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Overweight trends and determinants among adults and children in Indonesia

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ABSTRACT

Objective: To conduct a secondary data analysis detailing overweight prevalence and associations between key hypothesized determinants and overweight.

Design: This study is observational and used data from the Indonesian Family Life Survey (IFLS) (1993-2014). The IFLS is a home-based survey that collected socioeconomic, food intake, and physical activity data, and measured anthropometrics, on individual children and adults

Setting: Indonesia.

Primary Outcome Measures: We utilized the IFLS to describe the distribution of overweight by gender among adults (BMI ≥ 25 kg/m^2) and by age among children, over time. Overweight was defined as weight-for-height z-score > 2, among children aged 0-5 years and as BMI-for-age z-score > 1, among children aged 6-18 years. We described individuals who were overweight, by selected characteristics over time and then employed multivariate logistic regression to explore risk factors and their association with overweight in 2014.

Results: One-third of adults were overweight in 2014 and women consistently had a higher overweight prevalence compared to men. Between 1993 and 2014 the prevalence of overweight increased by 100% and 88%, among women and men, respectively. Among children and adolescents, the prevalence of overweight increased by more than 100% (1993-2014). In 2014, 7.5% of children aged 0-5 years were overweight, as were about 15% of school-age children and adolescents. Although overweight prevalence remains higher in urban areas, the increase in overweight prevalence was larger among rural (versus urban) residents, and by 2014 the proportions of overweight adults were evenly distributed by wealth. Urban area residence, higher wealth, higher education, and consumption of energy-dense foods were associated with higher odds of overweight among most adults and children.

Conclusions: Urgent program and policy action is needed to reduce and prevent overweight among all ages.

Key Words: Overweight, Indonesia, nutrition transition, Indonesian Family Life Survey

Strengths and Limitations of this Study

- We are able to compare overweight trends over time among all age groups, explore the consumption of energy-dense foods and physical activity, and investigate hypothesized risk factors for overweight using regression-based methods.
- We use a recent dataset that is nationally representative of Indonesia.
- We largely employ cross-sectional data, therefore, we cannot infer any causal associations and there may be unmeasured confounding.
- Data on the consumption of a select number of energy-dense foods was only collected in 2014, which limits our ability to make conclusions about the association between energy-dense foods and overweight.
- Physical activity levels were based on respondent recall.

INTRODUCTION

Indonesia is undergoing a nutrition transition, defined as characteristic changes in diet and physical activity patterns [1,2]. The double burden of malnutrition – defined as the co-existence of undernutrition and overnutrition – is therefore an increasing concern in Indonesia [3]. The National Basic Health Research Survey showed that the prevalence of adult overweight (body mass index [BMI] ≥ 25 kg/m^2) increased from 22% in 2010 to 26% in 2013, and was 35% in 2018. Yet, overweight has received relatively little programmatic attention, despite its grave consequences on the risk of non-communicable diseases, which are major drivers of health care costs. Moreover, there is limited information on the changing prevalence and risk factors of overweight by age group in Indonesia.

Globally, both macro- and micro factors have been found to be associated with overweight. At the macro-level, there is strong positive and linear relationship between national per capita income and overweight. These increases in national income are characterized by a shift away from traditional diets toward processed foods, that are higher in fat and calories, and decreased physical activity. Poor dietary habits are increasingly common among Indonesians, which is largely related to the changing food environment. Food availability per capita has grown by 40% in Indonesia, with 20% coming from fat sources (e.g. palm oil) [4]. Data from the 2013 National Basic Health Research Survey indicated inadequate consumption of fruits and vegetables among the majority of Indonesians, and one prior study reported that higher consumption of meat and dairy was associated with a higher prevalence of obesity in Indonesia [5]. Prior evidence from Indonesia and the Southeast Asia region also suggests widespread consumption of energy-dense foods and a positive association between consumption of processed foods, meat, dairy, and "Western foods"

and overweight prevalence among children and adults [4–6]. The population is also increasingly adopting a more sedentary lifestyle [3].

Few prior studies have used national-level data in Indonesia to explore the trends and determinants of overweight across different age groups, nor have most prior studies assessed determinants of overweight using regression-based methods, which better account for confounding. The objective of this paper was to conduct a secondary data analysis detailing overweight prevalence and associations between key hypothesized determinants and overweight, for all age groups in Indonesia. We believe the evidence will be useful for future advocacy efforts on obesity prevention and to inform relevant policy dialogues and program design.

METHODS

Survey Design and Study Population

These analyses utilized the publicly available Indonesian Family Life Survey (IFLS), which has previously been detailed elsewhere [7]. The IFLS is a longitudinal, home-based survey that collected socioeconomic and health data on individual respondents including children aged 0-18 years and adults ≥ 19, and their households over time. The survey was first fielded in 1993 and there have been four subsequent rounds of data collection (1997, 2000, 2007, 2014). Follow-up surveys were fielded on the full sample and split-off households. Therefore, new members were added to the panel during each subsequent survey wave.

The original, multi-stage sampling frame was based on households from 13 out of 27 Indonesian provinces: North Sumatra, West Sumatra, South Sumatra, Lampung, DKI Jakarta, West Java, Central Java, Yogyakarta, East Java, Bali, West Nusa Tenggara, South Kalimantan, and South Sulawesi. This represented approximately 83% of the Indonesian population in 1993 [7]. Indonesia now has 34 provinces, as eight have been added since 1999. As individuals moved

between provinces within Indonesia over time, additional provinces were represented in the survey. In 2014, 24 provinces were represented.

Survey Questions

Many questions were consistently asked during each survey wave, but some were added or eliminated over the 20-year survey period to reflect the changing economic context. The household questionnaire collected information on household characteristics such as its size, physical infrastructure, access to sanitation and water sources, and food expenditures. Each selected adult respondent was inquired about demographic and socioeconomic characteristics, educational attainment, decision making, smoking history, mental health, and health care utilization. Beginning in 2000, adults were also asked about their food intake in the past week, specifically, whether they ate each food type and the frequency of consumption. In 2000 and 2007, questions focused on dietary staples (e.g. rice, eggs, dairy) and iron- and vitamin-A rich foods (e.g. meat, green leafy vegetables, carrots, sweet potatoes). Energy-dense foods (instant noodles, fast food, soft drinks, fried snacks) were added in 2014. In addition, married women were asked about their reproductive history and breastfeeding and complementary feeding practices for children born within the five years prior to the survey.

In 2007 and 2014, adults were asked about the type, duration (< 2 hours or ≥ 2 hours), and number of days of physical activities they engaged during the last week. Activity type included vigorous activity, moderate activity, and walking, using a modified version of the International Survey on Physical Activities. Vigorous physical activity was defined as any activities that make you breathe much harder than normal (e.g. heavy lifting, digging, cycling with loads). Moderate physical activity was defined as any activities that make you breathe somewhat harder than normal

(e.g. carrying light loads, bicycling, or mopping the floor). Walking included at work and at home, walking from place to place, and walking for recreation.

The child questionnaire paralleled the adult questionnaire, with age-appropriate modifications. Specifically, information was collected on age, gender, educational attainment, morbidities, healthcare utilization, and food frequency. Physical activity was not collected among children. For children younger than 11, the mother, female guardian, or household caretaker answered the questions. Children aged ≥ 11 years were allowed to respond for themselves.

Height and weight were measured for adults and children by trained interviewers, using a rigorous research protocol [7]. Interviewers completed both didactic and hands-on anthropometric training and after completing each questionnaire and measurements in the field, interviewers checked for completeness and errors, using a computer assisted program. Supervisors randomly observed interviewers to ensure that measurements were being performed according to the training instructions. Height was measured to the nearest millimeter using a Seca plastic height board. Recumbent height was measured among children aged < 24 months. Weight was measured to the nearest one-tenth of a kilogram using a Camry model EB1003 scale.

Statistical Analysis

Overweight served as our *a priori* primary endpoint (i.e. outcome). Among adults (aged ≥ 19 years) overweight was defined as BMI ≥ 25 kg/m^2. Among children and adolescents aged 6-18 years, overweight was defined as BMI-for-age z-score > 1 using the World Health Organization (WHO) reference [8]. Among children aged 0-5 years, overweight was defined as weight-for-height [WHZ] z-score > 2 using the Multicentre Growth Reference Study standard [9].

Appropriate cutoffs were applied to create dichotomous or categorical variables for age, education attainment, and occupation. Urban/rural residence, diet, and physical activity data were modelled as binary variables. Household wealth quintiles were created using principal component analysis, using following variables: type of floor material, type of toilet, type of cooking fuel and ownership of assets including: land, livestock, vehicle(s), household appliances, furniture and utensils, jewelry, and monetary savings. Dichotomous variables were created from the aforementioned categorical variables and a frequency test was run for each of the new variables to ensure that those variables with a variance of zero were removed. The wealth score was then split into quintiles based on the distribution of the data in a given survey year.

Household food expenditures on rice and cooking oil represented the household level expenditure on each item as a percentage of the households' total expenditures on food. Food expenditures were then dichotomized as lower and higher based on the mean value in each survey year. Rice was selected as it is a key staple in Indonesia. Cooking oil was also selected because it has been shown to perpetuate energy imbalance.

Descriptive statistics are presented as percentages for categorical variables or means for continuous variables. The distribution of overweight by gender (adult women and adult men aged and ≥ 19 years) and age (0-5 years, 6-12 years, 13-18 years) was detailed for each survey year. Then, we described individuals who were overweight, by the aforementioned characteristics (e.g. education, wealth), from 1993 to 2014. Finally, we described the distribution of the consumption of energy-dense foods (2014) and of physical activity among adults (2007, 2014).

