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ARTICLE

Is there an endogeneity problem between health and apartment value? Gender differences and the impact of obesity on property self-evaluation

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Abstract
Background Numerous studies have compared self evaluation and market values of apartments by employing hedonic regressions. Most of these studies demonstrated that self evaluation of apartments are typically overly optimistic. Yet, none of these studies explored the relationship between self-evaluation of apartments and obesity as a proxy for self esteem, particularly among women. Previous empirical evidence suggests weight discrimination against women in employment and income, education and romantic relationships. Following the influence of western values and norms regarding a slim body image of women and the implications of these social obesity penalties, one would anticipate a lower self evaluation of apartment value among obese women. Another strand of the literature shows that compared to men, women are more conservative financial investors. *Objectives* To explore gender differences in self-evaluation of apartments with respect to *BMI* ($=\frac{WEIGHT}{HEIGHT^2}=\frac{kg}{meter^2}$ where $BMI \geq 30$ is defined as obese person) as a proxy for self esteem. In an economic rational domain, housing price evaluations are not expected to be influenced by personal characteristics (such as gender, wealth, employment marital and immigration status, number of children) and psychological features of the evaluator. Consequently, the current study is closely related to the literature that deals with real estate and behavioral finance and economics. *Methods* We analyze a representative sample of the Israeli population, obtained from the 2015–2016 longitudinal survey carried out by the Israeli Central Bureau of Statistics (ICBS), where the responses of each individual were recorded twice (during 2015 and 2016). The survey includes information on weight and height of each family member, from which the *BMI* measure is calculated (weight ÷ height^2), as-well-as apartment value, gender and a long list of economics and socio-demographic control variables, and apartment characteristics. To investigate this research question, we use a 2SLS methodology, and run the empirical model separately based on ethnic origin and gender. *Results* Findings suggest that for both genders, *BMI* is negatively correlated with self-evaluation of apartments. Yet, compared to men, female self-evaluation of housing prices are more conservative and less influenced by *BMI* changes. This outcome is obtained despite the fact that as part of the modern western societies, Jewish Israeli women are more susceptible to weight gain. Research findings thus support the conclusion that the evaluation of women are more conservative and risk averse. Moreover, with respect to obesity, compared to males, the cognitive error in price evaluation is smaller among females.

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1 Introduction

Obesity is a known risk factor for a long series of health problems (e.g., Wikström et al., 2015; Yoon et al., 2015; Hermesch et al., 2016; OECD, 2019; Shamriz et al., 2017, Yan et al., 2017; Gasse et al., 2019). Obesity might be partially attributed to unhealthier food consumption and lack of physical exercise. The lack of physical activity and obesity have been identified by the World Health Organization as a global pandemic and the fourth leading risk factor for global mortality responsible for an estimated 3.2–5.0 million deaths annually (Sallis et al., 2016; WHO report).

Following Arbel et al., (2019a, 2019b), the objective of the current study is to explore gender differences in self-evaluation of apartments with respect to *BMI* ($=\frac{WEIGHT}{HEIGHT^2}=\frac{kg}{meter^2}$) as a proxy for self esteem. Many studies compared self evaluation and market values of apartments by employing hedonic regressions (e.g., Tur-Sinai et al., 2020: 7–8). Most of these studies demonstrated that self evaluation of apartments are overly optimistic. Based on the American Housing Survey, Kiel and Zabell (1999) found that on average, recent buyers report house values that are 8.4% higher than the stated sales prices. Yet, this gap dropped to only 3.3% for owners with longer tenure. Anenberg (2011*a*) demonstrated that sellers who put their homes on the market after a period where prices declined, tend to overstate the value of their home. Similar findings were analysed in Genesove and Mayers (1997, 2001) for the Chicago housing market.[1] Two reasons proposed by the authors to explain this phenomena are a liquidity constraint (the required downpayment for subsequent apartment) and loss aversion (Kahneman and Tverski, 1979): "When house prices fall after a boom, as in Boston, many units have a market value below what the current owner paid for them. Owners who are averse to losses will have an incentive to attenuate that loss by deciding upon a reservation price that exceeds the level they would set in the absence of a loss, and so set a higher asking price, spend a longer time on the market, and receive a higher transaction price upon a sale." Genesove and Mayers (2001, page 1235) Anenberg (2011*b*) strenghten and extends these findings.

In the Israeli context, compared to the United States, recently Tur-Sinai et al. (2020) found a much greater overestimation by homeowners of 20% and a median bias of 15%. These estimates are much higher than the range of biases found in previous research. This fact may be attributed to a wider spread between the asking price of a property and the sales price in the Israeli real estate market than in the US market that was the focus of much of the previous literature analysis.[2]

Finally, other related articles in real estate and behavioral finance explored the Israeli sales programs of housing units to public-housing tenants during 1990–2000. Referring to discount rates proposed to tenants based on socio-economics criteria, Arbel et al. (2014, 2016) demonstrated that buyers are prone to use previous discount rates as anchors and

[1] The authors state that: "In a bust, however, homes tend to sit on the market for long periods of time with asking prices well above expected selling prices, and many sellers eventually withdraw their properties without sale." (page 1233).

[2] Referring to the Israeli housing market see also: Romanov et al. (2012), Fleishman and Gubman (2015).

the decision to buy is influenced by the first reduction rate proposed to tenants. Ben-Shahar et al. (2016) found evidence supporting loss-aversion among buyers, which, in turn, is attenuated among disabled persons. A possible interpretation is a more rational decision making process with more limitations. Keysar et al. (2012) found similar evidence supporting the conclusion that compared to their native language, people engage in more rational decision making in a foreign language. Differently put, use of a foreign language may be viewed as a disability imposed on the participants in the experiments.

The current study is closely related to the literature that deals with real estate and behavioral finance and economics. Referring to the Israeli housing market, an interesting aspect, which was not previously explored, is the relationship between self-evaluation of apartments and obesity as a proxy for self esteem, particularly among women. In an economically rational domain, housing price evaluations are not expected to be influenced by personal characteristics (such as gender, wealth, employment marital and immigration status, number of children) and psychological features of the evaluator. In contrast, Northcraft and Neale (1987) provide strong evidence that previous laboratory research on decisional heuristics and biases is applicable to "real world," information-rich, interactive estimation and decision contexts.

