductive health care facilities and women's delivery and post-natal outcomes. The results show an increased probability of institutional delivery, increased proper pre-natal and post-natal care, and a reduction in the gender gap in infant mortality. Our paper complements Aggarwal (2021) by examining a reform that also increased access to health care for disadvantaged communities via transportation infrastructure. However, our paper differs by evaluating a disadvantaged setting in a developed country with a national advanced health care infrastructure, where basic health care facilities are already provided for within localities. As such, our focus is on older adults, for whom secondary health care services are more relevant.

Our paper proceeds as follows. In the next section, we provide some background information on the Arab population in Israel and describe the disparities between the Arab and Jewish population in terms of health outcomes and access to health care facilities. We also provide some background on the reform that introduced public transportation to Arab towns in Israel beginning in 2008. We then proceed to describe our data (Section 3), our empirical strategy (Section 4), followed by results and a discussion of these results (Section 5). Robustness checks are provided in Section 6, followed by concluding remarks.

2 Background

2.1 The Arab Population in Israel and Health Services

Arabs constitute roughly 20% of the population of Israel (8 million in 2014). The vast majority of Arabs reside in separate towns and cities, which for the most part are ranked low socioeconomically. The Arab population in Israel is characterized by low income, employment rates, and educational attainment, and high fertility rates.[6]

All citizens in Israel are covered by Israel's national health insurance plan. The vast majority of doctors in Israel - whether primary care or secondary care specialized doctors - serve patients within this plan. Primary care doctors and most other basic services, such as prenatal care or basic nurse services, are generally available locally even within small communities. Primary care doctors provide referrals due to medical requests or conditions to secondary care specialists. Secondary care services are often only available in large medical centers, thus accessing them entails travel to a larger nearby city for residents from small towns or

[4] Indeed, Palència et al. (2013) document lower utilization of specialized health care services among lower social classes in Spain.
[5] Sommers et al. (2017) provide a thorough summary of this topic while Black et al. (2019) provide more recent findings.
[6] We note that the Israeli Arab population referred to in this study does not include Palestinians living in the West Bank or the Gaza Strip, who are not citizens of Israel.

communities.

There are significant life expectancy gaps between Arabs and Jews in Israel, with the mean life expectancy at birth among Jews in 2015 being 82.7 but only 79 among Arabs (Chernochovaky et al. (2017)). In terms of morbidity, the Arab population has significantly higher rates in many leading health risk factors, such as diabetes and high blood pressure (Chernochovaky et al. (2017)). Although some of these gaps can be explained by socioeconomic and cultural differences between Arabs and Jews (Baron-Epel et al. (2007); Baron-Epel and Kaplan (2009)), there is also evidence pointing at reduced access to healthcare as a potential cause. Chernochovaky et al. (2017) report that the mean distance to the nearest hospital from an Arab town in Israel is 22 km, in comparison to 14 km for Jewish towns. Indeed, there are no hospitals or major health centers in Arab towns in Israel.[7] Furthermore, according to Israel's 2016 social survey, while 57 percent of Jews reported visiting a specialized doctor in the last year, only 30 percent of muslim Arabs reported this (Chernochovaky et al. (2017)). This can help explain the large gaps in terms of efficiency in healthcare utilization between Arabs and Jews - Arabs utilize emergency room treatment at much higher rates than their Jewish counterparts (Chernochovaky et al. (2017)), thus indicating that they significantly delay preventative measures that can be provided by specialized physicians.

2.2 Public Transportation in Israel and within Arab Communities

Public transportation in Israel operates primarily via buses, taxis or inter-city trains. Public transportation services are not provided within a free market; rather, they are under the regulatory supervision of the Israeli MOT, which determines the extent of competition between operators for each region and locality, provides permits and licenses for each route, and sets the routes, stations, frequencies and prices.

Despite very low private car ownership rates among Arabs, due to economic constraints, and many women not being able to drive due to traditional barriers, Arab communities have been significantly deprived of public transportation infrastructure until the last decade. According to an Israeli government report from 2016, in 2009 41% of Arab localities in Israel had no public transportation services and an additional 43% had only a low level (Greenwald et al. (2018)). For many communities (including cities with populations of several tens of thousands), the only option for mobility was either walking to a bus/train station outside the community (usually more than a few kilometers) or taking unauthorized vans that served these communities, which cost significantly more than public transportation bus services in Israel, were sporadic in their time schedules, and posed a constraint on women from these traditional communities, who could not travel in crowded vans among men.

In 2007 the Minister of Transportation announced a 5-year plan to invest over 200 million NIS annually[8] to fill this gap. The new bus networks gradually developed over the next years and increased significantly residents' mobility within and between their communities and access to large Jewish cities located close to

[7] This is with the exception of Nazareth, the largest Arab city in Israel, which has several Christian hospitals (rather than Israeli government-funded ones) and is excluded from our sample, as it was served by bus lines prior to 2008 (see data section below).

[8] roughly equivalent to 57 million USD in 2007.

them, thus expanding work and education opportunities, as well as access to professional health services. In 2011, the new Minister of Transportation announced that over 400 million NIS were spent on infrastructure and public transportation over the last few years and that 3.5 million passengers from Arab towns and communities utilize the improved public transportation network annually. According to a report for the Israeli parliament concerning public transportation in Arab towns, women were the main beneficiaries of this reform, comprising the majority of passengers on these new bus lines (Ronen (2014)). Nonetheless, despite substantial investment and improvements, the gaps in public transportation between Jewish and non-Jewish communities remain considerable (Naali-Yosef and Cohen (2012)).

In a recent study, Abu-Qarn and Lichtman-Sadot (Forthcoming) evaluate the effect of public transportation penetration to Arab towns in Israel on labor force participation and educational attainment among young adult Arabs. The paper finds that young adult males had increased their educational attainment in response to buses connecting both to higher education and work opportunities and increased their labor force participation at the expense of educational attainment in response to buses that connect work opportunities without connecting to higher education opportunities.

Figure 1 presents the gradual penetration of public transportation to the towns in our sample over time. The vertical axis provides the number of towns served by bus lines, and the horizontal axis is a timeline for the years 2007-2014. By construction, all 39 towns in our sample had no public transportation services at the end of 2007. However, by 2014, the end of our sample period, 22 towns were served by public transportation. Even after initial public transportation penetration, bus services continued to expand for different towns over the course of our sample period.

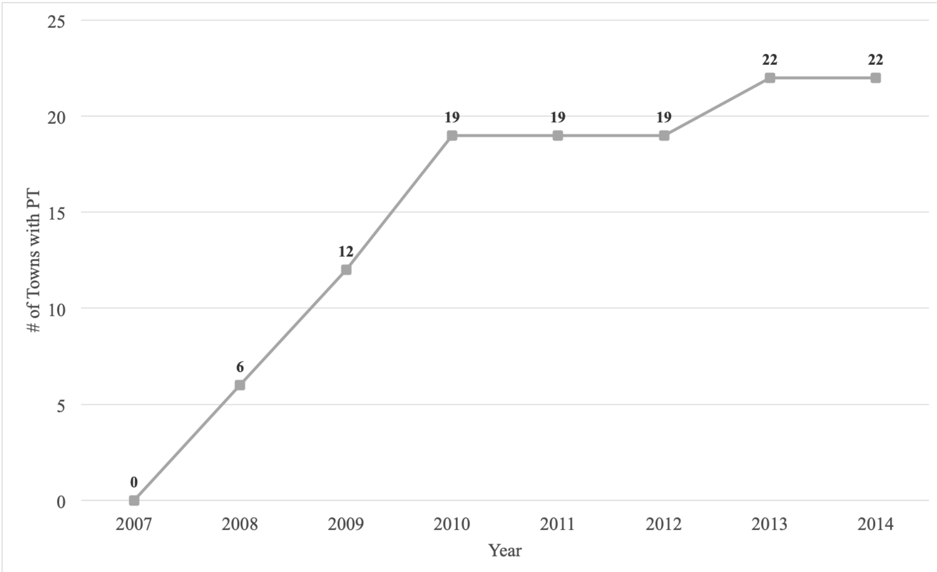
3 Data

Our data are obtained primarily from two sources. Data on all bus lines in Israel, their frequencies, origin and final destination were provided to us by the Israeli MOT for the period 2008-2014. Data on outcomes concerning the health of individuals in Arab communities in Israel were extracted from a survey of the Arab minority in Israel conducted by the Galilee Society in 2004, 2007, 2010, and 2014 (Arab Survey, hereafter).[9]

Each cycle of the Arab Survey covers roughly 15,000 individuals from about 3,000 households, with the exception of the 2010 cycle which was limited to 8,500 individuals from 1,900 households. All four cycles are repeat cross-sections, and it is not possible to follow households through the years of the survey. Household members were asked about household and demographic characteristics, employment and education, as well as health measures. Individuals report whether they suffer from any chronic health conditions based on a diagnosis by a physician. They also indicate which chronic diseases they suffer from. We aggregate

[9]The Galilee Society is a Palestinian Arab non-government organization located in Israel. The Arab Survey is conducted by the Rikaz Center for Social Research within the Galilee Society and its funding is provided by organizations such as the European Union, among others.

Figure 1: The Number of Towns in the Sample with Public Transportation Penetration



Notes: This figure presents the gradual penetration of bus lines to the towns in our sample over time. Our sample covers 39 towns. The vertical axis is the number of towns served by the buses. See Data Section for further details on our bus line data.

the four most common health conditions among older adults - heart problems, high cholesterol, high blood pressure, and diabetes - into a single indicator variable indicating whether they were diagnosed with at least one of these. We also construct a separate indicator variable for whether individuals have been diagnosed with rare health conditions that the survey inquires about. These include: asthma, migraines, ulcer, joint problems, anemia, cancer, bone disease, genetic blood disease, and epilepsy. Each of these conditions has a prevalence of 4 percent or less among the older adult population in our sample (for some health conditions even less than 1 percent) but the indicator variable for suffering from at least one of these conditions has a mean of over 15 percent. The 2007-2014 surveys also inquired about weight and height for a subset of the sample, from which we constructed BMI measures. We constructed an indicator variable for BMI that is greater than 25, which is the official threshold for being defined as overweight. We thus perform our analysis on four dependent variables: three are health variables that are dependent on physician diagnosis - Having No Chronic Health Conditions, Having a Common Health Condition, or Having a Rare Health Condition - and one - Overweight - is a health measure that is self-reported and not dependent on physician diagnosis.

