

Supplementary Materials for:

“Investigating the relationship between family environments and children’s adoption of obesity-related behaviours in Italy”

A. Variables definition

In our empirical application, we contrast two sets of behaviours based on their potential effect on childhood over-weight and obesity risk: relatively healthy behaviours that may lower the risk of obesity (i.e., PA-practice, Breakfast-consumption and FV-consumption), and potentially obesogenic behaviours (i.e., Snacks-consumption), which may indirectly increase the risk of children obesity (Lustig, 2001). This enables us to also evaluate whether the association between household-level and children’s behaviours differs when relatively healthier or less healthy behaviours are considered. The key variables used in this analysis to capture these behaviors are further described below, while Table S1 reports the original questions and answers from ISTAT MHDLA data (ISTAT, 2021) used to derive them.

Regular practice of physical activity

The choice of focusing on PA-practice is motivated by the central role that this behaviour plays in preventing overweight and obesity, especially considering that regular engagement in PA-practice during childhood provides a basis for the lifelong maintenance of this habit (Steinbeck, 2001). In our analysis, we use the information collected from the MHLDA survey to define a dummy variable for regular PA-practice (*PA-practice*) taking the value of 1 for all respondents who declared regularly practicing one or more sports throughout the year, and zero otherwise (Table S1).

Adequate fruits and vegetables consumption

The adequate consumption of FV represents the basis of a healthy diet given the high fiber content and low energy density of these foods (Rolls et al., 2004), reducing the risk of incurring overweight and obesity and their related diseases (Arcan et al., 2007; Pearson et al., 2009). According

to nutritional guidelines, at least five portions a day of FV should be consumed as part of a healthy diet (Centro di Ricerca Alimenti e Nutrizione, 2019; Rolls et al., 2004). Therefore, in our empirical application, we use two variables provided by the MHLDA survey data (i.e., number of portions of fruits and number of portions of vegetables consumed daily by each individual respectively) to define the key variable of interest (*FV-consumption*) which takes the value of 1 for all respondents who consume at least 5 portions of fruits and vegetables daily, and zero otherwise (Table S1).

Adequate breakfast consumption

Regular and adequate Breakfast-consumption is associated with a better diet quality, a reduced risk of cardiovascular disease and dyslipidaemia, as well as a reduced risk of becoming overweight/obese (Hallström et al., 2013). In line with health guidelines (Centro di Ricerca Alimenti e Nutrizione, 2019), a healthy breakfast is considered a breakfast providing adequate energies and nutrients through the consumption of foods such as yogurt, bread, cereals, etc. Based on individual responses to the MHLDA survey question regarding breakfast consumption habits, we define a dummy variable (*Breakfast-consumption*) which takes the value of 1 for all respondents consuming a complete breakfast, and zero otherwise. This variable also takes the value of 0 for those respondents who only drink coffee or tea without having any food (Table S1).

Daily snacks consumption

Several studies confirm that snacks-consumption (in our study intended as daily consumption of savoury snacks such as potato chips, popcorn, etc.) exposes children to a higher risk of becoming overweight or obese (Jahns et al., 2001). We identify consumers regularly snacking through a specific dummy variable (*Snacks-consumption*) taking the value of 1 for all individuals who consume salty snacks at least once a day. This variable takes the value of 0 for all respondents who consume salty snacks less than once a day (Table S1).

Table S1 Recoded variables and respective original questions and answers from the Multipurpose Survey on Households Daily Life Aspects (MHDLA) conducted by ISTAT (2018, 2021).

Original questions from the MHDLA conducted by ISTAT	Variable recoded
Do you have the habit of having breakfast? (If you have more than one breakfast per day, please refer only to the first one)	Adequate breakfast-consumption
No	No
Yes, I only drink something, as for example tea or coffee (not milk), but without eating	No
Yes, I drink tea or coffee (not milk), and I eat something	Yes
Yes, I drink milk, milk with coffee, or cappuccino, but without eating	No
Yes, I drink milk, milk with coffee, or cappuccino, and I eat something	Yes
Yes, I only eat something (e.g., biscuits, bread, pastry), but without drinking	Yes
Yes, I do another typology of breakfast, as for instance yogurt, cereal, juice, etc.	Yes
In your free time, do you regularly practice any sport? ^a	Regular practice of physical activity
Yes	Yes
No	No
How often do you consume savoury snacks?	Daily snack-consumption
More than once a day	Yes
Once a day	Yes
Few times a week	No
Less than once a week	No
Never	No
Number of portions of fruit daily consumed Number of portions of salad and vegetables daily consumed	Adequate FV consumption
Sum of the FV portions daily consumed equal or greater than five	Yes
Sum of the FV portions daily consumed lower than five	No

^a The present question was selected from the MHDLA as the only question explicitly addressing the practice of physical activity or sport *in a regular manner* – in line with the CREA and WHO guidelines (Bull et al., 2020; Centro di Ricerca Alimenti e Nutrizione, 2019).