Previous literature on obesity demonstrates the particular inclination of native Jewish Israeli women to gain weight at a slower pace compared to female immigrants from Russia (Arbel et al., 2020a, 2020b). Another strand of the literature demonstrates weight discrimination against women in employment and income, education and romantic relationships (e.g., Asgeirsdottir, 2011; Atella et al., 2008; Averett, 2014; Brunello & D'Hombres, 2007; Caliendo & Gehrsitz, 2016; Campos-Vazquez & Gonzalez, 2020; Cawley, 2004; Fikkan & Rothblum, 2012; Garcia & QuintanaDomeque, 2006; Han et al., 2011; Hansson et al., 2010; Lundborg et al., 2014; Morris, 2007). Finally, Baeckström et al. (2020) demonstrate that in the U.K. female investors with male advisors are more risk averse, feel less knowledgeable and less confident about their investment decisions. They also invest 11%-points less than women with female advisors. Indeed, female investors advised by women report the highest risk tolerance and make the lowest portfolio allocation to risk-free assets across the full sample, including men.

We observe a representative sample of the Israeli population, obtained from the 2015–2016 longitudinal survey carried out by the Israeli Central Bureau of Statistics (ICBS) where the responses of each individual were recorded twice (during 2015 and 2016). The survey includes information on weight and height of each family member, from which the *BMI* measure is calculated (weight ÷ height^2), as-well-as apartment value, gender and a long list of economics and socio-demographic control variables, and apartment characteristics. One of which is gross annual income of the household. Arbel et al (2019a) has demonstrated a *drop* in projected *BMI* among retired Israeli women above 67 years with higher gross annual income from a pension.

Given that self-evaluation of apartments and *BMI* are determined endogeneously (i.e., according to the OECD report from 2017, 2019 (obesity update), weight and height are self-reported in Israel), a 2SLS methodology is required to correct this endogeneity problem and provide consistent estimates (e.g., Anatolyev and Gospodinov (2011a, 2011b); Greene (2012); Anatolyev and Skolkova (2019) and Arbel et al. (2019b)).

Interestingly, our findings suggest that for both genders, *BMI* is negatively correlated with apartment self-evaluation. Yet, compared to men, female self-evaluation of housing prices is more conservative and less influenced by *BMI* changes. While a 1-point *BMI* rise (drop) decreases (increases) the projected evaluation by 338,818 NIS among men, the equivalent figure for women is only 195,775 NIS. If the market value of an Israeli average

apartment was 1,478,000 NIS in 2016, while the male bias is 22.92%, the female bias for a 1-point *BMI* change reduces by 57.78% to 13.246%. This outcome is obtained despite the fact that women are more susceptible to weight gain, particularly in western societies (e.g., Torstveit et al., 2015; Prioschery et al., 2017; Guzmán de la Garza, 2019).

The remainder of this article is organized as follows. Section 2 presents descriptive statistics of the variables incorporated in the empirical model. Section 3 describes the empirical model and results. Finally, Sect. 4 concludes and summarizes.

2 Descriptive statistics

Table 1 gives the descriptive statistics of the variables, which will be later incorporated in the regression analysis (i.e., mean, standard deviation., minimum, maximum). Given that the empirical model is applied separately to females and males, the table is segmented based on gender. It is stratified by adult Jewish Israeli females (section A) and males (section B). Jews comprise the majority group—75% of the Israeli population (Israeli Central Bureau of Statistics Press Release, July 27, 2018). In section B we also report 95–99% confidence intervals of male-female differences.

According to the variable definitions of the ICBS, weight in kilograms was measured in light clothing and without shoes. The average Jewish Israeli female's weight is 66.11 kg, and the average Jewish Israeli male's weight is 82.35 kg (*WEIGHT*). The null hypothesis of zero male-female average weight difference is clearly rejected at the 1% significance level. The 99% confidence interval of male–female weight difference ranges between 14.77 and 17.70 kg in favor of men.

According to the variable definitions of the ICBS, height in meters was measured without shoes. The average Jewish Israeli female's height is 1.63 m, and the average Jewish Israeli male's height is 1.76 m (*HEIGHT*). The null hypothesis of zero male-female height difference is clearly rejected at the 1% significance level. The 99% confidence interval of male–female height difference ranges between 12.49 cm and 13.99 cm in favor of men.

This paper examines whether *BMI* (as a proxy for prevalence of obesity) and apartment values are endogenous (dependent) variables. The implication is the chicken and egg problem (e.g., Arbel et al., 2020a). One possibility is that *BMI* affects apartment value, namely, under equal conditions obese persons are more inclined to decrease the self-valuation of their apartment. The second possibility is that better housing (reflected in higher apartment value) influences people to be less obese, namely, develop better awareness to the importance of nutrition and elevated level of physical activity.

To test these research hypotheses, one would need to formulate an empirical model, which includes a system of two structural equations. The first equation includes *BMI* as the dependent variable (on the left-hand side) and apartment value along with a series of exogenous (independent) variables on the right-hand side. The second equation includes apartment value as the dependent variable (on the left-hand side) and BMI along with a series of exogenous (independent) variables on the right-hand side. This formulation is presented in subsequent sections.

The first endogenous (dependent) variable in the empirical model, described mathematically in the subsequent section, is *BMI*. This measure is considered a convential measure for obesity. It is calculated as $\text{weight} \div \text{height}^2$, where $25 \le BMI < 30$ is considered overweight, and $BMI \ge 30$ is considered obesity (e.g., Arroyo-Johnson & Mincey, 2016). The latter is a risk factor for a long series of health problems (e.g., Wikström et al., 2015; Yoon