Prior conceptual models [10–12], along with the availability of data in the IFLS were used to identify plausible determinants of the obesity endemic in Indonesia. In order to create a parsimonious model, univariate analyses first explored risk factors and their association with

overweight, using cross-sectional logistic regression models, for five groups in 2014: adult women, adult men, children aged 0-5 years, children aged 6-12 years, and children aged 13-18 years. Largely, variables were included in multivariate models if they were statistically significantly associated with the dependent variable in univariate models (defined as $p < 0.05$). Age, gender, urban/rural residence, and wealth were included in the multivariate logistic regression models irrespective of statistical significance. Pregnant women were excluded from analyses. We assessed multicollinearity in all models.

In sensitivity analyses, we explored the association between selected risk-factors and overweight among adults, over time (1993-2014), using modified Poisson models [13]. These longitudinal models were considered sensitivity analyses because individual-level consumption of energy dense foods and physical activity data were not available in prior years. Alpha was set to 0.05 to determine statistical significance. All analyses employed sampling weights, which account for the survey design and were performed using Stata 15.1 (StataCorp LP, College Station, TX). Neither patients nor the public were involved in this secondary data analysis.

RESULTS

Between 1993 and 2014 the prevalence of overweight among adults doubled from 17.1% to 33.0% (Figure 1). The prevalence of overweight among children under-five years increased from 4.2% to 9.4% between 1993 and 2007, but since then, remained relatively stagnant. Among children aged 6-12 years and 13-18 years, the prevalence of overweight increased from 5.1% and 7.1% in 1993 to 15.6% and 14.1% in 2014, respectively.

The characteristics of overweight individuals are presented in Tables 1-4 and in Supplemental Table 1. More women and men aged over 40 years (versus younger ages) were overweight over the past two decades (Tables 1-2). Over time, most overweight women and men

had at least primary school education, and more than half lived in urban areas. The distribution of wealth among overweight adults varied over time. In 1993, the largest percentage of overweight women (29.4%) was in the richest households, whereas in 2014, wealth was evenly distributed (~20%). Trends were similar for men.

Table 1. Percent Distribution of Selected Characteristics Among Overweight Adult Women Aged 19 + in Indonesia Over Time

	1993[1,2]		1997[1,2]		2000[1,2]		2007[1,2]		2014[1,2]	
	n	%	n	%	n	%	n	%	n	%
Age										
19-29 y	97	18.9	248	18.7	423	14.7	848	15.6	1,197	10.9
30-39 y	253	38.1	531	32.6	728	30.5	1,167	24.8	1,937	19.6
40-49 y	178	25.4	473	27.0	699	29.9	1,044	31.1	1,511	31.9
50-59 y	97	14.3	255	13.2	342	15.4	618	17.6	996	24.4
≥ 60 y	24	3.3	169	8.6	254	9.6	389	10.9	551	13.2
Education										
No Education	39	7.3	225	14.5	276	11.2	279	9.1	263	6.9
Primary	415	66.7	832	61.7	1,232	54.6	1,702	53.7	2,198	50.4
Junior or Senior	152	20.3	308	19.4	711	27.0	1,109	28.6	2,077	32.8
University	43	5.7	69	4.4	172	7.2	335	8.6	623	9.9
Parity[3]										
≤ 2	16	15.2	20	43.1	71	20.1	56	20.1	428	35.8
3-4	19	17.7	8	14.2	72	18.4	76	24.9	230	29.9
≥ 5	84	67.1	20	42.7	254	61.5	191	55.0	306	34.4
Smoking Status										
Non-Smoker	614	96.7	1,553	95.6	2,311	96.1	3,889	97.5	6,027	97.4
Smoker	25	3.3	73	4.4	99	3.9	101	2.5	134	2.6
Marital Status										
Never Married	10	2.8	85	5.0	146	4.8	237	4.9	291	3.1
Married	582	89.1	1,336	82.7	1,926	80.4	3,298	81.9	5,185	81.7
Other	49	8.1	220	12.3	351	14.8	475	13.2	714	15.2
Employment										
Not working	362	57.0	803	50.8	969	39.8	1,527	37.6	2,178	35.2
Agriculture	27	5.5	135	8.8	260	11.6	517	14.5	816	15.6
Skilled Manual[4]	44	6.2	141	9.3	201	9.3	315	8.2	479	8.4
Skilled[5]	202	31.3	545	31.1	956	39.2	1,616	39.7	2,618	40.8
Residence										

Rural	150	33.4	583	43.0	893	41.5	1,604	47.3	2,286	46.0
Urban	499	66.6	1,093	57.0	1,553	58.5	2,462	52.7	3,906	54.0
Wealth										
Lowest	81	14.4	238	17.3	323	15.2	603	16.3	1,095	23.0
Second	64	10.3	233	16.9	388	19.5	875	27.6	1,087	22.7
Middle	163	21.0	312	23.4	430	20.9	521	15.8	781	17.3
Fourth	203	24.9	270	19.9	426	20.8	679	20.4	894	18.7
Highest	645	29.4	330	22.5	475	23.5	645	19.9	848	18.3
Family Size										
≤ 4	249	40.2	533	33.3	1,161	48.8	1,274	30.2	3,898	65.3
> 4	400	59.8	1,143	66.7	1,285	51.2	2,792	69.8	2,294	34.7
Province										
Bali	78	18.6	213	13.0	305	14.0	522	16.8	774	17.0
Central Java	107	26.0	243	22.7	369	24.2	576	24.3	885	25.1
West Java	92	20.4	272	23.5	416	25.6	606	19.4	955	19.8
Other	372	35.0	948	41.0	1,353	36.1	2171	39.4	3,232	38.0
Food Expenditures[6]										
Rice										
Lowest	186	49.5	880	53.1	1,242	51.6	2,114	53.2	3,137	53.0
Highest	205	50.5	790	46.9	1,198	48.4	1,951	46.8	3,051	47.0
Cooking oil										
Lowest	198	42.5	786	49.3	1,174	48.6	1,827	45.4	3,562	58.6
Highest	340	57.5	882	50.7	1,266	51.4	2,238	54.6	2,625	41.4

[1] Overweight is defined as body mass index ≥ 25kg/m^2. Percentages are weighted to be representative of the population of Indonesia in the given survey year
[2] Excludes women who are currently pregnant
[3] Parity is only queried among ever-married women
[4] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction
[5] Skilled labor combines the following employment sectors: retail and service, transportation
[6] Represents the household level expenditure on each item as a percentage of the households' total expenditures on food

Table 2. Percent Distribution of Selected Characteristics Among Overweight Men Aged 19 + in Indonesia Over Time

	1993[1]		1997[1]		2000[1]		2007[1]		2014[1]	
	n	%	n	%	n	%	n	%	n	%
Age										
19-29 y	27	7.3	88	13.4	224	14.1	419	15.6	573	16.5
30-39 y	117	34.3	196	30.7	356	28.7	698	24.6	1,048	21.7
40-49 y	121	33.4	215	32.0	336	31.8	549	30.6	885	25.4
50-59 y	52	14.4	123	16.1	184	17.2	326	20.7	514	25.0
≥ 60 y	35	10.6	62	7.8	99	8.2	164	8.5	262	11.4

Education										
No Education	6	2.0	24	3.8	32	2.5	32	1.8	39	1.8
Primary	153	44.6	227	40.8	385	34.2	553	34.5	725	32.4
Junior or Senior	124	37.9	210	35.6	519	43.0	805	42.6	1,288	45.0
University	68	15.5	112	19.8	247	20.3	386	21.1	612	20.8
Smoking Status										
Non-Smoker	163	44.9	289	41.3	527	44.8	897	43.6	1,481	46.5
Smoker	181	55.1	371	58.7	651	55.2	1,212	56.4	1,779	53.5
Marital Status										
Never Married	4	3.0	54	8.2	131	8.6	218	8.9	353	9.6
Married	342	96.8	605	90.4	1,031	89.7	1,850	88.2	2,833	87.1
Other	1	0.2	11	1.4	22	1.7	56	2.9	95	3.3
Employment										
Not working	34	12.4	70	9.8	84	7.4	165	8.7	248	8.7
Agriculture	27	9.9	100	15.2	179	15.8	328	16.1	500	16.7
Skilled Manual[2]	87	25.8	123	19.7	199	17.5	377	17.7	598	18.8
Skilled Labour[3]	185	51.9	366	55.4	687	59.4	1,231	57.6	1,874	55.9
Residence										
Rural	73	33.5	211	35.7	381	36.0	717	39.0	987	37.4
Urban	279	66.5	473	64.3	818	64.0	1,439	61.0	2,294	62.6
Wealth										
Lowest	22	7.3	82	11.8	130	10.9	324	15.6	547	19.9
Second	26	6.7	88	14.1	166	16.1	460	23.9	562	20.1
Middle	61	18.7	135	22.5	214	19.4	304	15.5	445	17.0
Fourth	72	20.6	118	19.7	267	23.8	418	22.1	554	19.9
Highest	169	46.6	205	31.9	315	29.8	418	22.9	661	23.1
Family Size										
≤ 4	128	36.9	218	32.7	579	50.0	712	30.9	2,061	63.9
> 4	224	63.1	466	67.3	620	50.0	1,444	69.1	1,220	36.1
Province										
Bali	38	16.5	70	9.7	116	10.8	227	14.4	369	14.0
Central Java	58	29.6	88	20.3	162	22.6	289	23.2	457	24.2
West Java	38	17.2	100	23.2	195	26.4	308	20.3	433	21.0
Other	141	23.8	313	32.7	540	31.2	980	34.2	1531	33.1
Food Expenditures[4]										
Rice										

Lowest	83	43.0	365	53.5	627	52.0	1,135	53.5	1,709	54.5
Highest	103	57.0	314	46.5	564	48.0	1,016	46.5	1,561	45.5
Cooking oil										
Lowest	89	34.5	290	43.6	525	45.2	936	42.8	1,811	56.6
Highest	203	65.5	388	56.4	665	54.8	1,215	57.2	1,459	43.4

[1] Overweight is defined as body mass index ≥ 25kg/m^2. Percentages are weighted to be representative of the population of Indonesia in the given survey year
[2] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction
[3] Skilled labor combines the following employment sectors: retail and service, transportation
[4] Represents the household level expenditure on each item as a percentage of the households' total expenditures on food

Nearly equal proportions of boys and girls aged 0-19 years were overweight and a majority had a parent with at least primary school education (Supplemental Tables 1-3). Across all groups, the proportion of overweight children who had an overweight mother increased between 1993 and 2014. The distribution of urban/rural residence among overweight children also changed over time, with more overweight children and adolescents residing in urban areas by 2014 (~60%) compared to 1993. The distribution of wealth among overweight children and adolescents also varied over time, but like adults, by 2014, wealth was almost evenly distributed by quintile (~20%).