Most of our analysis focuses on the older adult population - age 50-75. Most chronic health conditions - particularly those documented in the Arab Survey - become prevalent around age 50. As a result, at this age, diagnosis and healthcare service utilization becomes increasingly relevant in order to prevent and treat these conditions. Our results are not sensitive to expanding this age range by 5-10 years. We limit the upper bound of our sample's age range, as we wish to include the population for which public transportation usage is relevant, and at older ages, this is more of a problem. We present further analysis for adults ages

30-49, and most of these results confirm the higher relative relevance of these health outcomes among the older adult population, rather than younger adult age ranges.

We report results separately for males and females. This is due to several reasons. First, male and female responses to different health conditions may vary. For example, three of the four health conditions categorized as Common Health Conditions in our data - namely heart problems, high cholesterol, and high blood pressure - are still for the most part perceived as male health conditions (Mosca et al. (2000, 2013)), although cardiovascular disease (i.e. heart problems) is the leading and second leading cause of death among women in the U.S. and Europe, respectively (Eurostat (2020)). Second, Arabs in Israel are highly traditional, in particular the older adult population which was not exposed to recent transitions within Israel's Arab society towards greater social and economic opportunities to females. This can potentially result in varying gender responses to greater access to secondary health care. For example, gender differences in independent mobility outside of their town may result in different responses to bus penetration. Lastly, there is evidence that females utilized the new bus lines more than men within the Arab population (Ronen (2014)), and this can result in different responses based on gender.

The MOT data on bus lines details every bus line in Israel and its frequency on three representative Tuesdays - at the end of March, June and December - each year between 2008 and 2014.[10] Based on this, we summed the frequencies of all bus lines serving a town for those three dates. We then divided these frequency sums by the town population at the relevant year. This results in 3 bus intensity measures for each year. Under the assumption that residents' health conditions are not immediately affected by the contemporaneous intensity of bus lines serving their town, our main variable of interest is the mean of the 3 bus intensity measures over the course of the year preceding one's interview date.

Bus line data could not be obtained prior to 2008. As such, if a town was served by bus lines as of early 2008, we could not know when these bus lines were introduced.[11] We thus could not determine what the treatment variable values should be for these towns prior to 2008. As a result, we excluded 17 towns from our sample that were served by bus lines as of early 2008.[12] We further excluded towns that only appeared in our pre-treatment period - i.e. did not appear in 2010 or 2014.[13]

As residents in towns ranked lowest socioeconomically have the least access to private vehicles, most of our analysis focuses on these towns, which we select based on Israel's Central Bureau of Statistics (CBS) socioeconomic (SE) ranking. The lowest ranked towns have a ranking of 1 or 2, out of a scale of 1 - the lowest - to 10 - the highest.[14] In other analysis, we show results for individuals from towns ranked higher

[10]Note that the end of December is a normal work week in Israel. The dates selected - at the end of March, June and December - were determined by the MOT based on its capabilities in terms of extracting data from its system.

[11]MOT data for bus lines begin only in 2008 because prior to that all documentation of bus lines in Israel were not digitized by the MOT and no data was found available.

[12]A total of 26 Arab towns were served by bus lines as of early 2008. Out of these, 19 towns are covered in the Arab Survey, but for two of them we were able to verify that public transportation was indeed only introduced in January 2008, so they were kept in the sample.

[13]Most towns in our sample do not appear in all 4 survey years and the number of town-year combinations in our sample is at most 78 (depending on the gender sample). Table 9 in the Appendix provides a list of the towns in our sample.

[14]SE rankings are based on demographic variables, such as the mean age, ratio of adults to children, the share of families with four or more children, educational attainment, employment, and living standards. The ranking is in integers ranging from 1 - the lowest -

socioeconomically, with a ranking of 3-5 from the CBS SE ranking scale.[15] Our final sample includes roughly 1,300 males and females ages 50-75 from 39 towns ranked lowest socioeconomically. From towns with a higher SE ranking, we have roughly 1,500 males and females from this age group. Despite the Arab Survey covering over 8,500 individuals in each of its four cycles, the relatively small final sample is consistent with excluding towns with public transportation pre-2008 and that were only surveyed in the pre-treatment years coupled with the overwhelmingly young composition of the Arab population in Israel.[16]

3.1 Summary Statistics

In Table 1, we present summary statistics for our sample of adults aged 50-75 by their towns' socioeconomic ranking. Table 1 suggests significant differences in bus intensity measures between towns ranked lower and higher socioeconomically (when conditioning on non-zero bus measures). This suggests that the assignment of bus frequencies is not random. However, as we will outline in Section 4.2 below, our identification does not rely on purely random assignment but rather on the exogeneity of our bus intensity measures conditional on fixed effects. We establish this in Table 2, which tests for a correlation between time-varying town characteristics and bus intensity measures. We further show in our analysis that our results are not sensitive to the exclusion of individual-level control variables, thus suggesting that our main variables of interest in our regression analysis are not correlated with town demographic characteristics.

Table 1 also presents evidence of differences in our health dependent variables across SE status. While older adults from higher SE ranked towns have lower diagnosis rates of health conditions, they have a greater prevalence of overweight.

Figure 2 presents the distribution of bus intensity measures for the sample of males and females aged 50-75 from the lowest socioeconomically ranked towns, conditional on non-zero bus intensity values. As can be seen, there are over 450 individuals out of slightly less than 1,300 with non-zero values and the variation between these measures is quite large.

to 10 - the highest. The index is updated every 2-3 years, with the exception of a break in updates between 2008 and 2013. Arab towns in Israel are ranked low in this index - in our sample, most are ranked 4 or under, and more than half are ranked 1 or 2. A SE ranking of 1 (4) in 2013 implied a mean of 9 (12.7) years of schooling for those aged 25-54, in comparison to the national Israeli mean of 13.5 years of schooling. Mean per capita monthly income in towns with a SE ranking of 1 (4) was 1,181 (3,183) NIS, equivalent at the time to $325 ($877), in comparison to the national Israeli mean of 4,057 NIS ($1,118).

[15] Five is the highest SE ranking among the Arab towns in our data, and there are only two such towns. All other towns are ranked four or below.

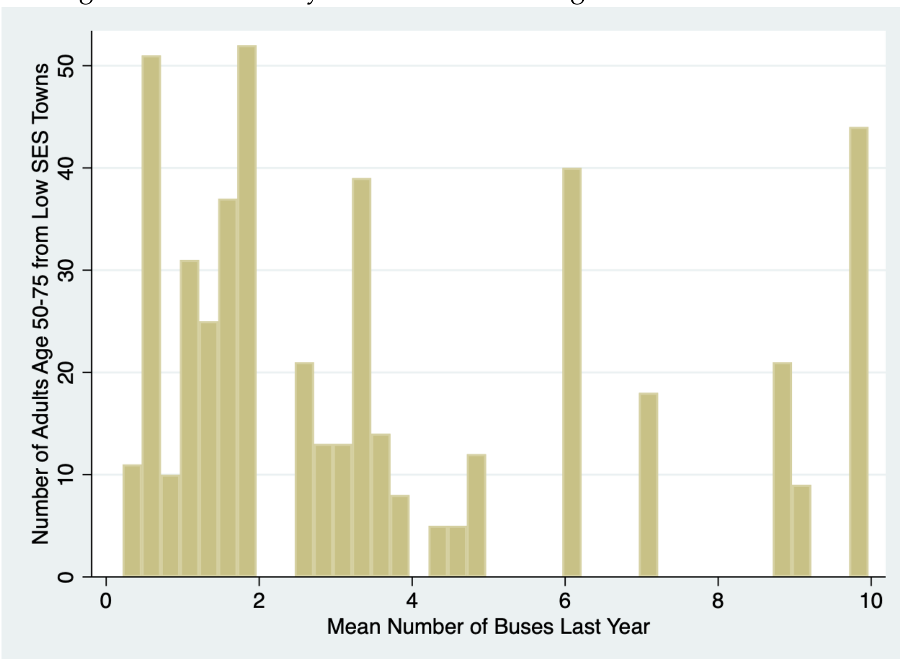
[16] In 2010, for example, Arabs in Israel that were ages 55+ comprised a mere 7.5 percent of the overall Arab population in Israel (CBS (2010)). Considering that of the 39 eligible towns in our sample of towns covered in the Arab Survey, there is a total of slightly less than 23,000 observations over the four cycles, a final sample of 2,800 adults ages 50-75 from these towns is fairly consistent with the age composition of the Arab population in Israel.

Table 1: Summary Statistics

	Lowest Socioeconomic Status Towns		Higher Socioeconomic Status Towns	
	Males	Females	Males	Females
Age	59.59	59.14	60.18	59.76
	(7.11)	(6.93)	(7.48)	(7.18)
Married	0.98	0.77	0.97	0.77
	(0.15)	(0.42)	(0.18)	(0.42)
Household Head	0.98	0.19	0.98	0.18
	(0.12)	(0.39)	(0.15)	(0.38)
Number of Household	5.42	4.62	4.38	3.66
Members	(2.79)	(2.92)	(2.21)	(2.12)
Year of Schooling	7.82	4.96	9.03	6.20
	(4.54)	(4.30)	(4.29)	(4.65)
Interview Month	6.36	6.33	6.56	6.59
	(2.69)	(2.67)	(2.82)	(2.85)
Mean Number of Buses Last	1.32	1.44	1.41	1.42
Year per 1K Residents	(2.56)	(2.60)	(3.45)	(3.52)
Mean Number of Buses Last Year	3.74	3.73	4.39	4.39
per 1K Residents, Non-Zero	(3.08)	(3.00)	(4.90)	(5.02)
No Chronic Health Conditions	0.41	0.36	0.44	0.39
	(0.49)	(0.48)	(0.50)	(0.49)
Reporting at least one Common	0.49	0.51	0.47	0.51
Health Condition	(0.50)	(0.50)	(0.50)	(0.50)
Reporting at least one Rare	0.16	0.23	0.12	0.18
Health Condition	(0.36)	(0.42)	(0.33)	(0.39)
Overweight	0.53	0.59	0.64	0.65
	(0.50)	(0.49)	(0.48)	(0.48)
Observations	653	643	834	842

Notes: The sample is individuals aged 50-75 from the Arab Survey for towns that did not have public transportation prior to 2008 . Standard deviations are in parenthesis. Mean Number of Buses Last Year is the mean across three dates in the preceding year of the frequencies of all bus lines serving the town per 1000 residents in the town. Lowest socioeconomic (SE) status towns refers to towns ranked 1-2. Higher SE status towns refers to towns ranked 3 and higher. For details on town SE ranking, see footnote 14 in Section 3. Common Health Conditions refers to the following: diabetes, heart problems, high cholesterol, or high blood pressure. Rare Health Conditions refers to the following: asthma, migraines, ulcer, joint problems, anemia, cancer, bone disease, genetic blood disease, and epilepsy.