Table 1 Descriptive statistics. a. Jewish females b. Jewish males

Variable	Definition	*N*	Mean	STD	Min	Max
WEIGHT	Weight in kilograms in light clothing and without shoes	1.063	66.11	12.37	44	117
HEIGHT	Height in meters without shoes	1.063	1.63	0.06	1.49	1.87
BMI	weight ÷ height^2	1.063	25.03	4.64	16.60	44.58
*BMI*25	1 = *BMI* ≥ 25 (overweight, Type I and Type II obesity); 0 = otherwise (*BMI* < 25)	1.063	0.4675	0.4992	0	1
*BMI*30	1 = *BMI* ≥ 30, (Type I and Type II obesity); 0 = otherwise (*BMI* < 30)	1.063	0.1317	0.3383	0	1
APRT_VALUE	Self assessed apartment value in NIS	1.063	1,925,270	1,254,740	13,000	1.50×10^{-7}
AGE	Personal age in years	1.063	49.67	16.41	19	80
SINGLE	1 = single; 0 = otherwise	1.063	0.1486	0.3559	0	1
MARRIED	1 = married; 0 = otherwise	1.063	0.7046	0.4564	0	1
DIVORCED	1 = divorced; 0 = otherwise	1.063	0.0809	0.2728	0	1
WIDOWED	1 = widowed; 0 = otherwise	1.063	0.0659	0.2481	0	1
NATIVE	1 = Native Jewish Israeli (born in Israel); 0 = otherwise	1.063	0.6406	0.4800	0	1
EUROPE_AMERICA	1 = Jewish immigrants from European or American countries; 0 = otherwise	1.063	0.2625	0.4402	0	1
ASIA_AFRICA	1 = Jewish immigrants from Asian or African countries	1.063	0.0969	0.2960	0	1
HHSIZE	Number of persons in the household	1.063	3.56	1.72	1	11
SCHYEARS	Number of school years	1.063	14.60	2.07	4	16
NON_PARTICIPANT	1 = not looking for a job; 0 = otherwise	1.063	0.2935	0.4556	0	1
EMPLOYED	1 = employed; 0 = otherwise	1.063	0.6576	0.4747	0	1
UNEMPLOYED	1 = unemployed; 0 = otherwise	1.063	0.0489	0.2158	0	1
GRTOTINC	Gross annual total income in NIS	1.063	293,038.8	316,793.1	360	3,223,913
CONSTRUCT_AGE	Age of the structure in years	1.063	27.72	15.81	12	70
SINGLE_FAMILY	1 = single family detached unit; 0 = otherwise	1.063	0.3509	0.4774	0	1

Table 1 (continued)

Variable	Definition	*N*	Mean	STD	Min	Max
WEIGHT	Weight in kilograms in light clothing and without shoes	1.086	82.35$^{\#\#\#}$ [14.77, 17.70]	13.98	44	120
HEIGHT	Height in meters without shoes	1.086	1.76$^{\#\#\#}$ [0.1249, 0.1399]	0.07	1.49	1.90
BMI	weight ÷ height^2	1.086	26.61$^{\#\#\#}$ [1.0897, 2.0785]	4.23	17.58	45.72
BMI25	1 = BMI ≥ 25 (overweight, Type I and Type II obesity); 0 = otherwise (BMI < 25)	1.086	0.5718$^{\#\#\#}$ [0.0490, 0.1596]	0.4950	0	1
BMI30	1 = BMI ≥ 30, (Type I and Type II obesity); 0 = otherwise (BMI < 30)	1.086	0.1976$^{\#\#\#}$ [0.0076, 0.0881]	0.3840	0	1
APRT_VALUE	Self Assessed Apartment Value in NIS	1.086	2,008,712 [_ 57.343, 224,225]	1,276,698	13,000	1.50×10^{-7}
AGE	Personal age in years	1.086	49.29 [−2.24, 1.48]	17.04	19	80
SINGLE	1 = single; 0 = otherwise	1.086	0.1869$^{\#\#}$ (0.0067, 0.0699) [−0.0032, 0.0798]	0.3900	0	1
MARRIED	1 = married; 0 = otherwise	1.086	0.7385$^{\#}$ [−0.0159, 0.0837]	0.4397	0	1
DIVORCED	1 = divorced; 0 = otherwise	1.086	0.0534$^{\#\#}$ (−0.0487, −0.0063) [−0.0553, 0.0003]	0.2249	0	1
WIDOWED	1 = widowed; 0 = otherwise	1.086	0.0212$^{\#\#\#}$ [−0.0673, −0.0220]	0.1440	0	1
NATIVE	1 = Native Jewish Israeli (born in Israel); 0 = othewise	1.086	0.6731 [−0.0203, 0.0853]	0.4692	0	1
EUROPE_AMERICA	1 = Jewish immigrants from European or American countries; 0 = otherwise	1.086	0.2256$^{\#\#}$ (−0.0732, −0.0005) [−0.0846, 0.0109]	0.4182	0	1
ASIA_AFRICA	1 = Jewish immigrants from Asian or African countries	1.086	0.1013 [−0.0289, 0.0376]	0.3019	0	1

Table 1 (continued)

Variable	Definition	*N*	Mean	STD	Min	Max
HHSIZE	Number of persons in the household	1.086	3.78### [0.0322, 0.4230]	1.79	1	11
SCHYEARS	Number of school years	1.086	14.47 [−0.3611, 0.1111]	2.18	4	16
NON_PARTICIPANT	1 = not looking for a job; 0 = otherwise	1.086	0.2569# [−0.0862, 0.0131]	0.4371	0	1
EMPLOYED	1 = employed; 0 = otherwise	1.086	0.6731 [−0.0369, 0.0680]	0.4693	0	1
UNEMPLOYED	1 = unemployed; 0 = otherwise	1.086	0.0700## (0.0011, 0.0410) [−0.0052, 0.0473]	0.2552	0	1
GRTOTINC	Gross annual total income in NIS	1.086	316,394.5# [−11,867, 58,579]	316,522.3	3,000	3,223,913
CONSTRUCT_AGE	Age of the structure in years	1.086	27.57 [−1.9186, 1.6192]	16.00	12	70
SINGLE_FAMILY	1 = single family detached unit; 0 = otherwise	1.086	0.3564 [−0.0477, 0.0587]	0.4791	0	1

[95%] (99%) confidence intervals of male–female differences are given in (round) [square] brackets. NIS is the local Israeli currency (1 NIS ≈ 0.25 US Dollar)

# $p < 0.1$ for male–female differences. ## $p < 0.05$ for male–female differences. ### $p < 0.01$ for male–female differences

et al., 2015; Hermesch et al., 2016; OECD, 2017; Shamriz et al., 2017; Yan, et al., 2017; Gasse et al., 2019). However, with two exceptions (Arbel et al., 2020a, 2020b), an important limitation of the existing analyses lies in the fact that endogeneity problems were rarely considered. Ignoring these problems may lead to inconsistent estimates (e.g., Johnston & Dinardo, 1997: 305–309; Greene, 2012: 259–296).

The average *BMI* of the Jewish Israeli females is 25.03 and the standard deviation is 4.64 (*BMI*). The average *BMI* of the Jewish Israeli males is 26.61 and the standard deviation is 4.23. The null hypothesis of zero male-female *BMI* difference is clearly rejected at the 1% significance level. The 99% confidence interval of male-female *BMI* difference ranges between 1.0897 points and 2.0785 points in favor of men. Given that compared to females, both the weight and height of males are higher, it seems that weight overpowers height in the *BMI* formula.