Distribution of Consumption of Energy-Dense Food and Physical Activity

Approximately 60% of adults reported consuming instant noodles during the last week in 2014 (Table 3). Likewise, about 65% of adults reported consuming fried snacks, for approximately 4.0 days on average. Smaller proportions of adults regularly consumed fast food or soda (< 10%).

Trends were similar among children. Nearly 60% of children aged 6-59 months consumed instant noodles during the last week, as did three-quarters of children aged 6-12 years (77.5%) and 13-18 years (78.3%). Half (50.4%) of children aged 6-59 months and about two-thirds of children aged 6-18 years regularly consumed fried snacks. Similar proportions of children regularly consumed fast food (~15%), irrespective of age. All age groups of children consumed soda an

average of 2 days per week. Higher proportions of men were engaged in vigorous physical activity (38.0%) compared to women (10.7%). More than half the women and 70% of men reported being engaged in moderate physical activity and walking during the last week. Physical activity levels decreased, among both women and men, between 2007 and 2014 (data not shown).

Table 3. Distribution and Frequency of Consumption of Energy Dense Foods and Physical Activity in Indonesia, 2014

	Women		Men		Children Aged 6 mo-5 years		Children Aged 6-12 years		Children Aged 13-18 years	
	n	% or Mean	n	% or Mean	n	% or Mean	n	% or Mean	n	% or Mean
Instant Noodles										
Last Week[1]	9,818	60.0	8,703	63.7	2,674	56.8	5,467	77.5	2,084	78.3
Mean Days[2]		2.5		2.6		2.7		3.0		2.9
Fast Food										
Last Week[1]	1,718	9.0	1,291	8.8	685	14.5	1,357	18.8	450	16.3
Mean Days[2]		1.8		1.7		2.4		2.5		2.1
Soda										
Last Week[1]	1,956	10.7	3,281	22.6	278	5.0	1,075	14.5	647	23.0
Mean Days[2]		1.8		2.0		2.0		2.1		2.0
Fried Snacks										
Last Week[1]	9,706	65.4	8,668	68.8	2,282	50.4	4,530	66.4	1,841	72.0
Mean Days[2]		4.0		3.9		3.3		3.9		4.1
Vigorous Activity[1]										
Last Week[1]	15,191	10.7	13,148	38.0		na		na		na
Mean Days[2]		3.9		4.2		na		na		na
Moderate Activity[1]										
Last Week[1]	15,191	58.1	13,148	54.2		na		na		na
Mean Days[2]		4.8		4.4		na		na		na
Walking										

Last Week[1]	15,191	68.8	13,148	72.4	na	na	na
Mean Days[2]		5.1		5.1	na	na	na

na = not applicable

[1] Percent distribution, weighted to be representative of the population of Indonesia in the given survey year. n represents the number of respondents that consumed a particular item during the last week.

[2] The average number of days consumed is queried if the respondent reported that consumed in the last week. Weighted to be representative of the population of Indonesia in the given survey year.

[3]Defined using the International Physical Activity Questionnaire. Respondents are asked about each type of physical activity (i.e. vigorous, moderate, walking) separately and therefore, should be interpreted as mutually exclusive categories. Weighted to be representative of the population of Indonesia in the given survey year.

Regression-based Analyses Among Adults

Figure 2 summarizes all associations between hypothesized risk factors and overweight in multivariate models among adults and children. Among women, older age, higher education, living in an urban area, and higher household wealth status predicted overweight (Table 4). Married women, versus never married, also had higher odds of overweight (odds ratio [OR]=2.39; 95% confidence interval [CI]: 1.88, 2.98). Working in a skilled labor position, versus not working, was associated with 17% higher odds of overweight among women (OR=1.17; 95% CI: 1.04, 1.33) whereas working in agriculture-based labor, a physically demanding occupation, was associated with an approximately 30% lower odds of overweight (OR=0.66; 95% CI: 0.56, 0.78). Household expenditures on cooking oil (OR=1.24; 95% CI: 1.12, 1.38) and individual's consumption of fried snacks (versus no consumption) (OR=1.12; 95% CI: 1.00, 1.25) was associated with higher odds of overweight.

Table 4. Multivariate Logistic Regression Investigating the Association Between Selected Characteristics and Overweight Among Adults Aged 19 + in Indonesia in 2014

		Women[1,2]		Men[1,2]	
		n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
		N=9,073		N=5,775	
Age					
	19-29 y	2,403	Reference	1,441	Reference
	30-39 y	2,630	2.03 (1.75, 2.34) *	1,807	1.79 (1.40, 2.30) *
	40-49 y	1,943	2.83 (2.41, 3.31) *	1,320	2.37 (1.83, 3.08) *
	50-59 y	1,357	2.36 (1.97, 2.83) *	719	2.37 (1.76, 3.20) *

60+ y	740	1.68 (1.34, 2.12) *	488	0.92 (0.62, 1.36)
Education				
No Education	511	Reference	106	Reference
Primary	3,562	2.04 (1.59, 2.60) *	2,029	1.76 (0.87, 3.57)
Junior or Senior	3,809	1.89 (1.46, 2.46) *	2,854	2.47 (1.21, 5.04) *
University	1,191	1.67 (1.24, 2.26) *	786	3.66 (1.75, 7.65) *
Smoking Status				
Non-Smoker	8,881	Reference	1,849	Reference
Smoker	192	0.78 (0.55, 1.10)	3,926	0.51 (0.43, 0.60) *
Marital Status				
Never Married	683	Reference	774	Reference
Married	7,909	2.39 (1.88, 2.98) *	4,931	2.04 (1.48, 2.82) *
Other	481	1.54 (1.10, 2.15) *	70	1.59 (0.77, 3.27)
Employment				
Not Working	3,227	Reference	371	Reference
Agriculture	1,585	0.66 (0.56, 0.78) *	1,483	0.50 (0.35, 0.73) *
Skilled Manual[3]	794	0.92 (0.76, 1.12)	1,290	0.73 (0.51, 1.06)
Skilled[4]	3,466	1.17 (1.04, 1.33) *	2,631	1.15 (0.82, 1.61)
Physical Activity[5]:				
No Vigorous Activity		na	3,624	Reference
Vigorous Activity		na	2,151	0.93 (0.79, 1.10)
No Moderate Activity	3,663	Reference		na
Moderate Activity	5,410	1.10 (0.99, 1.22)		na
Consumed in the Last Week:				
Instant Noodles				
No	3,218	Reference		na
Yes	5,855	1.10 (0.98, 1.25)		na
Fast Food				
No	8,116	Reference	5,172	Reference
Yes	957	1.02 (0.85, 1.27)	603	1.34 (1.06, 1.69) *
Soda				
No		na	4,196	Reference
Yes		na	1,579	1.10 (0.92, 1.30)

Fried Snacks				
No	3,236	Reference	1,782	Reference
Yes	5,837	1.12 (1.00, 1.25) *	3,993	1.06 (0.89, 1.25)
Mean Number of Days Consumed in the Last Week[6]:				
Instant Noodles		na	5,775	0.99 (0.95, 1.04)
Household Level Food Expenditures[7]				
Rice				
Lowest	4,408	Reference		na
Highest	4,665	1.02 (0.91, 1.13)		na
Cooking oil				
Lowest	5,256	Reference	3,378	Reference
Highest	3,817	1.24 (1.12, 1.38) *	2,397	1.19 (1.02, 1.39) *
Residence				
Rural	3,803	Reference	2,401	Reference
Urban	5,270	1.21 (1.08, 1.35) *	3,374	1.26 (1.06, 1.50) *
Wealth				
Lowest	2,289	Reference	1,354	Reference
Second	2,017	1.23 (1.06, 1.44) *	1,271	0.95 (0.76, 1.20)
Middle	1,455	1.23 (1.03, 1.45) *	964	0.99 (0.77, 1.26)
Fourth	1,696	1.06 (0.90, 1.25)	1,127	1.06 (0.84, 1.34)
Highest	1,616	1.12 (0.95, 1.32)	1,059	1.17 (0.92, 1.48)

CI = confidence interval, na = not applicable, not included in multivariate model

[1] Overweight is defined as BMI ≥ 25 kg/m^2

[2] Odds ratios and confidence intervals are estimated using logistic regression and are weighted to account for the survey design. Pregnant women are excluded

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

[5] Defined using the International Physical Activity Questionnaire

[6] Modelled as a continuous variable, the average number of days consumed is queried if the respondent reported that they consumed item during the last week

[7] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

* $p < 0.05$

Similarly, among men, older age, higher educational attainment, and living in an urban area were associated with higher overweight (Table 4). Wealth was not associated with overweight among men. Married men, versus never married, had two-fold higher odds of overweight

(OR=2.04; 95% CI: 1.48, 2.82). Consuming fast food, compared to not consuming fast food, was associated with 34% higher odds of overweight among men (OR=1.34; 95% CI: 1.06, 1.69). Current smokers (versus non-smokers) (OR=0.50; 95% CI: 0.43, 0.60) and men who had an agriculture-based occupation (versus not working) (OR=0.50; 95% CI: 0.35, 0.73) had 50% lower odds of overweight. Results were similar when investigating associations among adults in multivariate, longitudinal models (Supplemental Tables 4 and 5).