Figure 2: Bus Intensity Measures - Adults Age 50-75 from Low Socioeconomically Ranked Towns



Notes: The sample includes individuals ages 50-75 from the Arab Survey from low socioeconomically ranked towns that did not have public transportation prior to 2008. Mean Number of Buses Last Year is the mean across three dates in the preceding year of the frequencies of all bus lines serving the town per 1000 residents in the town.

4 Empirical Strategy

4.1 Regression Specifications

If bus line penetration improved adult health outcomes, then we would mostly expect these improvements to prevail in the longer term, particularly when assessing chronic health conditions. We assign to each individual in our sample the mean of bus measures over the entire year preceding one's interview date. However, the actual effect of greater access to healthcare services on health outcomes may even take longer than a year. For this reason, our regression specification separately evaluates the effect of bus lines in the short term and long term, with the short term being up to two years since the initial introduction of public transportation to one's town. This results in the following regression specification:

$$\begin{aligned} Outcome_{itmy} &= \beta_0 + \beta_1 BusIntensityShortTerm_{tmy} + \beta_2 BusIntensityLongTerm_{tmy} \\ &\quad + \eta X_{itmy} + \mu_{s,y} + \gamma_t + \rho_m + \varepsilon_{itmy} \end{aligned} \tag{1}$$

We evaluate health outcomes for individual i in town t surveyed in month m in year y. Town t is part of subdistrict s. We control for individual-level and town-level demographic characteristics in equation (1)

(X_{ity}) - quadratic function of age, a series of indicators for the individual's relation to household head, the number of household members, individual's years of schooling (categorical), and the town's socioeconomic ranking. $\mu_{s,y}$ is subdistrict-year fixed effects, γ_t is town-level fixed effects, and ρ_m is fixed effects for the month of interview. All standard errors are clustered at the town level, to account for the possibility of within-town correlation of the error term, ε_{itmy} (Bertrand et al. (2004)).

Equation (1) is similar to a standard difference-in-differences (DID) specification only the main variable of interest is an intensity of treatment measure, rather than an indicator variable. In addition, the intensity of treatment measure is split into two - a variable for individuals observed up to 2 years since the initial introduction of bus lines to their town and a variable for individuals observed 2 years or more since the initial introduction of bus lines. This results in two coefficients of interest in equation (1): β_1 and β_2. Each capture the effect of each additional bus per 1000 residents serving the town in the short and long term, respectively. Treatment is staggered with the initial introduction of bus lines ranging between 2008 and 2013.

4.2 Identification

An ideal setting for causally identifying the effect of public transportation on health outcomes would randomly assign bus line penetration and their frequency changes across towns. Obviously, it is plausible that bus lines are not randomly assigned but rather are correlated with town characteristics that are also determinants of residents' health outcomes. We argue that our bus intensity measures are exogenous conditional on town and time fixed effects. As such, our regression specifications include town fixed effects, which control for any time-invariant differences between towns that are correlated with their bus intensity measures or the timing of public transportation penetration. In addition, our regression specifications take a more conservative approach than simply including year fixed effects, but rather include subdistrict-year fixed effects that control for time-variant shocks that are mutual to clusters of towns in close proximity to each other in a single year. Subdistricts are defined by Israel's CBS as areas with a mutual large (Jewish) city that serves as its economic and social activity center.[17,18]

In Table 2 we establish our identification assumption concerning the exogeneity of our bus intensity measures by showing a lack of correlation between town-level time-varying characteristics during 2003-2015 and our public transportation penetration measures, conditional on town and year fixed effects. We run regressions with annual town-level characteristics as dependent variables and mean annual bus inten-

[17] Subdistricts are called Napha in Hebrew.

[18] We note that our bus intensity measures do not only vary across towns and years but also to a small extent within town-year combinations, and this is due to varying interview timings for individuals in our sample. Because we take the mean bus intensity measures from the year preceding the interview date, if interview dates range over several months for certain town-year combinations, then this can result in different bus intensity measures within the same town for the same survey year. For our male older adult population from the lowest SES ranked towns, 8 town-year combinations have different bus intensity measures (out of 78). This is not sufficient variation to exploit the randomness of interview timings as a source for identifying a causal relationship between bus services and health outcomes within a regression specification with town-year fixed effects. However, this variation is exploited to some extent within our regression framework that includes subdistrict-year fixed effects.

Table 2: Public Transportation and Town Characteristics

	Demographic Town Characteristics Dependent Variables						
Dependent Variable	Infant Mortality per 1000 Births (Last 5 Years)	Mean Male Salary (2010 NIS)	Mean Female Salary (2010 NIS)	Percent Graduating with Matriculation Certificate	Last Year Number Self Employed (per 1K Adults)	Private Cars (per 1K Adults)	Accidents with Injuries (per 1000 Residents)
End of This Year All Buses	0.0847	-9.039	-12.50	-0.362	0.753	3.393	-0.0117
Intensity (per 1K Residents)	(0.0870)	(6.590)	(10.51)	(0.313)	(4.421)	(2.179)	(0.00865)
Number of Observations	333	379	379	401	414	398	425
R^2	0.769	0.916	0.833	0.615	0.191	0.957	0.608
Mean Dependent Variable	8.371	5531	3172	51.13	81.06	377.6	0.703
	Migration / Population Comoposition Dependent Variables						
Dependent Variable	Migration Balance (per 1K Residents)	Percent Age 0-19	Percent Age 20-44	Male Internal Migration (per 1K Residents)	Female Internal Migration (per 1K Residents)	Male Out Migration (per 1K Residents)	Female Out Migration (per 1K Residents)
End of Last Year All Buses	0.184	-0.0971	0.0809	0.0418	0.0920	-0.0307	-0.00779
Intensity (per 1K Residents)	(0.163)	(0.0708)	(0.0775)	(0.0664)	(0.0819)	(0.0347)	(0.0560)
Number of Observations	417	455	455	449	455	450	453
R^2	0.418	0.983	0.942	0.456	0.430	0.573	0.603
Mean Dependent Variable	1.011	48.48	35.46	3.011	5.172	2.601	4.811
P-Value Expalnatory Variable	0.267	0.179	0.304	0.533	0.269	0.381	0.89

Notes: The sample period is 2003-2015 and all town-level characteristic data is from the Israel CBS. Total number of towns varies based on dependent variable availability from 30 to 35. The top panel (demographic town characteristics) coefficient estimate presented is for this year's bus intensity measure and the bottom panel (migration dependent variables) coefficient estimate presented is for last year's bus intensity measure. All regressions include town and year fixed effects. Standard errors clustered at the town level are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

sity measures for the town as the explanatory variable, while controlling for town and year fixed effects. The coefficient estimates from these regressions are presented in the top panel of Table 2 and none are statistically significant at the 10% level.

We further establish causality by showing in the bottom panel of Table 2 that changes in our bus intensity measures are not correlated with town-level migration or population composition measures. The same regressions as in the top panel of Table 2 are run but with last year's bus intensity measure to allow for a lagged response in terms of migration. The statistically insignificant coefficient estimates in the bottom panel of Table 2 alleviate concerns that any changes in older adult health outcomes are driven by compositional changes in the town's population or perhaps changes in the availability of relatives to assist these older adults.[19]

Our identification also relies on parallel trends pre-treatment. We verify this through a placebo test for pre-existing trends in our outcomes of interest. We use the same sample of older adults from low SES ranked towns from our analysis, only excluding 2010 and 2014, the years for which there were positive values of bus penetration. We assign 2004 and 2007 observations "last year" bus intensities, as documented

[19]We stress that the Arab population in Israel is highly immobile with the vast majority residing in the same town they were born in for their entire life. The main exception is females who get married to someone outside of their hometown, in which case they move to the husband's hometown. Table 2 demonstrates this with mean outward and inward migration flows for our sample towns ranging from 2.6 to 5.2 persons per 1000 residents, which is very small. As a comparison, these figures are in the 40's for similarly-sized Jewish towns.

Table 3: Placebo Analysis - Assigning Bus Intensities Five Years Later for 2004 and 2007 Data

	Males	Females	Males	Females	Males	Females
	No Chronic Conditions		Common Health Conditions		Rare Health Conditions	
Buses Per 1000 Residents, Last Year -	0.0560	-0.0365	-0.0274	-0.168	-0.135	-0.0921
Within 2 Years of Bus Introduction	(0.333)	(0.151)	(0.291)	(0.146)	(0.177)	(0.147)
Buses Per 1000 Residents, Last Year -	0.192	0.0754	-0.158	-0.282*	-0.157	-0.0758
At least 2 Years After Bus Introduction	(0.308)	(0.140)	(0.271)	(0.140)	(0.164)	(0.134)
Observations	284	266	284	266	284	266
Mean of Dependent Variable	0.489	0.402	0.426	0.470	0.127	0.192
Town Fixed Effects	✓	✓	✓	✓	✓	✓
Subdistrict-Year Fixed Effects	✓	✓	✓	✓	✓	✓
Individual Level Controls	✓	✓	✓	✓	✓	✓

Notes: The sample is male and female older adults (ages 50-75) residing in the lowest SES ranked towns from 2004 and 2007. The table presents the coefficient estimates β_1 and β_2 from equation (1). For each dependent variable, results are presented for males and females in the first and second column, respectively. Individual level controls are the following: quadratic function of age, indicators for relation to household head, indicators for month of interview, number of household members, town's socioeconomic ranking (indicators), and educational attainment levels (categorical). "Buses per 1000 Residents, Last Year" for the individual being observed within 2 years of public transportation penetration to their town or at least two years after the introduction of public transportation to their town is as defined for the placebo analysis, with individuals from 2004 and 2007 treated as if they are observed in their towns in 2009 and 2012, respectively. Standard errors clustered at the town level are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

in our MOT bus line data for 2008 and 2011, respectively, thus treating them as if they are observed in 2009 and 2012, respectively. We then run regression specification (1) on the new data. The results are presented in Table 3 and exhibit non-significant coefficient estimates. Out of 12 coefficient estimates, one is statistically significant at the 10 percent level, which can be argued to be by chance.[20] We note that the results in Table 3 should be interpreted cautiously, as some coefficient estimates are quite large in magnitude and are not statistically significant due to large standard errors. Furthermore, the lack of statistical significance may also be driven by the smaller sample size, as only two survey years are utilized as opposed to four in the true analysis.