To measure the prevelance of overweight and obesity rates in the sample among Jewish Israeli females and males, we provide two dummy variables: *BMI*25 equals 1 if $BMI \geq 25$ (overweight, and obesity); and 0 otherwise ($BMI < 25$); and *BMI*30 equals 1 if $BMI \geq 30$ (obesity); and 0 otherwise ($BMI < 30$). Among the 1,063 and 1,086 Jewish Israeli females and males above 19 years, the proportions of those who suffer from overweight and obesity problems are 46.75% and 57.18%. The null hypothesis of no male-female proportional difference is clearly rejected at the 1% significance level. The 99% confidence interval ranges between 4.90 and 15.96% in favor of the men. Among the 1,063 and 1,086 Jewish Israeli females and males above 19 years, the proportions of those who suffer from severe obesity problems are 13.17% and 17.96%. The null hypothesis of no Jewish Israeli male-female proportional difference is clearly rejected at the 1% significance level. The 99% confidence interval ranges between 0.76 and 8.81% in favor of the men.

According to the OECD report from 2017, 2019 (obesity update), referring to the total Israeli population, in 2015 and nearest year, obesity rates in Israeli adults of 15 years and above is 17.4% among women and 18.3% among men. Israel is located slightly below the OECD average (20% for women, and 19% for men), where the lowest is Japan (3.1% for women, and 4.4% for men), and the highest is the United States (41% for women, and 35.5% for men). In 2016, obesity rates in Israeli adults of 15 year old and above rises to 18.8%.

As previously noted, the empirical model in subsequent sections includes two structural equations with two endogenous (dependent) variables. The second endogeneous (dependent) variable in the empirical model is *APRT_VALUE*, the self-assessed apartment value in NIS (the local Israeli currency, where 1 NIS 0.25 US Dollars). The average self-assesed apartment among Jewish Israeli women is 1,925,270 NIS (about 481,317.50 US Dollars) and among Jewish Israeli men is is 2,008,712 NIS (about 502,178 US Dollars). Despite the fact that the men evaluation is slightly higher, according to non-adjusted comparison, the null hypothesis of no men-women difference cannot be rejected.

Figure 1 compares the average housing price index and self-reported evaluation of owned apartments based on the housing expenditure survey.

This simple graph is in line with Tur-Sinai et al. (2020), who found a much greater overestimation by homeowners of 20% and a median bias of 15%.

The exogenous variables described in subsequent section include: personal and structure age and type, marital status, immigration status, family size, education and employment status, and gross annual income. Referring to the age variable, we include adult Jewish Israelis 19 years and older. This lower bound was chosen in an effort to consider married females (the minimum age of a married individual in the survey). The average personal age of both the Jewish Israeli female and male is about 49–50 years (*AGE*). The minimum age

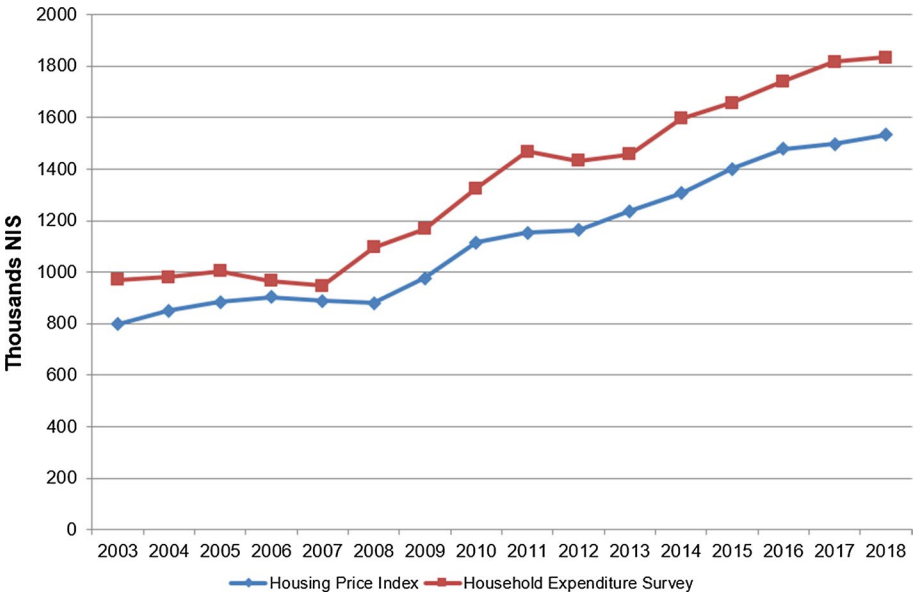

Fig. 1 Self-evaluation of owned apartments based on the household expenditure survey vs. the housing price Index. *Source* Israeli Central Bureau of Statistics (ICBS) Chart 7 (Hebrew)

is 19 years and the maximum age is 80 years. As anticipated, the male–female age difference is statistically insignificant.

Referring to the marital status variables, of the 1,063 Jewish Israeli women and 1,086 Jewish Israeli men, 14.86% and 18.69% are single (*SINGLE*), 70.46% and 73.85% are married (*MARRIED*), 8.09% and 5.34% are divorced (*DIVORCED*), and 6.59% and 2.12% are widowed (*WIDOWED*). Referring to immigration status variables, of the 1,063 Jewish Israeli women and 1,086 Jewish Israeli men, 64.06% and 67.31% were born in Israel (*NATIVE*); 26.25% and 22.56% were born in European-American countries and immigrated to Israel (*EUROPE_AMERICA*); and 9.69% and 10.13% were born in Asian African countries (*ASIA_AFRICA*). A further background on the immigration waves to Israel is given in Arbel et al (2019b).

According to Table 1, the average size of the family is 3–4 persons (*HHSIZE*). The average number of years at school and university is 14.47–14.60 (*SCHYEARS*), and the null that the number of education year is equal across gender is not rejected. Referring to the employment status, of the 1,063 Jewish Israeli women and 1,086 Jewish Israeli men, 29.35% and 25.69% are not looking for a job (*NON_PARTICIPANT*). The implication is that compared to Jewish Israeli men, the proportion of Jewish Israeli women who are not looking for a job is slightly higher. Yet, one cannot reject the null hypothesis that the proportions are equal at the 5% and 1% significance level. This null hypothesis is rejected only at the 10% significance level. Referring to the total Israeli population, according to the ICBS report (Table 1.2: Percentage of Participants in Civilian Labor Force by Age, Population Group and Gender from the 2016 labor-force survey), 33.8% = 100−66.2% Jewish Israeli females and 30% = 100−70% Jewish israeli males are non-participants in the workforce in 2016. Returning to the sample, of the 1,063 Jewish Israeli women and 1,086 Jewish Israeli men, 65.76% and 67.31% are employed, with statistical equality of employment

rate across gender (*EMPLOYED*). Of the 1,063 Jewish Israeli women and 1,086 Jewish Israeli men, 4.89% and 7.00% are unemployed (*UNEMPLOYED*). The difference in favor of the Jewish Israeli women is statistically significant at the 5% significance level.