Regression-based Analyses Among Children

In multivariate models for children aged 6 months to 5 years, consuming fast food (OR=1.48; 95% CI: 1.00, 2.19), urban residence (OR=1.64; 95% CI: 1.14, 2.35) and higher household wealth (OR=1.70; 95% CI: 1.03, 2.81) were associated with higher odds of overweight (Table 5). Among children aged 6-12 years, every 1-year increase in age was associated with 6% higher odds of overweight (OR=1.06; 95% CI: 1.01, 1.11). Having an overweight mother (OR=1.92; 95% CI: 1.59, 2.32), living in an urban area (OR=1.55; 95% CI: 1.26, 1.91), and higher household wealth status was associated with higher odds of overweight. On the contrary, parental employment in agriculture-based (OR=0.61; 95% CI: 0.44, 0.85) or skilled manual labor (OR=0.50; 95% CI: 0.33, 0.74) and living in households with > 4 people (OR=0.82; 95% CI: 0.68, 0.99) was associated with lower odds of overweight.

Having an overweight mother was associated with 92% higher odds of being overweight among adolescents (OR=1.92; 95% CI: 1.53, 2.43). Living in an urban area also predicted higher odds of overweight among this age group (OR=1.74; 95% CI: 1.33, 2.27). On the contrary, having a parent employed in agriculture-based labor (OR=0.64; 95% CI: 0.43, 0.96), skilled manual labor (OR=0.52; 95% CI: 0.33, 0.83) or skilled labor (OR=0.70; 95% CI: 0.53, 0.91), compared to not working, was associated with lower odds of overweight among adolescents.

Table 5. Multivariate Logistic Regression Models Investigating the Association Between Selected Characteristics and Overweight Among Children in Indonesia, 2014

	6 months - 5 years[1]		6 – 12 years[2]		13 – 18 years[2]	
	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
		N=3,424		N=4,791		N=3,186
Mean Age[3]	3,424	1.01 (0.88, 1.16)	4,791	1.06 (1.01, 1.11) *	3,186	0.84 (0.79, 0.91) *
Gender						
Boys	1,767	Reference	2,455	Reference	1,648	Reference
Girls	1,657	0.78 (0.58, 1.08)	2,336	0.96 (0.79, 1.15)	1,538	1.06 (0.85, 1.33)
Parental Education[4]						
No Education	188	Reference	313	Reference	264	Reference
Primary	1,234	0.97 (0.40, 2.36)	1,980	0.73 (0.48, 1.11)	1,505	1.01 (0.62, 1.66)
Junior or Senior	1,568	1.12 (0.47, 2.65)	1,997	0.84 (0.55, 1.27)	1,173	1.18 (0.71, 1.94)
University	434	1.12 (0.44, 2.87)	501	1.34 (0.84, 2.14)	244	1.38 (0.76, 2.49)
Parental Employment[4]						
Not Working	1,780	Reference	1,989	Reference	1,239	Reference
Agriculture	433	0.61 (0.31, 1.21)	821	0.61 (0.44, 0.85) *	581	0.64 (0.43, 0.96) *
Skilled Manual[5]	208	0.98 (0.52, 1.84)	371	0.50 (0.33, 0.74) *	264	0.52 (0.33, 0.83) *
Skilled[6]	1,003	1.15 (0.82, 1.63)	1,610	0.91 (0.73, 1.13)	1,102	0.70 (0.53, 0.91) *
Maternal Overweight						
Not Overweight	2,238	Reference	2,894	Reference	1,834	Reference
Overweight	1,186	1.20 (0.89, 1.62)	1,897	1.92 (1.59, 2.32) *	1,352	1.92 (1.53, 2.43) *
Consumed in the Last Week:						
Instant Noodles						
No	1,525	Reference		na		na
Yes	1,899	0.79 (0.57, 1.11)		na		na

	Fast Food						
	No	2,952	Reference	3,909	Reference		na
	Yes	472	1.48 (1.00, 2.19) *	882	1.16 (0.93, 1.45)		na
Residence							
	Rural	1,478	Reference	2,053	Reference	1,323	Reference
	Urban	1,946	1.64 (1.14, 2.35) *	2,738	1.55 (1.26, 1.91) *	1,863	1.74 (1.33, 2.27) *
Wealth							
	Lowest	830	Reference[7]	1,109	Reference	799	Reference
	Second	807	1.54 (0.94, 2.53)	1,056	1.43 (1.06, 1.92) *	735	1.11 (0.80, 1.54)
	Middle	565	1.43 (0.83, 2.48)	812	1.73 (1.26, 2.36) *	513	0.95 (0.66, 1.37)
	Fourth	671	1.70 (1.03, 2.81) *	931	1.45 (1.07, 1.95) *	574	0.95 (0.65, 1.37)
	Highest	551	1.61 (0.96, 2.70)	883	1.55 (1.14, 2.11) *	565	0.94 (0.66, 1.33)
Family Size							
	≤ 4		na	2,105	Reference	1,225	Reference
	> 4		na	2,686	0.82 (0.68, 0.99) *	1,961	0.87 (0.69, 1.10)

CI = confidence interval, na= not applicable, not included in multivariate model

[1] Overweight is defined as weight-for-height z-score > 2 using the MGRS Standard, estimated using logistic regression models and are weighted to account for the survey design

[2] Overweight is defined BMI z-score > 1 using the WHO reference, estimated using logistic regression models and weighted to account for the survey design

[3] Modelled as a continuous variable

[4] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data.

[5] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[6] Skilled labor combines the following employment sectors: retail and service, transportation

[7] Wealth was not significant in univariate model but is included in the multivariate model due to previously-established associations

* $p < 0.05$

DISCUSSION

Overweight, now considered a global pandemic, has increased in Indonesia over the last several decades and it persists among all age-groups. One-third of adults in Indonesia were overweight in 2014 and women consistently had a higher overweight prevalence compared to men. Between 1993 and 2014 the prevalence of overweight increased by 100% and 88%, among women and men, respectively. Similarly, among children and adolescents, the prevalence of overweight increased by more than 100% between 1993 and 2014. In 2014, 7.5% of children aged 0-5 years were overweight, as were 16% of school-age children and 14% of adolescents. In younger-aged children, boys had a slightly higher prevalence of overweight, whereas among adolescents, overweight prevalence was similar by gender (in 2014). In addition, among overweight individuals, the distribution of education, wealth, employment status, and urban/rural residence changed. Over the past two decades, more rural than urban residents became overweight, and in 2014, the proportions of overweight adults were evenly distributed among across wealth quintiles.

Consistent with prior literature, living in an urban area, higher wealth, higher education, and consumption of energy-dense foods were associated with higher odds of overweight [5,14]. Several other analyses have also reported higher rates of overweight in urban areas in lower-income countries [15,16] and in Indonesia specifically [17–20]. Urbanization alters supply-side factors, such as the food system and the rapid spread of supermarkets in low- and middle-income countries (LMIC), which makes low-cost, convenient, and highly processed foods more available and accessible [21–23]. Simulations suggest that a shift in the urban population from 25% to 75% is associated with a 4-percentage point increase of total energy from fat and an additional 12-percentage points of energy from sugar [24]. In addition, urbanization leads to lower physical activity, in part because occupations become more sedentary.

Among both men and women, higher education was associated with higher odds of overweight. Additionally, higher wealth was associated with 25% higher odds of being overweight among women and a 70%, 55%, and 74% higher odds of overweight among young children, school-age children, and adolescents, respectively. Higher education [5] and higher wealth or income [5,17] have been shown to be associated with higher overweight among adults and children in prior studies conducted in Indonesia. But importantly, descriptive statistics in our study also show a growing prevalence of overweight among lower-wealth groups. For example, among women, the percent of overweight women in the poorest and second wealth quintile grew by 60% and 120%, respectively, compared to higher wealth quintiles where the percent of overweight women decreased over time. This is consistent with prior studies, which have documented an increasing burden of overweight among women with lower education and in poorer households in Indonesia and other LMIC [25–28].

For both adults and children, consuming energy-dense foods (instant noodles, fried snacks, fast food) was associated with higher odds of overweight. Prior literature on the consumption of energy-dense foods in Indonesia is limited. But these results are generally consistent with findings that reported that the percent of total energy coming from fat has increased in this context [17,29] and one recent survey conducted in Asia that suggested the consumption of energy-dense or processed foods is widespread [4].

Results are also consistent with prior literature, which finds that maternal employment is associated with overweight in LMIC, both among women and their children [30,31]. In this sample, skilled occupations were associated with higher odds of overweight whereas agriculture-based employment was associated with lower odds of overweight. This is likely related to occupation-related physical activity; Monda and colleagues provide empirical evidence of a

reduction in the intensity of occupational activity with economic development in China [32]. In fact, reduced physical activity likely represents the most important cause of the rapid overweight increases between 1990 and 2010 in most LMIC (with dietary factors playing a more major role from 2010-present) [33].