5 Results

5.1 Bus Intensity Measures and Health Outcomes - Raw Data

We begin by presenting the means of our four dependent variables for various bus intensity measures for our sample of older adults residing in the towns ranked lowest socioeconomically. We present results by gender in Figure 3 below. We create bins of bus intensity measures (on the horizontal axis of each sub-figure in Figure 3), such that the number of observations for each gender for which the means are calculated are at least 50 (see Figure 2 for the distribution of bus intensity measures in our sample).

Figure 3 suggests a clear pattern for three of our dependent variables - No Chronic Health Conditions,

[20]The dependent variable "Overweight" is not included in this analysis as weight and height measurements were not included in the 2004 survey.

Common Health Conditions, and Rare Health Conditions. As the bus intensity measures transition from zero to non-zero, we observe a supposedly deterioration of health - a decrease in the probability of having no chronic health conditions and an increase in the probability of having either a common or rare health condition. However, this pattern is reversed for the higher bus intensity measures. This suggests that upon initial introduction of buses - when bus intensity is relatively low - adverse health conditions are more prevalent, but later on - as bus intensity measures continue to rise - this trend fades off. We will argue that something is offsetting this initial effect of public transportation penetration, and it is health improvements in the long term due to greater access to secondary health care services.

We note that these patterns are not observed for the dependent variable Overweight. In fact, there is no clear trend in overweight means as we transition from zero bus intensity to the lower non-zero bus intensity measures. However, there is evidence of a slight decline in overweight in response to the higher bus intensity measures, relative to the mean overweight when the the bus intensity measure is zero. This may suggest a decrease in overweight in the long-term when bus intensity measures are higher.

We proceed to our regression analysis, which analyzes separate effects for the long term versus the short term, to confirm our conjectures based on the evidence from Figure 3.

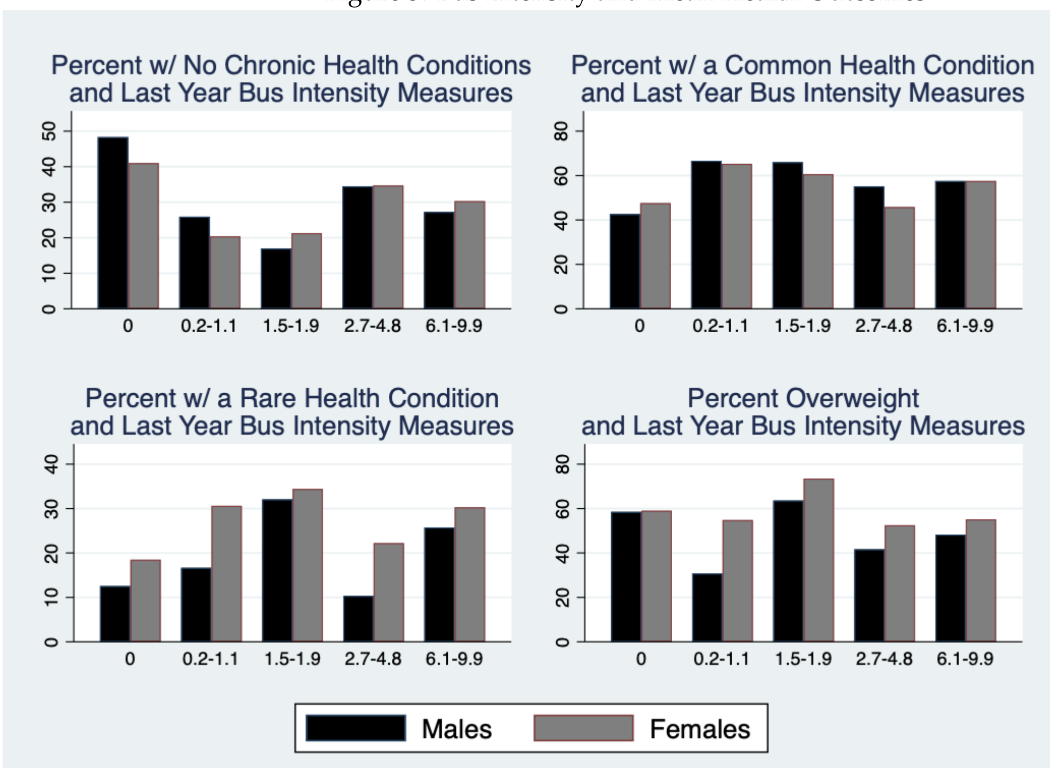
5.2 Regression Results - Low SES Adult Population

Table 4 presents results for our regression specification - equation (1) - for all adults ages 30-75 residing in the lowest SES ranked towns. For each dependent variable, the coefficients β_1 and β_2 are presented separately for the male and female samples, with and without individual-level control variables. The coefficient estimates are relatively stable across specifications with and without individual-level control variables, thus alleviating concerns that our main explanatory variable in the regression is correlated with these.

Table 4 primarily documents adverse effects of health outcomes in response to public transportation penetration. Both females and males report a lower probability of having no chronic health conditions. Females report greater diagnosis of common health conditions (heart problems, high cholesterol, high blood pressure, or diabetes), and males report a greater prevalence of being diagnosed with a rare health condition. The probability of female overweight increases. With the exception of overweight, all statistically significant adverse effects are in the short term and are no longer apparent in the long term. Although the difference between the short and long term coefficient estimates is not statistically significant (p-values from t-tests are not presented in Table 4, this could suggest that these supposedly adverse effects are stronger in the short term than they are in the short term - at least for chronic health conditions.

Quantitatively, the female response in terms of the probability of having no chronic conditions is a 3.9 percentage points decline for every additional bus frequency per 1000 residents (as a mean of the measures during the year preceding their interview date). Given that the mean of this measure is 1.44 (see Table 1) implies a decrease of 5.6 percentage points, which is a 16 percent decrease from the mean. Similar calculations reveal that the female probability of having at least one of the common health conditions and

Figure 3: Bus Intensity and Mean Health Outcomes



Notes: The sample includes individuals ages 50-75 from the Arab Survey from low socioeconomically ranked towns that did not have public transportation prior to 2008. The horizontal axis in each sub-figure presents the range of bus intensity measures across which the mean health outcome indicated in the title of that sub-figure was calculated. Each range includes at least 50 observations for each gender.

Table 4: Public Transportation Penetration and Adult Health in Low SES Towns

	Males		Females		Males		Females	
	No Chronic Conditions				Common Health Conditions			
Buses Per 1000 Residents, Last Year - Within 2 Years of Bus Introduction	-0.0152	-0.0113*	-0.0229**	-0.0165**	0.00917	0.00522	0.0172**	0.0123**
	(0.00956)	(0.00599)	(0.00919)	(0.00648)	(0.0113)	(0.00762)	(0.00682)	(0.00568)
Buses Per 1000 Residents, Last Year - At least 2 Years After Bus Introduction	0.00167	-0.0162	-0.00735	-0.0150	-0.0136	0.000956	-0.00493	0.00203
	(0.0152)	(0.0179)	(0.0175)	(0.0171)	(0.0141)	(0.0150)	(0.0140)	(0.0133)
Observations	2,030	2,030	2,041	2,041	2,030	2,030	2,041	2,041
R-squared	0.085	0.306	0.070	0.345	0.073	0.286	0.063	0.305
Mean of Dependent Variable	0.683	0.683	0.667	0.667	0.242	0.242	0.241	0.241
	Rare Health Conditions				Overweight			
Buses Per 1000 Residents, Last Year - Within 2 Years of Bus Introduction	0.0161***	0.0166***	0.00505	0.00187	0.0175	0.0161	0.0186	0.0215
	(0.00282)	(0.00207)	(0.00523)	(0.00409)	(0.0120)	(0.0136)	(0.0143)	(0.0145)
Buses Per 1000 Residents, Last Year - At least 2 Years After Bus Introduction	0.00448	0.0107	0.00435	-0.0041	0.0198	0.0107	0.0202*	0.0264*
	(0.00730)	(0.0104)	(0.00810)	(0.00610)	(0.0156)	(0.0180)	(0.0103)	(0.0135)
Observations	2,030	2,030	2,041	2,041	747	747	835	835
R-squared	0.048	0.092	0.067	0.159	0.212	0.232	0.149	0.186
Mean of Dependent Variable	0.0842	0.0842	0.115	0.115	0.584	0.584	0.491	0.491
Town Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Subdistrict-Year Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Individual Level Controls		✓		✓		✓		✓

Notes: The table presents the coefficient estimate β_1 and β_2 from equation (1). For each dependent variable, results are presented for the male and female adult population (age 30-75) in the first 2 and last 2 columns, respectively. Within each sex, results are presented with or without individual level controls - quadratic function of age, indicators for relation to household head, indicators for month of interview, number of household members, town's socioeconomic ranking (indicators), and educational attainment levels (categorical). "Buses per 1000 Residents - Last Year" refers to the mean bus frequency measure for the individual's town of residence among the 3 dates documented in bus line data during the year preceding the individual's interview date. This variable is either for individuals observed within 2 years of public transportation penetration to their town or at least two years after the introduction of public transportation to their town. "Common Health Conditions" is an indicator equal to one if diagnosed by a physician with at least one of the following: heart problems, high cholesterol, high blood pressure, or diabetes. "Rare Health Conditions" is an indicator for having been diagnosed by a physician with at least one of the following: asthma, migraines, ulcer, joint problems, anemia, cancer, bone disease, genetic blood disease, and epilepsy. Standard errors clustered at the town level are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

the male probability of having at least one of the rare health conditions increases by 7.7 and 11.1 percent of the mean, respectively.

We next evaluate whether some of the responses observed in Table 4 vary between older adults (ages 50-75) and younger adults (ages 30-49). Most of the health conditions we examine have a much greater prevalence among older adults. Figure 5 in the Appendix demonstrates this. We present results for coefficient estimates of β_1 and β_2 from equation (1) in Table 5 for two samples of adults residing in the lowest SES ranked towns - ages 30-49 and ages 50-75.