B. Summary statistics

As shown in Table S2, reporting the summary statistics of the *household models* variables, children are distributed among age classes, and both genders are equally represented. Almost half of the families (47.3%) have at least one adult affected by overweight or obesity, and in 22.2% of households this is true for both adults. Only 30.5% of the households do not have any adults affected by overweight or obesity.

Focusing on the behaviours analysed in this study, more than half of the families have adults with adequate breakfast-consumption (59.69%) or with no daily Snacks-consumption (94%). However, most families (92.4%) do not show adequate FV-consumption. Lastly, only in 9.69% of the adults engage in regular PA-practice.

Observing both parents (Table S3), our data show that mothers, rather than fathers, are generally more inclined to adequate Breakfast-consumption (78.17% vs. 69.72%, respectively) and to reach the recommended FV-consumption (5.44% vs. 3.51%, respectively). On the other hand, mothers are less likely to engage in regular PA-practice with respect to fathers (17.93% vs. 26.01%, respectively). The daily Snack-consumption is similar for both parents and generally low (3.47% vs. 3.64%, respectively).

As shown in Table S4, the proportion of children exhibiting the investigated behaviours range widely. A large percentage of children show adequate Breakfast-consumption (82.23%), while 12.35% of the sample report daily Snacks-consumption. Only a small percentage of children show recommended FV-consumption (2.92%), while half of the observed children report regular PA-practice.

Table S2 Summary statistics of the explanatory variables of the *household models* (n=45,333).

Variables	Classes	Relative frequencies (%)			
Age Children age	3 - 5 y	18.48			
	6 - 10 y	34.33			
	11 - 13 y	20.57			
	14 - 17 y	26.62			
Gender Children gender	Male	51.45			
	Female	48.55			
Overweight/obese Adults with overweight/obesity within the household ^a	No one	30.50			
	At least one	47.30			
	All	22.20			
Education Household head educational level	Elementary school license or lower	3.08			
	Secondary school license	31.85			
	High school diploma	45.37			
	University degree or higher	19.7			
Employment Household head employment	Employed	85.23			
	Unemployed ^b	14.77			
Geographical Geographical area of residence ^c	Northern Italy	43.90			
	Central Italy	17.00			
	Southern Italy and Isles	39.10			
Children number Number of children within the household	1	30.87			
	2	52.60			
	3 or more	16.53			
Adults' behaviour Adults in the household manifesting the behaviour		<i>Eating breakfast</i>	<i>PA</i>	<i>Snacking</i>	<i>5 FV a day</i>
	No one	11.81	65.75	94.00	92.40
	At least one	28.50	24.56	4.87	6.25
	All	59.69	9.69	1.13	1.35

^aOverweight: BMI >25 and <30 ; Obesity: BMI>30 (Amine et al., 2003).^b The unemployed class includes also students, unfit to work, pensioners and housewives or men.

Table S3 Summary statistics of the explanatory variables¹ of the *parental models* (n=45,333).

Variables	Classes	Relative frequencies (%)			
Father with overweight/obesity ^a	Yes	60.11			
Mother with overweight/obesity ^a	Yes	31.59			
Father education	Elementary school license or lower	3.20			
	Secondary school license	33.50			
	High school diploma	45.41			
	University degree or higher	17.89			
Mother education	Elementary school license or lower	2.72			
	Secondary school license	25.78			
	High school diploma	46.65			
	University degree or higher	24.85			
Father employment ^b	Employed	88.02			
Mother employment ^b	Employed	57.11			
		<i>Eating breakfast</i>	<i>PA</i>	<i>Snacking</i>	<i>5 FV a day</i>
Father behaviour	Present	69.72	26.01	3.64	3.51
Mother behaviour	Present	78.17	17.93	3.47	5.44

^aOverweight: BMI >25 and <30 ; Obesity: BMI>30 (Amine et al., 2003).^b The unemployed class includes also students, unfit to work, pensioners and housewives or men.

¹The summary statistics of the control variables that are common to both the *household* and the *parental* models (i.e., number of children, geographical area of residence, children's age and gender, and yearly dummies) are reported in Table S2.

Table S4 Summary of investigated children's behaviours (n=45,333).