Similar to our results, Rachmi and colleagues report that overweight prevalence is higher among younger-aged boys versus girls in Indonesia [5]. Finally, having an overweight mother was strongly associated with higher odds of overweight among school-age children and adolescents. Although the importance of intergenerational nutrition is often a concern for undernutrition, it warrants consideration for overnutrition as well. Pre-pregnancy maternal overweight puts infants at increased risk of being born large-for-gestational-age and subsequently overweight during childhood [34–39]. A child born to a mother who is overweight is twice as likely to be overweight as a child, compared to a child whose mother was normal weight [37,38] .

Our findings call for urgent action to mitigate overweight among all age-groups in Indonesia. Combined approaches targeting to improve the enabling environment, supply and demand sides are warranted, which includes enhancing the food environment, food system, and effective social behavior change communication [40,41]. Fiscal measures, such as food- and beverage-related taxes, to reduce the consumption of unhealthy items and subsidies for fruits and vegetables production and consumption, may be effective in improving the overall food environment [41–44]. Regulatory (or even voluntary) measures to control warning labelling systems and marketing of unhealthy foods and beverages may also improve the obesogenic environment [41,45,46]. It is also important to address overweight early, as child and adolescent obesity tracks into adulthood [47,48]; interventions aimed at improving nutrition literary and eating and physical activity behaviors through school-based nutrition education and effective

social and behavior change communication to mobilize the support of the entire community also warrant consideration [41,49,50]. Finally, multi-sectoral engagement and efforts are required to holistically tackle the obesity epidemic through a food systems approach.

These findings and recommendations should be interpreted while keeping in mind the limitations of our study. First, we largely employ cross-sectional data, therefore, we cannot infer any causal associations and there may be unmeasured confounding. Data on the consumption of a select number of energy-dense foods was only collected in 2014, which limits our ability to make conclusions about the association between energy-dense foods and overweight. Breastfeeding and complementary feeding practices were not assessed following the standard methods. Physical activity levels were based on respondent recall. Finally, these findings may not be generalizable beyond Indonesia. Despite some limitations, we are able to compare overweight trends over time among all age groups, explore the consumption of energy-dense foods and physical activity, and investigate hypothesized risk factors for overweight using regression-based methods, using a recent dataset that is nationally representative of Indonesia.

Indonesia is undergoing nutrition transition, as evidenced by the increasing prevalence of overweight, the ubiquitous consumption of energy-dense foods, and decreasing levels of physical activity. These data suggest urgent program and policy action is needed to reduce and prevent overweight among all age groups. In addition, these data highlight the need for prevention strategies that also target men and boys, as well as the increasing prevalence of overweight among rural and poorer populations. A multipronged strategy is warranted employing multi-sectoral, multi-stakeholder actions and solutions to strengthen health systems and foster an enabling environment, improve the supply-related issues including the availability and quality of relevant services, and enhance knowledge and cultivate demand for services.

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Conflict of Interest Statement

The authors do not have any conflicts of interest to declare.

Author Contributions

The authors' responsibilities were as follows: VMO performed the statistical analysis and wrote the paper. All authors designed the research, developed the research plan, and had responsibility for the final content.

Data Statement

Data are publicly available at https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html

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Figure 1. Percent Distribution of Overweight/Obesity in Indonesia Over Time[1-4]

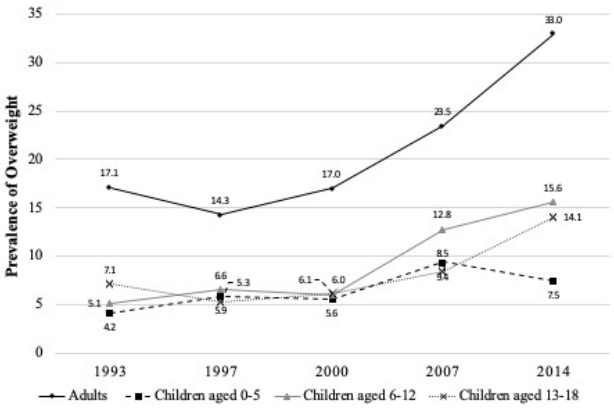
[see attached Figure 1]

[1] Percentages are weighted to be representative of the population of Indonesia in the given survey year
[2] Adults: excludes women who are currently pregnant. Overweight/obesity defined as BMI ≥ 25 kg/m^2
[3] Children Aged 0-5 years: overweight/obesity defined as weight-for-height z-score > 2 using the MGRS Standard
[4] Children Aged 6-18 years: overweight/obesity as BMI-for-age z-score > 1 using the WHO Reference

Figure 2. Summary of Associations between Selected Characteristics and Overweight/Obesity in Multivariate Models

[See Attached Figure 2]

-- not applicable; ns = not significant
Associated with higher odds of overweight/obesity in multivariate models
Associated with lower odds of overweight/obesity in multivariate models
Direction of association with overweight/obesity is mixed in multivariate models
[1] Parental characteristic for child models



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Online Supplemental Material

Supplemental Table 1. Percent Distribution of Selected Characteristics Among Overweight Children Aged 0-5 in Indonesia Over Time

	1993[1]		1997[1]		2000[1]		2007[1]		2014[1]	
	n	%	n	%	n	%	n	%	n	%
Age										
0-2 y	58	76.6	88	81.5	145	72.2	301	72.7	230	62.4
3-5 y	20	23.4	21	18.5	47	27.8	107	27.3	133	37.6
Gender										
Boys	40	52.7	56	47.9	112	58.2	236	55.1	210	57.7
Girls	38	47.3	109	52.1	80	41.8	172	44.9	153	42.3
Ever Breastfed[2]										
No	4	5.4	0	0	3	2.4	11	3.2	10	2.7
Yes	46	94.6	25	100.0	132	97.6	350	96.8	318	97.3
Exclusively Breastfed[2]										
No	49	95.4	23	88.9	131	96.1	332	92.8	274	84.4
Yes	1	4.6	2	11.1	4	3.9	29	7.2	54	19.6
Complementary Foods[2]										
< 6 mo or ≥ 8 mo	41	94.8	21	100	110	96.2	290	91.2	247	55.8
≥ 6 mo to < 8 mo	1	5.2	0	0	4	3.8	31	8.8	51	44.2
Parental Education[3]										
No Education	9	17.0	19	18.0	20	11.6	24	8.1	11	3.9
Primary	31	61.1	53	57.4	98	51.4	118	35.1	96	33.0
Junior or Senior	12	17.7	18	17.5	56	29.3	169	45.3	156	47.3
University	3	4.2	7	7.0	14	7.7	44	11.5	56	15.8
Parental Employment[3]										
Not working	30	58.1	77	71.0	118	61.2	230	57.8	185	53.7
Agriculture	5	9.3	5	3.8	18	11.3	35	9.6	22	5.6
Skilled Manual[4]	9	16.1	9	8.6	13	7.3	36	9.0	24	7.3
Skilled[5]	11	16.5	17	16.5	39	20.2	103	23.5	130	33.4
Maternal Overweight										
Not Overweight	33	79.5	88	85.1	158	88.3	288	73.3	198	58.7
Overweight	10	20.5	15	14.9	23	11.7	104	26.7	149	41.3
Residence										
Rural	46	70.6	56	55.6	91	49.0	151	44.2	123	39.2
Urban	32	29.4	53	44.4	101	51.0	257	55.8	240	60.8

Online Supplemental Material

Wealth										
	Lowest	26	39.8	20	20.7	39	22.1	114	31.6	56	18.8
	Second	7	7.2	15	14.8	37	21.0	80	22.4	69	25.0
	Middle	12	17.0	27	25.2	34	19.9	60	19.3	43	16.3
	Fourth	19	28.3	15	14.6	31	19.2	53	15.2	65	22.5
	Highest	13	7.7	24	24.7	29	17.7	46	11.4	52	17.4
Family Size										
	≤ 4	26	22.1	30	26.9	86	46.9	167	41.1	195	54.2
	> 4	52	77.9	79	73.1	106	53.1	241	58.9	168	45.8

[1] Overweight defined as weight-for-height z-score > 2 using the MGRS Standard. Percentages are weighted to be representative of the population of Indonesia in the given survey year

[2] Breastfeeding data are reported by the mother retrospectively. Exclusively breastfed indicates whether the child was only given breastmilk (no water or complementary foods) when the child was aged 0-6 months. Complementary foods indicate appropriate timing of complementary foods, that is, the introduction of complementary foods when the child was 6-8 months old.