The results in Table 5 show that the short-term effects observed in Table 4 on the probability of having no chronic health conditions or a common health condition are indeed driven by the older adult population. For rare health conditions, the male short-term effect observed in Table 4 is similar for both the younger and older adult samples. The increase in overweight observed among females is entirely driven by the younger adult age group. In fact, older adult males and females actually experience a decrease in the probability of being overweight in the long term. For the older adult sample, the supposedly adverse effects continue to be statistically meaningful solely in the short term, as was exhibited in Table 4.

Quantitatively, the magnitude of the older adult responses observed are substantial relative to the dependent variable means. The female response in terms of the probability of having no chronic conditions is a 4.3 percentage points decline for every additional bus frequency per 1000 residents (as a mean of the measures during the year preceding their interview date). Given that the mean of this measure is 1.44 (see Table 1) implies a decrease of 6.2 percentage points, which is a 17 percent decrease from the mean. Similar calculations reveal that the female probability of having at least one of the common health conditions and the male probability of having at least one of the rare health conditions increases by 9 and 11 percent of the mean, respectively. The probability of older adults being overweight in the long term decreases by 16 and 22 percent of the mean for males and females, respectively.

Taken together, the results presented in Tables 4 and 5 suggest that in the short term there are increased diagnosis rates of chronic, common and rare health conditions in response to public transportation penetration and these statistically significant effects are no longer observed in the long term. In addition, this is primarily driven by the older adult population. Lastly, the older adult population exhibits improved health in the long term in response to public transportation penetration and this is through a decrease in the probability of being overweight. In contrast to this, younger adult females exhibit an increase in the probability of being overweight both in the short and long term.

For the older adult population, we argue that the increased prevalence of adverse health conditions is in response to greater diagnosis of health conditions rather than a deterioration of their health in response to public transportation penetration. This is supported by the finding that adverse effects for the older adults are stronger in the short term, when improved health outcomes are less likely. In the longer term, when improvements in health outcomes are more likely and can offset the increased diagnosis rates, we should observe weaker - if any - in adverse health effects. For overweight, we even observe in the long term improvements for male and female older adults. This is also consistent with the fact that our overweight measure is based on self-reported weight and height measurements so it is not based on diagnosis by a doctor, and as such we should not observe an increase in this in response to greater access to health care specialists.

Despite the consistent picture in the older adult population results, for younger adult females, we observe increases in the probability of overweight both in the long and short term, and in the long term they actually appear stronger. The increased overweight rates may be due to pre-existing trends among females. However, we are unable to test for this, as overweight data is only available starting in 2007.[21] We further

[21] We tried to get a sense of overweight trends in the female Arab younger adult population for this period, but could not obtain credible statistics. Specifically, the Israel Ministry of Health conducted three surveys during 2003-2015 inquiring about population health status and covering the Arab population as well. Overweight rates among Arab females ages 35-44 were stable across the three surveys (22.5, 19.6 and 21.1 percent in 2003-2004, 2007-2010, and 2013-2015, respectively) but the reports are very explicit about these

note that we may have to interpret all overweight results (including those of older adults) more cautiously, as the sample sizes are much smaller for this dependent variable, in comparison to our other dependent variables. This is due to no weight and height measurements in the 2004 survey and only a sub-sample covered in the three other surveys. Lastly, an additional possible explanation for increased overweight among younger adult females is that long distances to accessing public transportation penetration prior to bus penetration within towns were an opportunity for physical activity for this population and with the reduced distance to accessing public transportation this mode of staying in shape became more rare, thereby leading to greater overweight rates.

5.3 Regression Results - High SES Older Adult Population

We conducted the same regression analysis as in Table 5 on the sample of older adults in higher SES Arab towns. Although higher SES towns are still ranked fairly low, their vehicle ownership rates are higher. As such, we should expect public transportation to have smaller effects or affect less health outcomes among these populations. The results are presented in Table 6 and indeed confirm our expectations and exhibit public transportation effects in fewer health outcomes, in comparison to Table 5. For male common health conditions, there is evidence of a decreased probability in the long term. For female rare health conditions, there is evidence of increased diagnosis rates in the short-term. However, this coefficient estimate is very large in magnitude, and it is entirely driven by including asthma as one of the rare health conditions, thus suggesting that this result is likely spurious.[22]

5.4 Mortality

Given the evidence of increased diagnosis rates in response to public transportation penetration, we wish to verify that our results are indeed driven by higher diagnosis rates of health conditions that existed regardless of public transportation penetration rather than by deterioration in adult health. We therefore proceed to examine the effect of public transportation on mortality rates among adults ages 50 and older in Arab towns in Israel.

We utilize data from Israel's CBS that is obtained in cooperation with Israel's Ministry of Health on annual deaths at the town-level. For each Arab town, we obtained restricted data documenting the number of annual deaths for the period 2003-2016 by sex for ages 50-75 resulting from the following leading causes of death: cancer, respiratory conditions, heart conditions, infections, and liver/kidney problems. For our results to be statistically meaningful, we limit our sample to towns that had at least two deaths annually

estimates being imprecise due to small sample sizes (Ministry of Health (2005, 2012, 2017)).

[22]Specifically, we ran the same regression as in Table 6 for the same sample but with rare health condition now defined as having at least one of the components of rare health condition, with the exception of asthma. The short-term coefficient estimate dropped to 0.06 with a p-value of 0.5. When conducting the same exercise while excluding every other component of the dependent variable rare health conditions, the coefficient estimate remained stable around its value in Table 6, with p-values under 0.05. In our sample of 842 females ages 50-75 from higher SES towns, 18 of them have a positive indicator for asthma, 5 of which are observed with positive public transportation measures. If the positive and large coefficient estimate is entirely driven by this health conditions, given such a small number of observations driving this result, we conclude that this result is spurious.

Table 5: Public Transportation Penetration and Adult Health in Low SES Towns - Older vs. Younger Adults

	Ages 30-49		Ages 50-75		Ages 30-49		Ages 50-75	
	Males	Females	Males	Females	Males	Females	Males	Females
	No Chronic Conditions				Common Health Conditions			
Buses Per 1000 Residents, Last Year -	-0.00661	-0.0100	-0.0225	-0.0427***	0.00197	0.00686	0.0163	0.0313**
Within 2 Years of Bus Introduction	(0.00570)	(0.00715)	(0.0173)	(0.0120)	(0.00503)	(0.00490)	(0.0229)	(0.0118)
Buses Per 1000 Residents, Last Year -	-0.0283	-0.0176	-0.00783	-0.0338	0.0102	0.00278	0.00133	0.0174
At least 2 Years After Bus Introduction	(0.0182)	(0.0140)	(0.0153)	(0.0201)	(0.0160)	(0.0106)	(0.0169)	(0.0181)
Observations	1,377	1,398	653	643	1,377	1,398	653	643
R-squared	0.186	0.192	0.246	0.272	0.179	0.161	0.215	0.229
Mean of Dependent Variable	0.815	0.810	0.406	0.358	0.123	0.117	0.492	0.510
	Rare Health Conditions				Overweight			
Buses Per 1000 Residents, Last Year -	0.0134***	0.000402	0.0134**	0.00755	0.0148	0.0329*	-0.0190	-0.0193
Within 2 Years of Bus Introduction	(0.00256)	(0.00498)	(0.00592)	(0.0128)	(0.0113)	(0.0182)	(0.0209)	(0.0229)
Buses Per 1000 Residents, Last Year -	0.0141	0.00652	0.00838	-0.0199	0.0171	0.0762***	-0.0647*	-0.0905***
At least 2 Years After Bus Introduction	(0.00894)	(0.00416)	(0.0226)	(0.0191)	(0.0313)	(0.0190)	(0.0380)	(0.0256)
Observations	1,377	1,398	653	643	512	535	235	300
R-squared	0.086	0.115	0.154	0.211	0.292	0.214	0.333	0.336
Mean of Dependent Variable	0.0501	0.0644	0.156	0.226	0.607	0.436	0.532	0.590
Town Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Subdistrict-Year Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Individual Level Controls	✓	✓	✓	✓	✓	✓	✓	✓

Notes: The sample is male and female older adults residing in the lowest SES ranked towns. The table presents the coefficient estimates β_1 and β_2 from equation (1). For each dependent variable and age group, results are presented for males and females in the first and second column, respectively. Individual level controls are the following: quadratic function of age, indicators for relation to household head, indicators for month of interview, number of household members, town's socioeconomic ranking (indicators), and educational attainment levels (categorical). "Buses per 1000 Residents - Last Year" refers to the mean bus frequency measure for the individual's town of residence among the 3 dates documented in bus line data during the year preceding the individual's interview date. This variable is either for individuals observed within 2 years of public transportation penetration to their town or at least two years after the introduction of public transportation to their town. "Common Health Conditions" is an indicator equal to one if diagnosed by a physician with at least one of the following: heart problems, high cholesterol, high blood pressure, or diabetes. "Rare Health Conditions" is an indicator for having been diagnosed by a physician with at least one of the following: asthma, migraines, ulcer, joint problems, anemia, cancer, bone disease, genetic blood disease, and epilepsy. Standard errors clustered at the town level are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Public Transportation Penetration and Older Adult Health in Higher SES Towns - Short Term vs. Long Term

	Males	Females	Males	Females
	No Chronic Conditions		Common Health Conditions	
Buses Per 1000 Residents, Last Year -	0.124	-0.0881	0.129	0.110
Within 2 Years of Bus Introduction	(0.121)	(0.0747)	(0.143)	(0.0878)
Buses Per 1000 Residents, Last Year -	0.0260	-0.0293	-0.0359**	0.0108
At least 2 Years After Bus Introduction	(0.0267)	(0.0178)	(0.0149)	(0.0162)
Observations	834	842	834	842
R-squared	0.169	0.220	0.176	0.196
Mean of Dependent Variable	0.435	0.394	0.474	0.507
	Rare Health Conditions		Overweight	
Buses Per 1000 Residents, Last Year -	-0.101	0.131**	0.0466	-0.105
Within 2 Years of Bus Introduction	(0.0984)	(0.0524)	(0.124)	(0.333)
Buses Per 1000 Residents, Last Year -	-0.00490	-0.00702	0.0125	-0.0343
At least 2 Years After Bus Introduction	(0.0175)	(0.0115)	(0.0282)	(0.0204)
Observations	834	842	371	454
R-squared	0.136	0.144	0.266	0.267
Mean of Dependent Variable	0.124	0.184	0.644	0.652
Town Fixed Effects	✓	✓	✓	✓
Subdistrict-Year Fixed Effects	✓	✓	✓	✓
Individual Level Controls	✓	✓	✓	✓