The average gross annual income per household is 293,039 NIS (about 73,260 US Dollars) for women, and 316,395 NIS (about 79,099 US Dollars) for men (*GRTOTINC*). The average age of the structure in years is 27.72 for women and 27.57 for men (CONSTRUCT_AGE), where the minimum is 12 years and the maximum is 70 years. Finally, 35.09%-35.64% of the apartments are single-family detached units (*SINGLE_FAMILY*).

3 Methodology and results

3.1 The empirical model

Consider the following empirical model consisting of two structural equations:

$$\begin{aligned} APRT\_VALUE = {} & \alpha_0 + \alpha_1 BMI + \alpha_2 AGE + \alpha_3 SCHYEARS + \alpha_4 EMPLOYED \\ & + \alpha_5 UNEMPLOYED + \alpha_6 GRTOTINC + \alpha_7 CONSTRUCT\_AGE \\ & + \alpha_8 SINGLE\_FAMILY + u_1 \end{aligned} \tag{1}$$

$$\begin{aligned} BMI = {} & \beta_0 + \beta_1 APRT\_VALUE + \beta_2 AGE + \beta_3 MARRIED + \beta_4 DIVORCED + \beta_5 WIDOWED \\ & + \beta_6 EUROPE\_AMERICA + \beta_7 ASIA\_AFRICA + \beta_8 HHSIZE + \beta_9 SCHYEARS \\ & + \beta_{10} EMPLOYED + \beta_{11} UNEMPLOYED + \beta_{12} GRTOTINC + u_2 \end{aligned} \tag{2}$$

where APRT_VALUE, and BMI are the endogeneous variables; and AGE, MARRIED, DIVORCED, WIDOWED, EUROPE_AMERICA, ASIA_AFRICA, HHSIZE, SCHYEARS, EMPLOYED, UNEMPLOYED, GRTOTINC, CONSTRUCT_AGE, SINGLE_FAMILY are the exogenous variables (CONSTRUCT_AGE and SINGLE_FAMILY over-identify Eq. (2); and MARRIED, DIVORCED, WIDOWED, EUROPE_AMERICA, ASIA_AFRICA, HHSIZE over-identify Eq. (1)); $\alpha_0, \alpha_1, \alpha_2, \cdots, \alpha_8$ and $\beta_0, \beta_1, \beta_2, \cdots, \beta_8$ are the structural parameters; and u_1 and u_2 are the random disturbance terms.

To obtain consistent estimates of the structural parameters we use a 2SLS methodology (e.g., Greene, 2012: 259–296; Arbel et al., 2020a, 2020b). The first step of the procedure is to solve the system so that the reduced-form equations will include the endogenous variables on the left-hand side (*APRT_VALUE*, and *BMI*), and all the exogenous variables on the right-hand side (*AGE*, *MARRIED*, *DIVORCED*, *WIDOWED*, *EUROPE_AMERICA*, *ASIA_AFRICA*, *HHSIZE*, *SCHYEARS*, *EMPLOYED*, *UNEMPLOYED*, *GRTOTINC*, *CONSTRUCT_AGE*, *SINGLE_FAMILY*). The second step is to estimate the reduced-form equation and generate the instrumental variables proj(*BMI*) and proj(*APRT_VALUE*). These variables in turn will replace the endogeneous variables *BMI* and *APRT_VALUE* at the right-hand side of Eqs. (1) and (2).

To examine the exogenity of the instruments in the reduced-form equations, we run a *J* test, which is a Lagrange multiplier test for overidetifying restrictions (e.g., Greene, 2012:

229–231). The test is based on: 1) regressing the residuals obtained from the reduced form equations on the instruments, including those which appear in both equations, and 2) running a Lagrange multiplier test, based on the number of excluded exogenous variables. A more advanced version of the tests and statistical tools with many (possibly weak) instruments is given by Anatolyev and Gospodinov (2011), and Anatolyev and Skolkova (2019), and is applied in subsequent sections.

3.2 Results

Table 2 reports the regression outcomes separately for the Jewish Israeli females and males and based on the empirical models given by Eqs. (1) and (2). As the results in Table 2 demonstrate, the null of the *J* test, according to which all the instrumental variables are exogenous, is supported empirically ($p=0.430$–0.997). Under equal conditions of age, marital status, immigrant status, school years, employment status, gross monthly income, apartment area, structure type and age, a one-point *BMI* increase is associated with an anticipated 175,995 NIS drop in the self-assessed apartment value for women ($p=0.0020$), and 338,818 NIS drop in the self-assessed apartment value for men ($p=0.0165$).

Referring to the age variable in Table 2, under equal conditions of projected *BMI*, marital status, immigrant status, school years, employment status, gross monthly income, apartment area, structure type and age, a one-year age increase is associated with an anticipated 27,759 NIS rise in the self-assessed apartment value for women ($p=0.0027$), and 28,600 NIS rise in the self-assessed apartment value for men ($p=0.0078$). As expected, projected BMI increases with age by 0.1059 points for women ($p<0.0001$) and 0.0465 points for men ($p=0.0006$). Other economics and socio-demographic control variables include: *SCHYEAR*, dummy variables for marital, immigration, employment status, and *GRTOTINC*. Referring to education, an additional year of schooling gives rise to an anticipated 86,789 NIS increase in self-assessed apartment value for Jewish Israeli men ($p=0.0021$). For Jewish Israeli women, the *BMI* is anticipated to drop by 0.1396 points with each additional year of schooling ($p=0.0603$).

Compared to single Jewish Israeli women and men, respective projected *BMI* of maried Jewish Israeli women is higher by 1.1273 points ($p=0.0138$) and of married Jewish Israeli men is higher by 1.6003 points ($p=0.0005$). Compared to single Jewish Israeli women, projected *BMI* of widowed women is higher by 2.425 points ($p=0.0011$). Compared to native Jewish Israelis, projected *BMI* of Jewish immigrants from North American and European countries is higher by 0.9837 points for women ($p=0.0069$), and 0.8438 points for men ($p=0.0224$). Compared to native Jewish Israeli women, projected *BMI* of Jewish women immigrants for Asian and African countries is lower by 0.9549 points ($p=0.0590$).