[3] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data

[4] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[5] Skilled labor combines the following employment sectors: retail and service, transportation

Online Supplemental Material

Supplemental Table 2. Percent Distribution of Selected Characteristics Among Overweight Children Aged 6-12 in Indonesia Over Time

	1993[1]		1997[1]		2000[1]		2007[1]		2014[1]	
	n	%	n	%	n	%	n	%	n	%
Child Age										
6-9 y	113	55.6	183	58.6	206	59.0	495	59.0	760	53.3
10-12 y	48	44.4	90	41.4	91	41.0	200	41.0	332	46.7
Gender										
Boys	77	44.0	144	51.4	166	54.5	387	55.1	601	53.4
Girls	84	56.0	132	48.6	133	45.5	310	44.9	492	46.6
Parental Education[2]										
No Education	10	7.5	126	27.3	42	15.2	51	9.1	46	5.4
Primary	69	70.5	49	51.9	135	44.4	230	40.4	282	32.5
Junior or Senior	23	13.0	15	14.9	91	30.5	237	37.3	441	45.4
University	14	8.9	254	5.8	25	9.9	85	13.3	182	16.8
Parental Employment[2]										
Not Working	53	46.3	162	61.0	132	44.0	317	45.3	448	42.9
Agriculture	6	6.9	32	11.3	42	14.1	76	12.9	91	9.7
Skilled Manual[3]	19	17.8	11	4.4	33	13.2	54	8.1	79	7.9
Skilled[4]	36	29.0	63	23.3	87	28.7	232	33.7	442	39.5
Maternal Overweight										
Not Overweight	60	68.9	184	72.3	186	66.2	356	56.2	454	44.9
Overweight	38	31.1	73	27.7	96	33.8	289	43.8	541	55.1
Residence										
Rural	61	56.7	129	53.8	112	39.9	255	45.3	298	37.0
Urban	100	43.3	146	46.2	187	60.1	442	54.7	795	63.0
Wealth										
Lowest	30	22.2	50	22.3	36	13.1	87	15.4	129	16.3
Second	17	16.1	37	14.4	44	18.1	142	26.0	160	21.4
Middle	36	20.5	44	19.6	45	20.4	75	13.0	141	19.3
Fourth	29	18.9	45	20.3	48	20.6	139	25.1	173	21.1
Highest	47	22.3	62	23.4	66	27.9	120	20.6	181	21.8
Family Size										
≤ 4	49	35.4	65	22.5	114	39.4	222	32.3	621	58.6
> 4	112	64.6	211	77.5	185	60.6	475	67.7	472	41.4

[1] Overweight defined as BMI-for-age z-score > 1 using the WHO Reference. Percentages are weighted to be representative of the population of Indonesia in the given survey year

[2] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

Supplemental Table 3. Percent Distribution of Selected Characteristics Among Overweight Children Aged 13-18 in Indonesia Over Time

	1993[1]		1997[1]		2000[1]		2007[1]		2014[1]	
	n	%	n	%	n	%	n	%	n	%
Child Age										
13-15 y	45	67.9	84	53.9	98	47.6	301	48.5	280	54.1
16-18 y	9	32.0	74	46.1	131	52.4	107	51.5	262	45.9
Gender										
Boys	40	52.2	90	44.9	95	35.8	150	40.7	333	48.9
Girls	43	47.8	121	55.1	179	64.2	217	59.3	374	51.1
Parental Education[2]										
No Education	7	10.8	48	27.4	45	19.5	36	10.9	36	6.5
Primary	46	72.0	96	53.7	136	56.3	164	54.6	240	42.2
Junior or Senior	9	8.0	34	15.4	47	17.0	93	27.2	265	41.0
University	3	9.2	7	3.5	14	7.2	23	7.3	72	10.3
Parental Employment[2]										
Not Working	38	64.9	112	56.8	91	36.8	132	39.9	277	45.3
Agriculture	2	4.3	14	8.1	39	16.6	43	13.7	64	11.0
Skilled Manual[3]	4	3.2	11	4.9	15	7.4	30	9.2	46	8.3
Skilled[4]	21	27.6	59	30.2	97	39.2	129	37.2	260	35.3
Maternal Overweight										
Not Overweight	28	57.2	110	54.3	132	56.3	173	54.2	256	40.7
Overweight	29	42.8	90	45.7	108	43.7	155	45.8	371	59.3
Household Level										
Residence										
Rural	20	39.7	69	37.9	114	45.5	134	42.4	204	39.5
Urban	63	60.3	142	62.1	160	54.5	233	57.6	503	60.5
Wealth										
Lowest	11	14.6	26	15.2	38	16.5	46	16.6	118	23.8
Second	5	3.3	28	13.5	40	20.0	71	25.6	119	24.0
Middle	18	30.2	44	27.8	47	21.2	33	12.5	80	16.1
Fourth	19	21.3	29	17.4	37	15.3	65	23.4	86	18.2
Highest	29	30.6	47	26.1	58	26.9	63	21.8	103	17.9
Family Size										
≤ 4	21	29.0	31	17.0	92	36.1	74	21.9	353	54.6
> 4	62	71.0	180	83.0	182	63.9	293	78.1	354	45.4

[1] Overweight is defined as BMI-for-age z-score > 1 using the WHO Reference. Percentages are weighted to be representative of the population of Indonesia in the given survey year

[2] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction
[4] Skilled labor combines the following employment sectors: retail and service, transportation

Supplemental Table 4. Univariate Logistic Regression Models Investigating the Associations Between Selected Characteristics and Overweight Among Adults in Indonesia in 2014

	Women[1,2]		Men[1,2]	
	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
Age				
19-29 y	4,350	Reference	3,680	Reference
30-39 y	4,217	2.23 (2.01, 2.46) *	3,981	1.95 (1.72, 2.22) *
40-49 y	2,807	2.93 (2.62, 3.27) *	2,766	2.41 (2.10, 2.76) *
50-59 y	2,053	2.26 (2.00, 2.56) *	1,748	2.09 (1.79, 2.44) *
60+ y	1,858	1.04 (0.91, 1.19)	1,612	0.95 (0.79, 1.13) *
Education				
No Education	1,033	Reference	381	Reference
Primary	4,912	2.89 (2.42, 3.45) *	4,192	2.44 (1.61, 3.70) *
Junior or Senior	4,894	2.98 (2.49, 3.55) *	4,901	4.30 (2.85, 6.49) *
University	1,581	2.90 (2.36, 3.55) *	1,487	8.48 (5.55, 12.94) *
Smoking Status				
Non-Smoker	14,772	Reference	4,552	Reference
Smoker	434	0.57 (0.45, 0.72) *	9,165	0.47 (0.43, 0.52) *
Marital Status				
Never Married	1,560	Reference	2,436	Reference
Married	11,549	3.37 (2.88, 3.95) *	10,780	2.04 (1.78, 2.34) *
Other	2,172	1.78 (1.48, 2.14) *	565	1.10 (0.82, 1.46)
Employment				
Not Working	5,713	Reference	1,291	Reference
Agriculture	2,355	0.73 (0.64, 0.82) *	3,565	0.63 (0.52, 0.77) *
Skilled Manual[3]	1,312	0.94 (0.81, 1.09)	2,886	1.06 (0.88, 1.28)
Skilled[4]	5,644	1.46 (1.33, 1.60) *	5,799	2.03 (1.71, 2.41) *
Physical Activity in the Last Week[5]:				
No Vigorous Activity	13,001	Reference	8,360	Reference
Vigorous Activity	1,556	0.94 (0.82, 1.07)	4,762	0.69 (0.62, 0.77) *
No Moderate Activity	6,015	Reference	6,126	Reference
Moderate Activity	8,542	1.18 (1.09, 1.28) *	6,996	0.98 (0.89, 1.07)
No Walking	4,706	Reference	3,628	Reference

Walking	9,851	0.98 (0.90, 1.07)	9,494	1.00 (0.90, 1.11)
Consumed in the Last Week:				
Instant Noodles				
No	5,125	Reference	4,428	Reference
Yes	9,425	1.10 (1.01, 1.19) *	8,685	1.03 (0.93, 1.14)
Fast Food				
No	12,902	Reference	11,825	Reference
Yes	1,648	1.18 (1.04, 1.34) *	1,288	1.55 (1.34, 1.80) *
Soda				
No	12,620	Reference	9,838	Reference
Yes	1,930	1.05 (0.93, 1.19)	3,275	1.13 (1.01, 1.25) *
Fried Snacks				
No	5,253	Reference	4,468	Reference
Yes	9,297	1.26 (1.16, 1.37) *	8,645	1.22 (1.10, 1.35) *
Mean Number of Days Consumed in the Last Week[6]:				
Instant Noodles	9,425	1.00 (0.97, 1.03)	8,685	0.95 (0.92, 0.98) *
Fast Food	1,648	0.99 (0.91, 1.08)	1,288	0.96 (0.83, 1.11)
Soda	1,930	1.01 (0.93, 1.09)	3,275	0.95 (0.90, 1.01)
Fried Snacks	9,297	1.04 (0.99, 1.06)	8,645	1.01 (0.99, 1.04)
Food Expenditures[7]				
Rice				
Lowest	7,946	Reference	7,165	Reference
Highest	7,315	1.14 (1.05, 1.23) *	6,583	0.99 (0.90, 1.08)
Cooking oil				
Lowest	9,192	Reference	8,391	Reference
Highest	6,067	1.25 (1.15, 1.36) *	5,355	1.34 (1.21, 1.47) *
Residence				
Rural	6,242	Reference	5,688	Reference
Urban	9,043	1.39 (1.29, 1.51) *	8,097	1.92 (1.74, 2.12) *
Wealth				
Lowest	2,818	Reference	2,879	Reference
Second	2,538	1.22 (1.06, 1.39) *	2,528	1.25 (1.07, 1.47) *

Middle	1,829	1.19 (1.03, 1.38) *	1,863	1.40 (1.18, 1.66) *
Fourth	2,129	1.14 (0.99, 1.32)	2,104	1.54 (1.31, 1.81) *
Highest	1,998	1.19 (1.03, 1.36) *	1,956	2.16 (1.85, 2.52) *
Family Size				
≤ 4	9,542	Reference	8,590	Reference
> 4	5,743	0.96 (0.89, 1.04)	5,195	0.97 (0.88, 1.07)

CI = confidence interval

[1] Overweight is defined as BMI ≥ 25 kg/m^2

[2] Odds ratios and confidence intervals are estimated using logistic regression and are weighted to account for the survey design. Models exclude women who are currently pregnant.