Notes: The sample is male and female older adults (ages 50-75) residing in the higher SES ranked towns. The table presents the coefficient estimates β_1 and β_2 from equation (1). For each dependent variable, results are presented for males and females in the first and second column, respectively. Individual level controls are the following: quadratic function of age, indicators for relation to household head, indicators for month of interview, number of household members, town's socioeconomic ranking (indicators), and educational attainment levels (categorical). "Buses per 1000 Residents, Last Year" refers to the mean bus frequency measure for the individual's town of residence among the 3 dates documented in bus line data during the year preceding the individual's interview date. This variable is either for individuals observed within 2 years of public transportation penetration to their town or at least two years after the introduction of public transportation to their town. "Common Health Conditions" is an indicator equal to one if diagnosed by a physician with at least one of the following: heart problems, high cholesterol, high blood pressure, or diabetes. "Rare Health Conditions" is an indicator for having been diagnosed by a physician with at least one of the following: asthma, migraines, ulcer, joint problems, anemia, cancer, bone disease, genetic blood disease, and epilepsy. Standard errors clustered at the town level are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

(by sex) for all years in the sample. We are limited in this analysis to towns that are officially recognized by the Israeli government - the data does not exist for towns that are not officially recognized, and we have 11 such towns in our Arab Survey sample. This results in 15 towns that are ranked lowest socioeconomically and 17 towns that are ranked higher. It should be noted that our sample of towns for each SES ranked group is not balanced, as some towns shift from being ranked lowest to higher (and vice versa) during the sample period. The number of deaths is divided by the number of residents (in thousands) in the town and year that are ages 60-75. The CBS provides population breakdowns by town and year only for specific age intervals and these did not include the possibility to calculate the population for ages 50-75.

In addition to mortality rates, we also utilize data from the CBS on the mean age at death for each year and town for deaths at ages 50 and over. For this we also restrict the deaths to those resulting from the above-mentioned health conditions.

Our regression specification is as in equation (1) but we include year fixed effects rather than subdistrict-year fixed effects due to the substantially smaller number of towns. We present results with or without linear time trends at the town level. The point estimates with or without linear time trends are quite similar, although the standard errors are sometimes larger with linear time trends. Our variables of interest are the mean bus intensity measures for the short and long term within two years of initial introduction and more than two years after initial introduction, respectively.

The results are presented in Table 7 for two dependent variables, and two SES samples for both genders. The results do not suggest increased mortality in response to public transportation. Furthermore, a few statistically significant coefficient estimates point in the direction of reduced mortality. Death rates may have decreased in the longer term in both the lowest and higher SES ranked towns and females' mean age at death seems to have increased in the long term in the lowest SES ranked towns. This validates our hypothesis that increased diagnosis of health conditions is not driven by health deterioration.

5.5 Discussion

We observe greater diagnosis rates of adverse health conditions among older adult Arabs in response to public transportation within two years of initial penetration to one's town. This suggests that public transportation penetration increases diagnosis rates of many health conditions in the short term.[23] The increases are no longer observed in the longer term, and for overweight, we observe decreased rates. Thus, in the short term, greater access to health care specialists increases diagnosis of health conditions that were apparently prevalent regardless of public transportation penetration. However, in the longer term, some of these increased diagnosis rates may be offset by actual improved health due to greater access to health care facilities and specialists, and these improvements are even observed with statistically meaningful estimates for overweight.

[23] We note that Polyakova and Hua (2019) also find increased chronic disease rates among low-income older adults in rural areas in the U.S. and speculate that this may be due to systematic under-diagnosis of chronic conditions in less affluent areas.

Table 7: Public Transportation Penetration and Adult Mortality

	Deaths per 1000 Residents, Ages 50-75				Mean Age at Death, Ages 50+			
	Males		Females		Males		Females	
				Lowest Socioeconomically Ranked Towns				
Buses Per 1000 Residents, Last Year - Within 2 Years of Bus Introduction	-0.434	-0.403	-0.752	-0.518	0.658	0.598	0.204	0.389
	(0.288)	(0.370)	(0.538)	(0.638)	(0.400)	(0.457)	(0.213)	(0.292)
Buses Per 1000 Residents, Last Year - At least 2 Years After Bus Introduction	-0.769**	-0.798	-0.0816	0.222	0.0220	-0.0417	0.348**	0.613*
	(0.287)	(0.652)	(0.161)	(0.196)	(0.166)	(0.325)	(0.143)	(0.311)
Observations	152	152	99	99	152	152	99	99
R-squared	0.303	0.328	0.390	0.432	0.258	0.277	0.307	0.370
Mean of Dependent Variable	15.26	15.26	10.11	10.11	73.02	73.02	72.42	72.42
				Higher Socioeconomically Ranked Towns				
Buses Per 1000 Residents, Last Year - Within 2 Years of Bus Introduction	-0.824	-0.595	-0.0176	-0.317	0.387	0.272	0.366	0.364
	(0.605)	(0.682)	(0.552)	(0.597)	(0.514)	(0.522)	(0.325)	(0.406)
Buses Per 1000 Residents, Last Year - At least 2 Years After Bus Introduction	-0.217***	-0.134	-0.0817	-0.277**	0.228**	0.0927	0.0103	0.0198
	(0.0517)	(0.156)	(0.133)	(0.0976)	(0.102)	(0.143)	(0.0447)	(0.102)
Observations	198	198	139	139	198	198	139	139
R-squared	0.284	0.351	0.280	0.449	0.214	0.365	0.225	0.315
Mean of Dependent Variable	14.21	14.21	9.600	9.600	73.91	73.91	73.10	73.10
Town Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Individual Level Controls	✓	✓	✓	✓	✓	✓	✓	✓
Linear Time Trends		✓		✓		✓		✓

Notes: The sample is towns with at least 2 annual deaths in all years of our sample period - 2003-2016. The table presents the coefficient estimates β_1 and β_2 from equation (1) but without subdistrict-year fixed effects due to the smaller number of towns in the sample and with the addition of town-specific linear time trends in the second columns of each dependent variables-gender-SES ranking combination. "Buses per 1000 Residents, Last Year" refers to the mean bus frequency measure for the town among the 3 dates documented in bus line data during the year preceding the mortality data. This variable is either for individuals observed within 2 years of public transportation penetration to their town or at least two years after the introduction of public transportation to their town. Standard errors clustered at the town level are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Overweight is the only outcome in our analysis that does not rely on a doctor's diagnosis but rather on self-reported weight and height measurements. As such, it is not surprising that in the short term we do not observe an increased probability of overweight. It further makes sense that the decreased probability of overweight is most apparent in the longer term, in comparison to other health conditions. Following greater access to secondary health care specialists, older adult Arabs are doing more to improve their health. This is reflected in overweight measures more than other health measures that may still experience increased diagnosis rates due to greater access to secondary physicians.

We stress that the patterns observed in our results - increased diagnosis rates in the short term followed by null effects or improved health in the long term cannot be explained by potential health hazards introduced as a result of public transportation penetration, such as pollution. If such hazards were driving the higher diagnosis rates in the short term, then we should have also observed a persistence or even increase of higher diagnosis rates in the long term, when public transportation continued to serve these towns and even increased in its intensity. Our results - from Figure 3 and Tables 4-6 - are not consistent with this.

Mortality measures presented in Table 7 are also independent of doctors' diagnosis, and indeed we do not observe mortality results that reflect health deterioration in response to public transportation penetration. Furthermore, there is some evidence of decreases in mortality measures in response to public transportation penetration in the longer term.

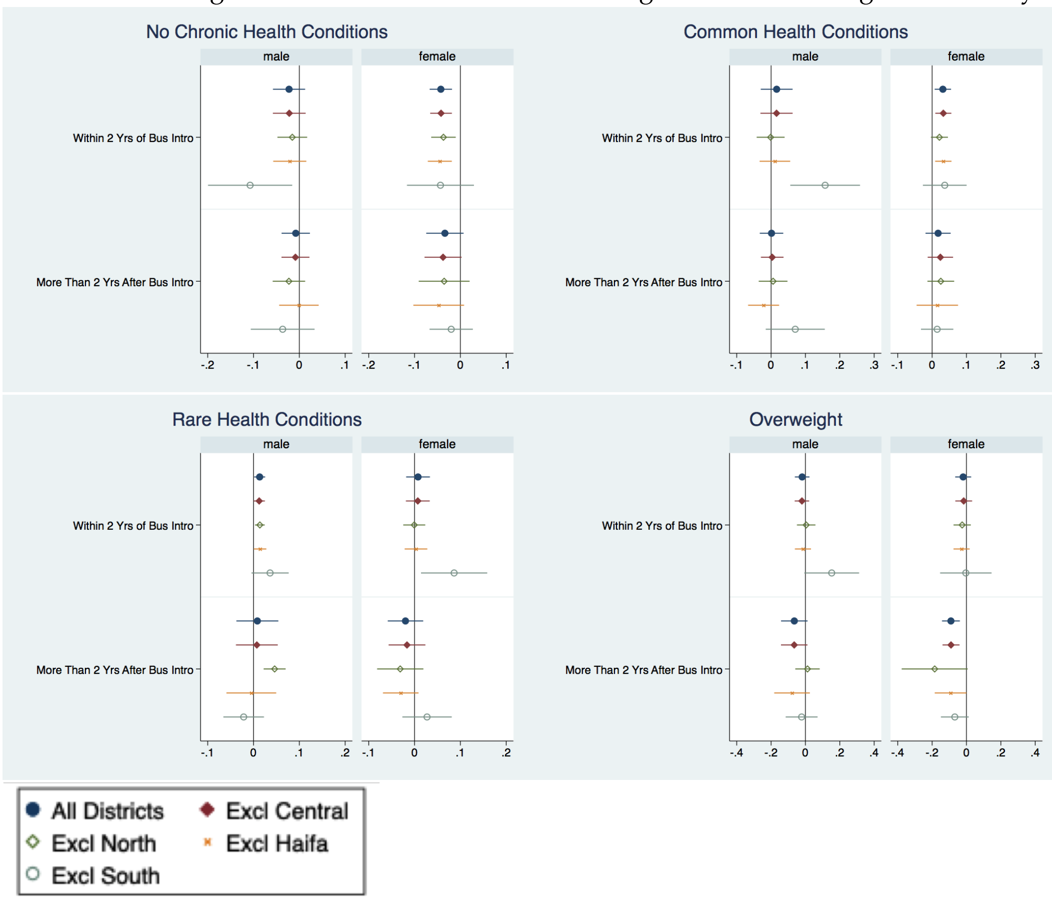
The short-term increases in diagnosis rates vary based on gender. Namely, female diagnosis of common health conditions increases, whereas for rare health conditions, the increase is only found among males. We note that females gained relatively more from the introduction of public transportation, as they were more constrained in using alternative modes of transit prior to the introduction. Furthermore, for our common health conditions, there is limited awareness of the high prevalence of these conditions (heart problems, high cholesterol) among females (Mosca et al. (2000, 2013)). Greater access to health care specialists may boost this awareness, thus resulting in higher diagnosis rates. The fact that only males respond in terms of rare health conditions may be due to the diagnosis of some of these conditions requiring greater travel to specific hospitals located further away geographically. Females' lower mobility within this traditional society may have inhibited greater access to these specific specialist health care services. Thus, despite evidence of greater female use of the new bus lines, in comparison to male use (Ronen (2014)), this may be confined to shorter travel distances that do not reach specific health care services associated with diagnosis of some of our rare health conditions.