Moreover, compared to non-participant women in the workforce, namely, women who are not looking for a job, projected *BMI* of employed women rise by 0.965 points ($p=0.0047$) and of unemployed women by 2.1762 points ($p=0.0013$). Compared to non-participant men in the workforce, projected *BMI* of unemployed men rise by 1.6065 points ($p=0.0031$). compared to non-participant women in the workforce, the expected apartment value assessement of unemployed women is higher by 653,782 NIS ($p=0.0107$). Finally, each additional NIS income growth is associated with 1.1502 NIS rise in projected apartment value for women ($p<0.0001$), and 1.1289 NIS rise for men ($p<0.0001$). For the Jewish Israeli women, each additional NIS annual income growth is associated with 1.29×10^{-6}

Table 2 Simultaneous equation model for the jewish israeli sample stratified by gender

	(1)	(2)	(3)	(4)
	WOMEN	*WOMEN*	*MEN*	*MEN*
VARIABLES	*APRT_VALUE*	*BMI*	*APRT_VALUE*	*BMI*
Constant	4,586,244.2337***	19.9459***	7,911,845.3666**	22.0337***
	(0.0030)	(<0.0001)	(0.0113)	(<0.0001)
Proj(*BMI*)	−195,998.1995***	–	-345,479.1944**	–
	(0.0079)	–	(0.0152)	–
Proj(*APRT_VALUE*)	–	-9.70×10^{-8}	–	5.05×10^{-7}
	–	(0.7960)	–	(0.1560)
AGE	27,759.0025***	0.1059***	28,599.2649***	0.0465***
	(0.0027)	(<0.0001)	(0.0078)	(0.0006)
MARRIED	–	1.1273**	–	1.6003***
	–	(0.0138)	–	(0.0005)
DIVORCED	–	0.1715	–	0.3328
	–	(0.7969)	–	(0.6429)
WIDOWED	–	2.4250***	–	0.4277
	–	(0.0011)	–	(0.6784)
EUROPE_AMERICA	–	0.9837***	–	0.8438**
	–	(0.0069)	–	(0.0224)
ASIA_AFRICA	–	−0.9549*	–	−0.2856
	–	(0.0590)	–	(0.5444)
HHSIZE	–	0.1550	–	0.0375
	–	(0.1210)	–	(0.6690)
SCHYEARS	29,601.4865	−0.1396*	86,789.4770***	−0.0129
	(0.1523)	(0.0603)	(0.0021)	(0.8420)
EMPLOYED	38,246.2217	0.9650***	93,616.4349	0.2794
	(0.7727)	(0.0047)	(0.5446)	(0.3912)
UNEMPLOYED	653,782.0264**	2.1762***	333,898.5797	1.6065***
	(0.0107)	(0.0013)	(0.3079)	(0.0031)
GRTOTINC	1.1502***	-1.29×10^{-6}*	1.1289***	-1.11×10^{-6}*
	(<0.0001)	(0.0675)	(<0.0001)	(0.0836)
CONSTRUCT_AGE	−7,410.8880***	–	−4,874.1040	–
	(0.0071)	–	(0.2015)	–
SINGLE_FAMILY	697,509.9585***	–	886,235.9589***	–
	(<0.0001)	–	(<0.0001)	–
Observations	1,063	1,063	1,086	1,086
p-value Regression Significance (F-statistics)	<0.0001	<0.0001	<0.0001	<0.0001
p-value for the *J* Test	0.430	0.996	0.690	0.997

The table refers to the Jewish Israeli sample of women and men. *P*-values are given in parentheses. *$p<0.1$; **$p<0.05$; ***$p<0.01$

points drop in projected *BMI* ($p=0.0675$), and for Jewish Israeli men $-1.11 \times 10^{-}6$ points drop in projected *BMI* ($p=0.0836$).

Two of the exogenous variables in the empirical model (*CONSTRUCT_AGE* and *SINGLE_FAMILY*) are related to apartment's features. Projected apartment value drops by 7,411 NIS for each additional structure age for women ($p=0.0071$). With a shift from an apartment in a multi-story structure to single family detached unit, projected apartment value rise by 697,510 NIS for women ($p<0.0001$) and 886,235 NIS for men ($p<0.0001$).

4 Summary and conclusions

Numerous studies compared self evaluation and market values of apartments by employing hedonic regressions. Most of these studies demonstrated that self evaluation of apartments tend to be optimistic (e.g., Kiel and Zabell, 1999; Genesove & Mayers, 2001; Anenberg, 2011*a*, 2011*b*; Romanov et al., 2012; Fleishman & Gubman., 2015; Tur-Sinai et al., 2020). Yet, none of these studies explored the relationship between self-evaluation of apartments and obesity as a proxy for self esteem, particularly among women. The objective of the current study is to investigate whether elevated obesity problems, reflected in higher *BMI* ($=\frac{WEIGHT}{HEIGHT^2}=\frac{kg}{meter^2}$) is associated with lower self esteem in western societies (e.g., Prioreschi et. al, 2017), which, in turn, may produce lower self-evaluation of apartment values. However, given that self-evaluation of apartment and *BMI* are determined endogeneously (i.e., according to the OECD report from 2017, 2019 (obesity update), weight and height are self-reported in Israel), a 2SLS methodology is required to correct this endogeneity problem and provide consistent estimates (e.g., Anatolyev and Gospodinov (2011); Greene (2012); Anatolyev and Skolkova (2019); and Arbel et al. (2020a, 2020b)). This methodology permits testing the chicken and egg problem, namely whether: 1) health and self-evaluation of apartments (as a proxy for self-esteem) are endogenous variables, 2) higher obesity levels produce lower valuation of apartments among females and males;. and 3) higher apartment values lead to lower prevalence of obesity among females and males.

Results of the study indicate that for the Jewish Israeli females and males, under equal conditions, higher projected *BMI*, where projections are based on the reduced-form equations, is associated with lower anticipated apartment evaluation, but not vice versa. Yet, compared to men, female self-evaluation of housing prices is more conservative and less influenced by *BMI* changes. This finding is supported empirically by other studies (e.g., Baeckström et al., 2020).

An important repercussion of our study relates to the psychological literature. On the one hand, the price evaluation of a rationally economic agent is not expected to be influenced by physical characteristics, such as obesity. Consequently, our findings exhibit a cognitive bias for both genders (for other examples of cognitive biases see Kahneman & Tversky, 1979; Northcraft & Neale, 1987; Kiel and Zabell, 1999; Genesove & Mayers, 2001; Anenberg, 2011a, 2011b; Romanov et al., 2012; Arbel et al., 2014; Arbel et al., 2016; Fleishman & Gubman., 2015; Tur-Sinai et al., 2020). On the other hand, compared to Jewish Israeli men, this cognitive bias reduces for Jewish Israeli women, despite the more severe penalty on obesity among western Jewish Israeli women (e.g., Asgeirsdottir, 2011; Atella et al., 2008; Averett, 2014; Brunello & D'Hombres, 2007; Caliendo & Gehrsitz, 2016; Campos-Vazquez & Gonzalez, 2020; Cawley, 2004; Fikkan & Rothblum, 2012; Garcia & QuintanaDomeque, 2006; Han et al., 2011; Hansson et al., 2010; Lundborg et al., 2014; Morris, 2007). Research findings thus support the conclusion that the evaluation of

women are more conservative and risk averse. Moreover, with respect to obesity, compared to males, the cognitive error in price evaluation is smaller among females.