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

[5] Defined using the International Physical Activity Questionnaire

[6] Modelled as a continuous variable, the average number of days consumed is queried if the respondent reported that they consumed item during the last week

[7] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

* $p < 0.05$

Supplemental Table 5. Longitudinal Associations Between Selected Characteristics and Overweight Among Adult Women Aged 19 + in Indonesia 1993-2014

		Risk Ratio (95% Confidence Interval)	
		Univariate[1,2]	Multivariate[1,2]
	N	Risk Ratio (95% CI)	Risk Ratio (95% CI)
Age	N=29,541		
19-29 y		Reference	Reference
30-39 y		2.00 (1.85, 2.17) *	1.75 (1.56, 1.97) *
40-49 y		2.33 (2.16, 2.51) *	2.02 (1.80, 2.27) *
50-59 y		1.85 (1.71, 2.00) *	1.76 (1.56, 1.98) *
60+ y		1.09 (1.00, 1.19) *	1.39 (1.21, 1.59) *
Education	N=25,970		
No Education		Reference	Reference
Primary		2.05 (1.89, 2.23) *	1.63 (1.47, 1.80) *
Junior or Senior		2.00 (1.82, 2.18) *	1.60 (1.42, 1.80) *
University		2.03 (1.81, 2.28) *	1.53 (1.32, 1.78) *
Smoking Status	N=28,967		
Non-Smoker		Reference	Reference
Smoker		0.58 (0.51, 0.66) *	0.75 (0.65, 0.87) *
Marital Status	N=29,055		
Never Married		Reference	Reference
Married		3.03 (2.63, 3.49) *	2.25 (1.81, 2.81) *
Other		2.01 (1.73, 2.34) *	1.60 (1.25, 2.06) *
Employment	N=28,726		
Not Working		Reference	Reference
Agriculture		0.72 (0.67, 0.77) *	0.77 (0.71, 0.84) *
Skilled Manual[3]		0.90 (0.82, 0.98) *	0.93 (0.84, 1.04)
Skilled[4]		1.30 (1.23, 1.36) *	1.13 (1.07, 1.20) *
Food Expenditures[5]			
Rice	N=28,654		
Lowest		Reference	Reference
Highest		1.12 (1.07, 1.17) *	1.00 (0.95, 1.06)
Soda	N=27,508		
Lowest		Reference	Reference
Highest		1.26 (1.19, 1.33) *	1.13 (1.06, 1.21) *

	Snacks	N=29,057		
	Lowest		Reference	Reference
	Highest		1.20 (1.15, 1.25) *	1.03 (0.98, 1.09)
	Cooking oil	N=29,172		
	Lowest		Reference	Reference
	Highest		1.31 (1.25, 1.37) *	1.17 (1.11, 1.23) *
Residence		N=29,537		
	Rural		Reference	Reference
	Urban		1.49 (1.43, 1.56) *	1.31 (1.24, 1.39) *
Wealth		N=23,055		
	Lowest		Reference	Reference
	Second		1.21 (1.11, 1.31) *	1.16 (1.06, 1.26) *
	Middle		1.26 (1.16, 1.36) *	1.17 (1.07, 1.27) *
	Fourth		1.37 (1.26, 1.48) *	1.21 (1.11, 1.32) *
	Highest		1.40 (1.30, 1.52) *	1.17 (1.07, 1.27) *
Family Size		N=29,540		
	≤ 4		Reference	Reference
	> 4		1.08 (1.03, 1.13) *	0.93 (0.88, 0.99) *

CI = confidence interval

[1] Overweight is defined as BMI ≥ 25 kg/m^2

[2] Risk Ratios and confidence intervals are estimated using a modified Poisson model and are weighted to account for the survey design. Excludes pregnant women. N =18,018 in multivariate model

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

[5] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

* $p < 0.05$

Supplemental Table 6. Longitudinal Association Between Selected Characteristics and Overweight Among Adult Men Aged 19 + in Indonesia 1993-2014

		Univariate[1,2]	Multivariate[1,2]
	N	Risk Ratio (95% CI)	Risk Ratio (95% CI)
Age	N=24,169		
19-29 y		Reference	Reference
30-39 y		2.18 (1.90, 2.50) *	1.74 (1.32, 2.28) *
40-49 y		2.64 (2.32, 3.00) *	2.04 (1.57, 2.66) *
50-59 y		2.18 (1.92, 2.47) *	1.90 (1.46, 2.48) *
60+ y		1.13 (0.98, 1.30)	1.24 (0.94, 1.65)
Education	N=21,072		
No Education		Reference	Reference
Primary		2.26 (1.74, 2.94) *	1.56 (1.17, 2.08) *
Junior or Senior		4.06 (3.11, 5.29) *	2.39 (1.77, 3.22) *
University		6.80 (5.18, 8.94) *	2.82 (2.07, 3.85) *
Smoking Status	N=23,764		
Non-smoker		Reference	Reference
Smoker		0.54 (0.50, 0.58) *	0.66 (0.60, 0.72) *
Marital Status	N=23,846		
Never Married		Reference	Reference
Married		2.07 (1.80, 2.38) *	1.87 (1.38, 2.53) *
Other		1.35 (1.02, 1.78) *	1.41 (0.85, 2.33)
Employment	N=23,463		
Not Working		Reference	Reference
Agriculture		0.65 (0.55, 0.76) *	0.60 (0.50, 0.72) *
Skilled Manual[3]		1.19 (1.02, 1.38) *	0.92 (0.76, 1.10)
Skilled[4]		2.10 (1.85, 2.39) *	1.30 (1.12, 1.52) *
Food Expenditures[5]			
Rice	N=23,310		
Lowest		Reference	na
Highest		1.01 (0.93, 1.09)	na
Soda	N=22,283		
Lowest		Reference	Reference
Highest		1.56 (1.43, 1.71) *	1.15 (1.05, 1.27) *

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	Snacks	N=23,703		
	Lowest		Reference	Reference
	Highest		1.58 (1.46, 1.71) *	1.11 (1.01, 1.22) *
	Cooking oil	N=23,797		
	Lowest		Reference	Reference
	Highest		1.55 (1.44, 1.68) *	1.23 (1.12, 1.34) *
Residence		N=24,168		
	Rural		Reference	Reference
	Urban		1.97 (1.82, 2.14) *	1.27 (1.15, 1.40) *
Wealth		N=21,036		
	Lowest		Reference	Reference
	Second		1.26 (1.09, 1.46) *	1.10 (0.94, 1.29) *
	Middle		1.56 (1.35, 1.80) *	1.30 (1.12, 1.52) *
	Fourth		1.79 (1.56, 2.06) *	1.30 (1.12, 1.51) *
	Highest		2.44 (2.14, 2.79) *	1.39 (1.20, 1.62) *
Family Size		N=24,169		
	≤ 4		Reference	Reference
	> 4		1.11 (1.02, 1.20) *	1.02 (0.93, 1.12)

CI = confidence interval; na = not applicable

[1] Overweight is defined as BMI ≥ 25 kg/m^2

[2] Risk Ratios and confidence intervals are estimated using a modified Poisson model and are weighted to account for the survey design. N=16,519 in multivariate model

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

[5] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

* $p < 0.05$

Supplemental Table 7. Univariate Logistic Regression Models Investigating the Associations Between Selected Characteristics and Overweight Among Children in Indonesia in 2014

		6 months - 5 years[1]		6-12 years[2]		13-18 years[2]	
		n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
Mean Age[3]		4,965	0.88 (0.80, 0.97) *	7,012	1.06 (1.02, 1.10) *	4,868	0.87 (0.83, 0.92) *
Gender							
	Boys	2,585	Reference	3,601	Reference	2,462	Reference
	Girls	2,380	0.75 (0.59, 0.96) *	3,411	0.87 (0.76, 1.01)	2,406	1.20 (1.01, 1.44) *
Ever Breastfed[4]							
	No	140	Reference		na		na
	Yes	4,429	1.15 (0.53, 2.47)		na		na
Exclusively Breastfed[4]							
	No	3,646	Reference				
	Yes	923	0.82 (0.59, 1.15)		na		na
					na		na
Introduction of Complementary Foods[4]							
	< 6 months or ≥ 8 months	3,379	Reference		na		na
	≥ 6 months to < 8 months	840	0.82 (0.58, 1.16)		na		na
Parental Education[5]							
	No Education	251	Reference	419	Reference	353	Reference
	Primary	1,562	1.39 (0.65, 2.98)	2,449	1.11 (0.76, 1.61)	1,904	1.26 (0.83, 1.91)
	Junior or Senior	2,055	1.69 (0.80, 3.59)	2,690	1.70 (1.17, 2.46) *	1,555	1.73 (1.14, 2.63) *
	University	564	2.29 (1.04, 5.05) *	686	3.00 (2.01, 4.47) *	331	2.13 (1.31, 3.46) *