6 Robustness Checks

6.1 Excluding Districts

To alleviate concern that our results are driven by a single district or a group of towns in close proximity to each other, we ran our regression from equation (1) excluding four different district combinations -

Figure 4: Robustness Check - Excluding Districts from Regression Analysis



Notes: The sample is male and female older adults (ages 50-75) residing in the lower SES ranked towns. Each graph presents for a separate dependent variable the coefficient estimates β_1 and β_2 from equation (1) along with their 95 percent confidence intervals for the sample of all districts, excluding Central district (and Jerusalem), excluding North District, excluding Haifa district, and excluding South district, according to the legend presented at the bottom. For additional explanations on the dependent and explanatory variables see Table 5.

Jerusalem and Central, North, Haifa, and South. Figure 4 plots for each dependent variable and each gender sample of older adults from low SES towns the estimates for β_1 and β_2, and their 95 percent confidence intervals. The top filled-in dot represents the estimate for older adults from Table 5, while all other dots exclude towns from certain districts as indicated by the legend at the bottom of the figure.

The results in Figure 4 demonstrate coefficient estimates that are relatively stable, although when towns from the South are excluded from the sample, adverse short term effects are more pronounced, even where null effects were observed for the entire sample. In some cases, excluding southern towns also resulted in increased standard errors, and this is consistent with the fact that over 30 percent of the observations in the sample are from the south, which accounts for 17 towns, out of a sample of 39.

6.2 Disaggregating Common Health Conditions Dependent Variable

Our dependent variable "Common Health Conditions" is an indicator variable equal to one if individuals reported being diagnosed by a physician with at least one of the following: heart problems, high cholesterol, high blood pressure, or diabetes. We run separate regressions for each of these dependent variables to better understand how public transportation affects each of these conditions separately. Table 8 presents the results of these specifications for older adults in the lowest SES ranked towns and older adults in the higher SES ranked towns in the top and bottom panels, respectively.[24]

Similar patterns to those observed in Tables 5-6 emerge in Table 8 - coefficient estimates are statistically significant when there is an increase in diagnosis rates in the short term or decreased diagnosis rates in the longer term. This is more apparent for the older adult population residing in the lowest SES ranked towns, also in accordance with Tables 5-6. Some of the coefficient estimates for older adults residing in the higher SES ranked towns are too large, but qualitatively they are consistent with the main results in Table 6.

We find no effect of public transportation on older adults' probability of having high blood pressure. This is not surprising, as high blood pressure among older adults is often diagnosed and managed within primary care, which was readily available prior to public transportation penetration.

An outlier in our results is the decrease in older adult low-SES female diabetes rates in the short term. It is plausible that this may be in response to greater access to secondary health care. However, it is not very convincing that these effects would be observed already within two years of initial public transportation penetration to one's town. The vast majority of those diagnosed with diabetes do not reverse their diagnosis and there is no cure for diabetes. As such, decreases in diagnosis rates should result primarily from preventative measures among those who are prone to diabetes but have not experienced it. This would require lifestyle choices among these persons, but in response to this the decrease in the probability of diabetes would not be expected to occur within a short time period of increased access to secondary health care .

We would like to note that our sample period is a period of significant changes in terms of awareness of increased diabetes and overweight among the Arab population and particularly among older Arab females, who experience the highest rates of overweight and diabetes in Israel.[25] While it is not directly obvious how this change in the health care community's attention towards diabetes can relate to lower diabetes rates among older Arab females, it is possible that greater awareness beginning around the middle of the sample period paid off by the end of the sample period in terms of reducing diabetes cases, and this reduction over time is correlated with greater public transportation penetration over time. We note that this is purely

[24]We do not present results for younger adults (age 30-49) in the lowest SES towns as the prevalence of each of these conditions separately is 4 percent or under for all conditions, with the exception of diabetes, with a mean of 6-7 percent in the population. Coupled with a small sample size, it is difficult to meaningfully interpret the coefficient estimates for such regressions.

[25]Diabetes is extremely high among older females in the Arab population - in 2015, 14.3 percent of females ages 45-54 and 32.2 percent of females ages 55-64 had diabetes, and this is compared with 5.3 and 12.3 precent rates respectively for the same-age Jewish female population (Chernochovaky et al. (2017)). Thus, diabetes rates among Arab females are nearly three times higher than among Jewish females for ages 45-64. For males, diabetes rates are also higher among Arabs, but the differences are not at the same orders of magnitude as in females (12.4 versus 7.8 precent and 26.9 versus 17.4 percent for ages 45-54 and 55-64, respectively).

Table 8: Disaggregating Common Health Conditions Dependent Variable

	Males	Females	Males	Females	Males	Females	Males	Females
	Heart Problems		Cholesterol		High Blood Pressure		Diabetes	
	Older Adults (Ages 50-75) - Low Socioeconomically Ranked Towns							
Buses Per 1000 Residents, Last Year -	-0.0120	0.0179***	0.0686***	0.0435***	0.00259	0.0112	0.00298	-0.0256**
Within 2 Years of Bus Introduction	(0.0105)	(0.00635)	(0.0114)	(0.0156)	(0.0206)	(0.0155)	(0.0130)	(0.0122)
Buses Per 1000 Residents, Last Year -	-0.0133	0.0191	0.0431*	0.0161	-0.0109	0.0167	0.0306*	-0.0291*
At least 2 Years After Bus Introduction	(0.0167)	(0.0144)	(0.0236)	(0.0267)	(0.0161)	(0.0145)	(0.0178)	(0.0146)
Observations	653	643	523	525	653	643	653	643
R-squared	0.132	0.194	0.213	0.226	0.174	0.199	0.188	0.244
Mean of Dependent Variable	0.170	0.107	0.191	0.202	0.216	0.345	0.265	0.291
	Older Adults (Ages 50-75) - Higher Socioeconomically Ranked Towns							
Buses Per 1000 Residents, Last Year -	0.163*	0.321***	-0.103	0.142	-0.0372	0.0790	0.0162	0.242***
Within 2 Years of Bus Introduction	(0.0948)	(0.0885)	(0.0919)	(0.115)	(0.106)	(0.0994)	(0.122)	(0.0636)
Buses Per 1000 Residents, Last Year -	-0.0245	-0.0133	0.00703	-0.00958	0.00797	0.0114	-0.0314***	0.00672
At least 2 Years After Bus Introduction	(0.0168)	(0.0157)	(0.0112)	(0.00958)	(0.0163)	(0.0176)	(0.0110)	(0.0249)
Observations	834	842	649	658	834	842	834	842
R-squared	0.110	0.159	0.201	0.174	0.154	0.195	0.197	0.191
Mean of Dependent Variable	0.143	0.112	0.159	0.157	0.245	0.315	0.265	0.324
Town Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Subdistrict-Year Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Individual Level Controls	✓	✓	✓	✓	✓	✓	✓	✓

Notes: The sample is male and female older adults residing in the lowest SES ranked towns and in the higher SES ranked towns in the top and bottom panels, respectively. The table presents the coefficient estimates β_1 and β_2 from equation (1). For each dependent variable, results are presented for males and females in the first and second column, respectively. Individual level controls are the following: quadratic function of age, indicators for relation to household head, indicators for month of interview, number of household members, town's socioeconomic ranking (indicators), and educational attainment levels (categorical). "Buses per 1000 Residents - Last Year" refers to the mean bus frequency measure for the individual's town of residence among the 3 dates documented in bus line data during the year preceding the individual's interview date. This variable is either for individuals observed within 2 years of public transportation penetration to their town or at least two years after the introduction of public transportation to their town. Standard errors clustered at the town level are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

speculative and we do not have evidence to support this.[26]

7 Concluding Remarks

We hypothesize that public transportation penetration to peripheral Arab towns in Israel will increase access to health care services and specialists. Our findings showed that increased public transportation increases older adults' diagnosis rates of common health conditions, including heart problems and high cholesterol, their diagnosis of rare health conditions, and their probability of having some chronic health condition more generally. This is more noticeable among populations that reside in towns ranked lower socioeconomically, which have less access to alternative modes of transportation. The increased diagnosis rates in the short term, followed by null effects on diagnosis rates or evidence of improved health in the longer term is consistent with improvements in some of these health outcomes in the longer term that are offsetting the observed rise in diagnosis. Indeed, for the probability of overweight, we observe a decline in response to public transportation penetration in the long term. The idea that increased diagnosis rates are not indicative of a decline in this population's health is further corroborated by an analysis of mortality measures, which do not increase - neither in the short term nor in the longer term - in response to public transportation penetration, and there is even some suggestive evidence of a decline in mortality.

Overall, our results emphasize the importance of reducing physical barriers in order to access secondary health care facilities and specialists, particularly among socioeconomically vulnerable populations. Health disparities between more advantaged and less advantaged populations are common throughout the world. The causes of these disparities have been investigated to varying extents and are numerous - cultural, educational, language barriers, and more. This paper shows that physical access to secondary health care can be one additional factor leading to health disparities, and moreover, it can be easily addressed by increased public transportation networks that connect to centers with specialist health care services.