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References

Anatolyev, S., & Nikolay, G. (2011). Specification testing in models with many instruments. *Econometric Theory, 27*, 427–441.

Anatolyev, S., & Skolkova, A. (2019). Many instruments: Implementation in Stata. *The Stata Journal, 19*(4), 849–896.

Anenberg, E. (2011). Loss aversion, equity constraints and seller behavior in the real estate market. *Regional Science and Urban Economics, 41*(1), 67–76. https://doi.org/10.1016/j.regsciurbeco.2010.08.003

Anenberg, E. (2011a). Uncertainty, learning, and the value of information in the residential real estate market. *Mimeo*.

Arbel, Y., Ben-Shahar, D., & Gabriel, S. (2014). Anchoring and housing choice: Results of a natural policy experiment. *Regional Science and Urban Economics, 49*, 68–83. https://doi.org/10.1016/j.regsciurbeco.2014.07.004

Arbel, Y., Fialkoff, C., & Kerner, A. (2016). Does the first impression matter? Efficiency testing of tenure-choice decision. *Regional Science and Urban Economics, 60*, 223–237. https://doi.org/10.1016/j.regsciurbeco.2016.07.004

Arbel, Y., Fialkoff, C., & Kerner, A. (2019a). The association of pension income with the incidence of type I obesity among retired israelis. *Journal of Obesity*. https://doi.org/10.1155/2019/5101867

Arbel, Y., Fialkoff, C., & Kerner, A. (2019b). Determinants of ownership rates among new immigrants ethnic origin and tenure mode in the host country. *Journal of Real Estate Literature, 27*(2), 189–226.

Arbel, Yuval, Fialkoff, Chaim, & Kerner, Amichai. (2020). The cause and effect problem: Is there mutual obesity among Arab Israeli couples? *PLoS ONE*. https://doi.org/10.1371/journal.pone.0240034

Arbel, Y., Fialkoff, C., & Kerner, A. (2020a). The chicken and egg problem: Obesity and the urban monocentric model. *The Journal of Real Estate Finance and Economics, 61*(4), 576. https://doi.org/10.1007/s11146-019-09737-5

Arroyo-Johnson, C., & Mincey, K. D. (2016). Obesity epidemiology worldwide. *Gastroenterology Clinics of North America, 45*(4), 571–579. https://doi.org/10.1016/j.gtc.2016.07.012

Asgeirsdottir, T. L. (2011). Do body weight and gender shape the work force? The case of Iceland. *Economics and Human Biology, 9*(2), 148–156. https://doi.org/10.1016/j.ehb.2010.12.001

Atella, V., Pace, N., & Vuri, D. (2008). Are employers discriminating with respect to weight? European evidence using quantile regression. *Economics and Human Biology, 6*(3), 305–329. https://doi.org/10.1016/j.ehb.2008.06.007

Averett, S. L. (2014). Obesity and labor market outcomes. *IZA World Labor*. https://doi.org/10.15185/izawol.32

Baeckström, Y., Marsh, I. W., & Silvester, J. (2020). Financial advice and gender: Wealthy individual investors in the UK. *Journal of Corporate Finance*. https://doi.org/10.1016/j.jcorpfin.2021.101882

Ben-Shahar, D., Arbel, Y., & Gabriel, S. (2016). Are the disabled less loss averse? Evidence from a natural policy experiment. *Economic Inquiry, 54*(2), 1291–1318.

Brunello, G., & D'Hombres, B. (2007). Does body weight affect wages? Evidence from Europe. *Economics and Human Biology, 5*(1), 1–19. https://doi.org/10.1016/j.ehb.2006.11.002

Caliendo, M., & Gehrsitz, M. (2016). Obesity and the labor market: A fresh look at the weight penalty. *Economics and Human Biology, 23*, 209–225. https://doi.org/10.1016/j.ehb.2016.09.004

Campos-Vazquez, R., & Gonzalez, E. (2020). Obesity and hiring discrimination. Economics and Human Biology, 37, 1–9.

Cawley, J. (2004). The impact of obesity on wages. *Journal of Human Resources, 39*(2), 451–474. https://doi.org/10.2307/3559022

de la Garza, G., Francisco, J., Salinas-Martínez, A. M., Zendejas-Valdéz, J. M., Cordero-Franco, H. F., Mathiew-Quirós, Á., & de la Garza-Salinas, L. H. (2019). Body frame size, body image, self-esteem,

and health-related quality of life in schoolchildren. *American Journal of Human Biology : The Official Journal of the Human Biology Council, 31*(5), e23294. https://doi.org/10.1002/ajhb.23294

Fikkan, J. L., & Rothblum, E. D. (2012). Is fat a feminist issue? Exploring the gendered nature of weight bias. *Sex Roles, 66*(9–10), 575–592. https://doi.org/10.1007/s11199-011-0022-5

Fleishman, L., & Gubman, Y. (2015). Mass appraisal at the Census Level: Israeli case. *Statistical Journal of the IAOS, 31*(4), 597–612. https://doi.org/10.3233/SJI-150939

Garcia, J., & Quintana-Domeque, C. (2006). Obesity, employment and wages in Europe. *Advances in Health Economics and Health Services Research, 17*, 187–217.

Gasse, C., Boutin, A., Demers, S., Chaillet, N., & Bujold, E. (2019). Body mass index and the risk of hypertensive disorders of pregnancy: The great obstetrical syndromes (GOS) study. *Journal of Maternal-Fetal & Neonatal Medicine, 32*(7), 1063–1068. https://doi.org/10.1080/14767058.2017.1399117

Genesove, D., & Mayer, C. J. (1997). Equity and time to sale in the real estate market. *The American Economic Review, 87*(3), 255–269.

Genesove, D., & Mayer, C. (2001). Loss aversion and seller behavior: Evidence from the housing market. *The Quarterly Journal of Economics, 116*(4), 1233–1260.

Greene, William H. (2012). *Econometric analysis* (7th ed.). Pearson Education Limited.