Children behaviours	Classes	Description	Relative frequencies (%)
Breakfast-consumption	Yes	Eating food for breakfast (with or without drinking)	82.23
	No	Not eating food (skipping breakfast or just drinking)	17.77
PA-practice	Yes	Doing regular physical activity	53.11
	No	Otherwise	46.89
Snacks-consumption	Yes	Daily consumption of savoury snacks (potato chips, popcorn, etc.)	12.35
	No	Savoury snack consumption less than once a day or null	87.65
FV-consumption	Yes	Consumption of the 5 daily-recommended portions of FV ^a	2.92
	No	Consumption lower than 5 portions of FV a day or null	97.08

^a According to WHO (WHO, 2026) one portion is defined as 80 g of fruit or vegetable (derived as dividing into five portions the WHO daily recommended total intake of 400 g/4 of fruits and vegetables for one adult).

C. Logit model estimation results

Table S5 Logit estimation results for the *household models* (n=45,333).

Variables (Reference class in brackets)	Classes	Investigated children's behaviours			
		<i>Breakfast - consumption</i>	<i>PA-practice</i>	<i>Snacks- consumption</i>	<i>FV- consumption</i>
Age (3 - 5 y)	6 - 10 y	-0.040	1.827***	0.366***	0.266***
	11 - 13 y	-0.619***	1.951***	0.647***	0.366***
	14 - 17 y	-1.026***	1.518***	0.556***	0.768***
Gender (Male)	Female	-0.228***	-0.384***	-0.090***	0.146**
Overweight/obese (No one)	At least one	-0.012	-0.044*	0.139***	-0.131**
	All	-0.086**	-0.121***	0.144***	-0.128
Education (Elementary school license or lower)	Secondary school license	-0.148**	0.572***	-0.134*	-0.245
	High school diploma	-0.077	0.974***	-0.438***	-0.193
	University degree or higher	0.087	1.353***	-0.847***	0.104
Employment (Unemployed)	Employed	0.059*	0.311***	-0.120***	0.088
Geographical (Northern Italy)	Central Italy	-0.045	0.024	-0.129***	-0.091
	Southern Italy and Isles	-0.138***	-0.595***	0.325***	-0.611***
Children number (1)	2	0.021	-0.033	0.037	-0.050
	3 or more	0.006	-0.383***	0.113**	0.141
Adults' behaviour (No one)	At least one	0.671***	0.746***	1.677***	1.925***
	All	1.286***	1.266***	2.902***	3.353***
	Constant	1.321***	-2.343***	-2.300***	-4.358***

Notes: Yearly dummy variables coefficients omitted for brevity. Significance tested across all the explanatory variables used in each model with respect to the class reference category reported in parentheses: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table S6 Logit estimation results for the *parental models* (n=45,333).

Variables	Classes	Investigated children's behaviours			
		<i>Breakfast - consumption</i>	<i>PA-practice</i>	<i>Snacks- consumption</i>	<i>FV- consumption</i>
(Reference class in brackets)					
Age (3 - 5 y)	6 - 10 y	-0.034	1.851***	0.364***	0.275***
	11 - 13 y	-0.611***	1.988***	0.636***	0.385***
	14 - 17 y	-1.018***	1.562***	0.532***	0.794***
Gender (Male)	Female	-0.231***	-0.395***	-0.089***	0.145**
Father with overweight/obesity (No)	Yes	0.025	-0.007	0.081***	-0.059
Mother with overweight/obesity (No)	Yes	-0.121***	-0.079***	0.038	-0.077
Father education (Elementary school license or lower)	Secondary school license	-0.049	0.350***	-0.100	-0.299
	High school diploma	0.030	0.549***	-0.260***	-0.276
	University degree or higher	0.137	0.710***	-0.496***	-0.202
Mother education (Elementary school license or lower)	Secondary school license	-0.222***	0.229***	-0.032	0.178
	High school diploma	-0.240***	0.602***	-0.268***	0.154
	University degree or higher	-0.124	0.852***	-0.567***	0.492**
Father employment (Unemployed)	Employed	0.084**	0.272***	-0.066	0.156
Mother employment (Unemployed)	Employed	-0.088***	0.318***	-0.087***	0.015
Geographical (Northern Italy)	Central Italy	-0.049	0.038	-0.139***	-0.096
	Southern Italy and Isles	-0.162***	-0.513***	0.289***	-0.612***
Children number (1)	2	0.014	-0.050**	0.053	-0.059
	3 or more	-0.010	-0.356***	0.099**	0.133
Father behaviour (No one)	Present	0.494***	0.548***	1.340***	1.508***
Mother behavior (No one)	Present	0.799***	0.752***	1.787***	1.928***
	Constant	1.461***	-2.661***	-2.164***	-4.565***

Notes: Yearly dummy variables coefficients omitted for brevity. Significance tested across all the explanatory variables used in each model with respect to the class reference category reported in parentheses: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

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