[26]We stress that greater awareness of potential health risk factors is likely unique (or at least much stronger) when it comes to diabetes among Arab females during this period. During the 15 or so years preceding our sample period, Arab female diabetes rates have risen substantially in comparison to those of Jewish females, after being relatively similar (Na'amnih et al. (2010)). Furthermore, awareness of this phenomenon became more apparent only in the early 2000's, as pointed out by Treister-Goltzman and Peleg (2015) and a literature search we conducted in medical journals that discusses the rise of diabetes cases among Arab females in Israel.

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Appendix

A List of Towns in the Sample

Table 9: Town List

Town Name	District	Yr Bus Intro	Males 2004	Males 2007	Males 2010	Males 2014	Females 2004	Females 2007	Females 2010	Females 2014
Abu Ghosh	Jerusalem	2009	0	0	0	8	0	0	0	10
Albatil Karkur	Southern		0	0	4	0	0	0	4	0
Algarrah	Southern		0	0	0	4	0	0	0	3
Alhmira	Southern		0	0	0	6	0	0	0	4
Almtahar	Southern		0	0	7	5	0	0	5	7
Altwail	Southern		0	0	5	0	0	0	3	0
Ar'Ara-Banegev	Southern	2010	5	4	1	5	4	5	3	8
Ateer	Southern		0	0	1	0	0	0	0	0
Beer Almshash	Southern		0	0	0	5	0	0	0	4
Beit Jann	Northern	2008	0	0	0	11	0	0	0	10
Demeide	Northern		0	0	0	14	0	0	0	9
Ein Hod	Haifa		0	0	0	7	0	0	0	6
Hura	Southern	2008	0	4	4	5	0	5	6	6
Iksal	Northern	2008	0	0	0	9	0	0	0	7
Jaljulye	Central	2008	0	0	0	8	0	0	0	6
Jisr Az-Zarqa	Haifa	2013	1	11	1	5	2	11	3	7
Judeide-Maker	Northern	2010	10	17	6	10	8	23	5	13
Kabul	Northern	2009	0	9	0	0	0	10	0	0
Kamane	Northern		9	0	7	0	10	0	11	0
Kuhla	Southern		0	0	0	6	0	0	0	3
Kuseife	Southern	2008	0	10	6	5	0	4	6	13
Laqye	Southern	2010	0	7	0	6	0	5	0	8
Ma'Ale Iron	Haifa	2013	22	6	15	8	27	5	15	14
Majd Al-Kurum	Northern	2009	0	1	23	4	0	1	26	5
Muqeible	Northern	2008	6	0	0	5	5	0	0	4
Nahef	Northern	2009	10	0	12	14	5	0	10	11
Qalansawe	Central	2010	9	9	15	6	8	13	15	6
Rahat	Southern	2009	12	29	16	12	7	25	19	9
Rahma	Southern		0	0	0	4	0	0	0	7
Ras Ali	Haifa		0	0	8	0	0	0	7	0
Sha'Ab	Northern	2009	10	9	7	0	10	4	4	0
Sheikh Dannun	Northern		0	0	15	0	0	0	12	0
Tal Almalah	Southern		5	0	7	0	4	0	5	0
Tayibe (Baemeq)	Northern		0	0	0	5	0	0	0	3
Tel Sheva	Southern	2010	3	2	9	0	0	3	6	0
Tuba-Zangariyye	Northern	2013	0	8	0	5	0	7	0	3
Umm Al-Fahm	Haifa	2010	21	28	7	1	20	27	13	4
Wadi Alni'Am	Southern		7	0	0	0	8	0	0	0
Yirka	Northern	2010	0	0	0	10	0	0	0	9

Notes: Total number of towns: 39. Male and Female columns refers to the number of observations in the sample of older adults (ages 50-75) for that town and year.

B Summary Statistics - Disaggregating Dependent Variables

In Table 10 we present summary statistics for the components of our aggregated dependent variables - Common Health Conditions and Rare Health Conditions. Common Health Conditions is comprised of diabetes, heart problems, high cholesterol, and high blood pressure. All other health conditions in Table 10 are components of Rare Health Conditions.

C Means of Dependent Variable by Age Group

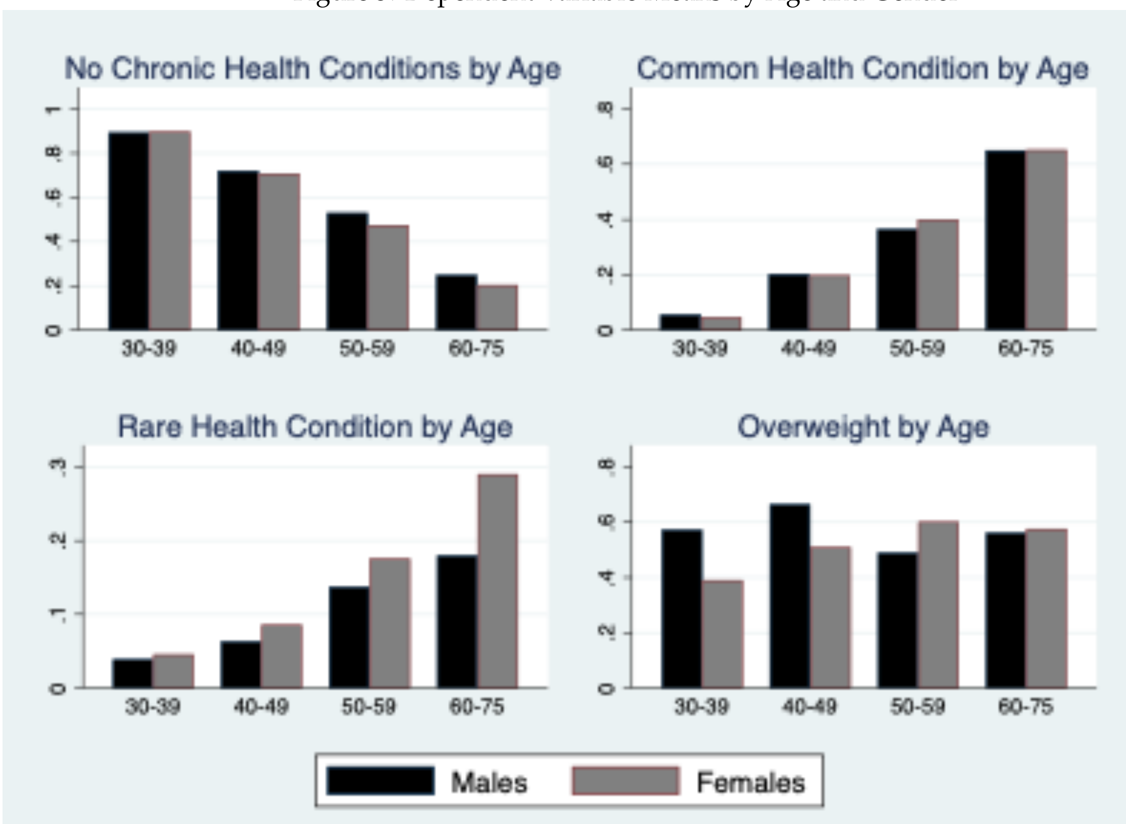
We present the means of our four dependent variables by age groups - 30-39, 40-49, 50-59, and 60-75 - and gender in Figure 5. As can be seen, for three of our four dependent variables - No Chronic Health Conditions, Common Health Conditions, and Rare Health Conditions - these health conditions are much more relevant at an older age . For Rare Health Conditions, there is a sharp increase when transitioning from the 40-49 to the 50-59 age range. For Overweight, only females demonstrate rising rates as age increases, and this is not as sharp as with the other health conditions that are much less apparent at younger ages.

Table 10: Summary Statistics - Disaggregating Dependent Variables

	Lowest Socioeconomic Status Towns		Higher Socioeconomic Status Towns	
	Males	Females	Males	Females
Diabetes	0.26	0.29	0.26	0.32
	(0.44)	(0.45)	(0.44)	(0.47)
Heart Problems	0.17	0.11	0.14	0.11
	(0.38)	(0.31)	(0.35)	(0.32)
High Cholesterol	0.19	0.20	0.16	0.16
	(0.39)	(0.40)	(0.37)	(0.36)
High Blood Pressure	0.22	0.35	0.24	0.31
	(0.41)	(0.48)	(0.43)	(0.46)
Asthma	0.0444	0.0404	0.0252	0.0214
	(0.2062)	(0.1971)	(0.1568)	(0.1447)
Migraine	0.0325	0.0438	0.0200	0.0289
	(0.1775)	(0.2049)	(0.1402)	(0.1676)
Ulcer	0.0352	0.0295	0.0180	0.0119
	(0.1845)	(0.1695)	(0.1330)	(0.1084)
Joint Problems	0.0352	0.1058	0.0528	0.0926
	(0.1845)	(0.3078)	(0.2237)	(0.2901)
Anemia	0.0107	0.0156	0.0036	0.0143
	(0.1031)	(0.1238)	(0.0599)	(0.1186)
Cancer	0.0230	0.0171	0.0144	0.0178
	(0.1499)	(0.1298)	(0.1192)	(0.1324)
Bone Problems	0.0115	0.0343	0.0139	0.0304
	(0.1066)	(0.1821)	(0.1170)	(0.1718)
Genetic Blood Disease	0.0060	0.0040	0.0050	0.0132
	(0.0774)	(0.0635)	(0.0704)	(0.1142)
Epilepsy	0.0060	0.0000	0.0017	0.0033
	(0.0774)	0.0000	(0.0407)	(0.0574)
Observations	653	643	834	842

Notes: The sample is individuals aged 50-75 from the Arab Survey for towns that did not have public transportation prior to 2008 . Standard deviations are in parenthesis. Mean Number of Buses Last Year is the mean across three dates in the preceding year of the frequencies of all bus lines serving the town per 1000 residents in the town. Lowest socioeconomic (SE) status towns refers to towns ranked 1-2. Higher SE status towns refers to towns ranked 3 and higher. For details on town SE ranking, see footnote 14 in Section 3.

Figure 5: Dependent Variable Means by Age and Gender



Notes: The figure presents the means of the respective dependent variable by age group and gender for the sample of adults residing in the lowest socioeconomically ranked towns. Total number of male and female observations is 2,030 and 2,041, respectively.