Han, E., Norton, E. C., & Powell, L. M. (2011). Direct and indirect effects of body weight on adult wages. *Economics and Human Biology, 9*(4), 381–392. https://doi.org/10.1016/j.ehb.2011.07.002

Hansson, L. M., N€aslund, E., & Rasmussen, F. (2010). Perceived discrimination among men and women with normal weight and obesity. A population-based study from Sweden. *Scandinavian Journal of Public Health, 38*(6), 587–596. https://doi.org/10.1177/1403494810372266

Hermesch, A. C., Allshouse, A. A., & Heyborne, K. D. (2016). Body mass index and the spontaneous onset of parturition. *Obstetrics & Gynecology, 128*(5), 1033–1038. https://doi.org/10.1097/AOG.0000000000001678

Israeli Central Bureau of Statistics (ICBS) Press Release, July 27, 2018: Religion and Self-Definition of Extent of Religiosity: Selected Data from the Society in Israel Report No. 10. Available at: https://www.cbs.gov.il/en/mediarelease/Pages/2018/Religion-And-Self-Definition-Of-Extent-Of-Religiosity-Selected-Data-From-The-Society-In-Israel-Report-No-10.aspx .

Israeli Central Bureau of Statistics (ICBS), December 9, 2018: 2016 Labor force survey: Table 1.2: Percentage of participants in civilian labor force by age, population group and gender. Available at: https://www.cbs.gov.il/en/publications/Pages/2018/Labour-Force-Surveys-2016.aspx.

Israel Central Bureau of Statistics (ICBS), January 24, 2019: Chart 7: Self-esteems values of owned apartments based on the household expenditure survey vs. housing price index. Available at: https://www.cbs.gov.il/en/publications/Pages/2019/Household-Income-and-Expenditure-Data-from-the-2016-Household-Expenditure-Survey-General-Summary.aspx.

Johnston, Jack, & Dinardo, John. (1997). *Econometric methods* (4th ed.). McGraw Hill International Edition.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263–291.

Keysar, B., Hayakawa, S. L., & San Gyu, A. (2012). The foreign-language effect: Thinking in a foreign tongue reduces decision biases. *Psychological Science, 23*(6), 661–668. https://doi.org/10.1177/0956797611432178

Kiel, K. A., & Zabel, J. E. (1999). The accuracy of owner-provided house values: The 1978–1991 american housing survey. *Real Estate Economics, 27*(2), 263–298. https://doi.org/10.1111/1540-6229.00774

Lundborg, P., Nystedt, P., & Rooth, D.-O. (2014). Body size, skills, and income: Evidence from 150,000 teenage siblings. *Demography, 51*(5), 1573–1596. https://doi.org/10.1007/s13524-014-0325-6

Northcraft, G. B., & Neale, M. A. (1987). Experts, amateurs, and real estate: An anchoring-and-adjustment perspective on property pricing decisions. *Organizational Behavior and Human Decision Processes, 39*(1), 84–97. https://doi.org/10.1016/0749-5978(87)90046-X

OECD report. (2017). Obesity update. Available at:https://www.oecd.org/health/health-systems/Obesity-Update-2017.pdf.

OECD. (2018). Overweight or obese population (measured/self reported, %of population aged 15+, 2018 or latest available) in OECD countries. Available at: https://data.oecd.org/pinboard-editor/.

OECD report. (2019). Obesity update. Available at: https://www.oecd.org/health/obesity-update.htm.

Prioreschi, A., Wrottesley, S. V., Cohen, E., Reddy, A., Said-Mohamed, R., Norris, S. A., Dunger, D. B., Twine, R., Tollman, S. M., & Kahn, K. (2017). Examining the relationships between body image, eating attitudes, BMI, and physical activity in rural and urban south african young adult females using structural equation modeling. *PLoS ONE, 12*(11), 1–16. https://doi.org/10.1371/journal.pone.0187508

Romanov, D., Fleischer, L. & Aviad, Tur-Sinai. (2012). Self-reported dwelling valuations — How accurate are they? *The Economic Quarterly, 59*(1/2), 79–109. (**Hebrew**).

Sallis, J. F., Cerin, E., Conway, T. L., Adams, M. A., Frank, L. D., Pratt, M., Salvo, D., et al. (2016). Physical activity in relation to urban environments in 14 cities worldwide: A cross-sectional study. *The Lancet, 387*(10034), 2207–2217. https://doi.org/10.1016/S0140-6736(15)01284-2

Shamriz, O., Leiba, M., Levine, H., Derazne, E., Keinan-Boker, L., & Kark, J. D. (2017). Higher body mass index in 16–19 year-old Jewish Adolescents of North African, Middle Eastern and European Origins is a predictor of acute myeloid leukemia: A cohort of 2.3 million israelis. *Cancer Causes & Control: An International Journal of Studies of Cancer in Human Populations, 28*(4), 331. https://doi.org/10.1007/s10552-017-0863-5

Torstveit, Monica Klungland, Aagedal-Mortensen, Kjersti, & Stea, Tonje Holte. (2015). More than half of high school students report disordered eating: A cross sectional study among norwegian boys and girls. *PLoS ONE, 10*(3), e0122681. https://doi.org/10.1371/journal.pone.0122681

Tur-Sinai, Aviad, Fleishman, Larisa, & Romanov, Dmitri. (2020). The accuracy of self-reported dwelling valuation. *Journal of Housing Economics*. https://doi.org/10.1016/j.jhe.2019.101660

WHO. Global strategy on diet, physical activity and health. Geneva: World Health Organization. Available at: http://www.who.int/dietphysicalactivity/pa/en/. Lastly accessed at February 2, 2020.

Wikström, K., Lindström, J., Harald, K., Peltonen, M., & Laatikainen, T. (2015). Clinical and lifestyle-related risk factors for incident multimorbidity: 10-year follow-up of finnish population-based cohorts 1982–2012. *European Journal of Internal Medicine, 26*(3), 211–216. https://doi.org/10.1016/j.ejim.2015.02.012

Yan, Y., Hou, D., Liu, J., Zhao, X., Cheng, H., Xi, Bo., & Mi, J. (2017). childhood body mass index and blood pressure in prediction of subclinical vascular damage in adulthood: Beijing blood pressure cohort. *Journal of Hypertension, 35*(1), 47–54.

Yoon, S. H., Han, K.-T., Kim, S. J., Sohn, T. Y., Jeon, B., Kim, W., & Park, E.-C. (2015). Combined effect of body mass index and body size perception on metabolic syndrome in South Korea: results of the fifth Korea National Health and Nutrition Examination Surveys (2010-2012). *BMC Public Health*, *15*(1), 1–15.

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