Parental Employment[5]						
Not Working	2,564	Reference	2,804	Reference	1,729	Reference
Agriculture	569	0.51 (0.30, 0.86) *	1,111	0.50 (0.38, 0.65)	737	0.51 (0.37, 0.71) *
Skilled Manual[6]	325	0.98 (0.60, 1.60)	559	0.81 (0.61, 1.08)	394	0.72 (0.50, 1.04)
Skilled[7]	1,469	1.22 (0.94, 1.59)	2,399	1.22 (1.04, 1.43) *	1,550	0.94 (0.76, 1.15)
Maternal Overweight						
Not Overweight	3,068	Reference	3,864	Reference	2,459	Reference
Overweight	1,664	1.31 (1.02, 1.67) *	2,597	2.03 (1.75, 2.37) *	1,835	2.18 (1.80, 2.64) *
Consumed in the Last Week:						
Instant Noodles						
No	2,002	Reference	1,616	Reference	581	Reference
Yes	2,613	0.69 (0.53, 0.90) *	5,382	1.03 (0.87, 1.23)	2,076	1.03 (0.78, 1.36)
Fast Food						
No	3,941	Reference	5,669	Reference	2,209	Reference
Yes	674	1.39 (1.01, 1.93) *	1,329	1.43 (1.21, 1.69) *	448	1.13 (0.85, 1.50)
Soda						
No	4,342	Reference	5,942	Reference	2,011	Reference
Yes	273	0.89 (0.50, 1.59)	1,056	1.17 (0.97, 1.42)	646	1.09 (0.84, 1.41)
Fried Snacks						
No	2,393	Reference	2,531	Reference	825	Reference
Yes	2,222	0.83 (0.64, 1.08)	4,467	1.12 (0.96, 1.31)	1,832	0.99 (0.78, 1.26)
Mean Number of Days Consumed in the Last Week[8]:						
Instant Noodles	2,613	1.00 (0.91, 1.10)	5,382	0.99 (0.95, 1.03)	2,076	0.99 (0.93, 1.05)

Fast Food	674	0.88 (0.74, 1.05)	1,329	0.91 (0.83, 1.00)	448	0.90 (0.77, 1.05)
Soda	2,222	0.89 (0.51, 1.55)	1,056	1.05 (0.96, 1.16)	646	1.10 (0.98, 1.24)
Fried Snacks	3,671	0.97 (0.89, 1.05)	4,467	0.98 (0.94, 1.01)	1,832	0.97 (0.92, 1.03)
Food Expenditures[9]						
Rice						
Lowest	2,469	Reference	3,334	Reference	2,151	Reference
Highest	2,489	1.15 (0.91, 1.46)	3,662	0.86 (0.75, 1.00)	2,704	0.93 (0.78, 1.11)
Cooking oil						
Lowest	2,992	Reference	3,993	Reference	2,785	Reference
Highest	1,966	1.23 (0.97, 1.57)	3,002	1.16 (1.00, 1.34)	2,071	1.11 (0.93, 1.33)
Residence						
Rural	2,083	Reference	2,915	Reference	1,969	Reference
Urban	2,882	1.57 (1.22, 2.02) *	4,097	2.01 (1.72, 2.35) *	2,899	1.71 (1.42, 2.07) *
Wealth						
Lowest	1,008	Reference	1,247	Reference	876	Reference
Second	964	1.37 (0.91, 2.06)	1,193	1.50 (1.14, 1.98) *	802	1.12 (0.83, 1.52)
Middle	654	1.25 (0.79, 1.98)	908	1.78 (1.34, 2.36) *	566	1.06 (0.76, 1.48)
Fourth	783	1.42 (0.93, 2.15)	1,037	1.64 (1.25, 2.15) *	617	1.08 (0.77, 1.51)
Highest	656	1.37 (0.89, 2.11)	993	1.83 (1.39, 2.40) *	617	1.12 (0.82, 1.54)
Family Size						
≤ 4	2,645	Reference	3,523	Reference	2,322	Reference
> 4	2,320	0.99 (0.78, 1.26)	3,489	0.75 (0.65, 0.87) *	2,546	0.83 (0.70, 0.99) *

CI = confidence interval; na = not applicable

[1] Overweight is defined as weight-for-height z-score > 2 using the MGRS Standard, estimated using logistic regression models and are weighted to account for the survey design

[2] Overweight is defined as BMI z-score > 1 using the WHO reference, estimated using logistic regression models and are weighted to account for the survey design

[3] Modelled as a continuous variable

[4] Breastfeeding data are reported by the mother retrospectively. Exclusively breastfed indicates whether the child was only given breastmilk (no water or complementary foods) when the child was aged 0-6 months. Complementary foods indicate appropriate timing of complementary foods, that is, the introduction of complementary foods when the child was 6-8 months old.
[5] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data
[6] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction
[7] Skilled labor combines the following employment sectors: retail and service, transportation
[8] Modelled as a continuous variable, the average number of days consumed is queried if the respondent reported that they consumed item during the last week
[9] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page Number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 5
Methods			
Study design	4	Present key elements of study design early in the paper	Pages 5,9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Pages 5,9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Pages 7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Pages 5-7
Bias	9	Describe any efforts to address potential sources of bias	Page 9
Study size	10	Explain how the study size was arrived at	Page 9, see flow chart
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Pages 8-9
		(*b*) Describe any methods used to examine subgroups and interactions	Page 9
		(*c*) Explain how missing data were addressed	Not applicable
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Page 9
		(*e*) Describe any sensitivity analyses	Page 9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	For this secondary data analysis, individuals were included if they had complete data for the exposure, outcome, and confounders.

		(b) Give reasons for non-participation at each stage	For this secondary data analysis, individuals were included if they had complete data for the exposure, outcome, and confounders.
		(c) Consider use of a flow diagram	See Supplemental Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Pages 9-11
		(b) Indicate number of participants with missing data for each variable of interest	See Supplemental Figure 1. For this secondary data analysis, individuals were included if they had complete data for the exposure, outcome, and confounders.
Outcome data	15*	Report numbers of outcome events or summary measures	Pages 9, Figure 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Provided in supplemental material
		(*b*) Report category boundaries when continuous variables were categorized	Page 8, Tables 1-6
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Supplemental Tables 4 and 5
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 13-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Not applicable

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Overweight in Indonesia: an observational study of trends and risk factors among adults and children

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Overweight in Indonesia: an observational study of trends and risk factors among adults and children

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ABSTRACT

Objective: To conduct a secondary data analysis detailing overweight prevalence and associations between key hypothesized determinants and overweight.

Design: This observational study used publicly available data from the Indonesian Family Life Survey (IFLS) (1993-2014). The IFLS is a home-based survey of adults and children that collected data on household characteristics (size, physical infrastructure, assets, food expenditures), as well as individual-level educational attainment, occupation type, smoking status, and marital status. These analyses utilized data on the self-reported consumption of ultra-processed foods and physical activity. Anthropometrics were measured.

Setting: Indonesia.

Primary Outcome Measures: We described the distribution of overweight by gender among adults (body mass index [BMI] ≥ 25 kg/m^2) and by age among children, over time. Overweight was defined as weight-for-height z-score > 2, among children aged 0-5 years and as BMI-for-age z-score > 1, among children aged 6-18 years. We also described individuals who were overweight by selected characteristics over time. Finally, we employed multivariable logistic regression models to investigate risk factors in relation to overweight in 2014.

Results: One-third of adults were overweight in 2014. Between 1993 and 2014 the prevalence of overweight among adults doubled from 17.1% to 33.0%. The prevalence of overweight among children under-five years increased from 4.2% to 9.4% between 1993 and 2007, but then remained relatively stagnant between 2007 and 2014. Among children aged 6-12 years and 13-18 years, the prevalence of overweight increased from 5.1% to 15.6% and from 7.1% to 14.1% between 1993 and 2014, respectively. Although overweight prevalence remains higher in urban areas, the increase in overweight prevalence was larger among rural (versus urban) residents, and by 2014,

the proportions of overweight adults were evenly distributed in each wealth quintile. Data suggest that the consumption of ultra-processed foods was common and levels of physical activity have decreased over the last decade. In multivariable models, urban area residence, higher wealth, higher education, and consumption of ultra-processed foods were associated with higher odds of overweight among most adults and children.

Conclusions: Urgent program and policy action is needed to reduce and prevent overweight among all ages.

Key Words: Overweight, Indonesia, nutrition transition, Indonesian Family Life Survey

Strengths and Limitations of this Study

- A key study strength is that we are able to compare overweight trends over time among all age groups, explore the consumption of ultra-processed foods and physical activity, and investigate hypothesized risk factors for overweight, using regression-based methods.
- We use a recent dataset that is nationally representative of Indonesia.
- A key limitation is that we largely employ cross-sectional data, and therefore, we cannot infer any causal associations.
- Data on the consumption of a select number of ultra-processed foods was only collected in 2014, which limits our ability to make conclusions about the association between ultra-processed foods and overweight.
- Physical activity levels were based on respondent recall.

INTRODUCTION

Indonesia is undergoing a nutrition transition as one-third of adults are now overweight or obese. Nutrition transition theory suggests that economic development, urbanization, and globalization result in an increase in the consumption of ultra-processed foods and a decrease in physical activity [1,2], which subsequently lead to a higher prevalence of overweight and non-communicable diseases. Context specific policy, food systems, sociocultural norms, and socioeconomics are also thought to play a role [2]. Mitigating the obesity pandemic through appropriate programs and policies requires a better understanding of setting-specific trends and their underlying determinants. Yet, prior studies provide limited information on the changing prevalence and risk factors for overweight, by age group, in Indonesia. We aimed to fill this gap in the literature by detailing overweight prevalence over time and investigating the relation between key risk factors and overweight, among all age groups in Indonesia.

Several factors have likely contributed to the increasing prevalence of overweight in Indonesia. First, economic development, urbanization, and globalization have altered the food environment in Indonesia [3], as these factors result in easier access to and demand for processed foods [4,5]. In Indonesia, food availability per capita has increased by 40% over the last two decades, which is largely driven by an increase in the availability of fats (e.g. palm oil) [6]. Subsequently, poor dietary habits are now common among Indonesians. Data from the 2013 National Basic Health Research Survey indicated inadequate consumption of fruits and vegetables among the majority of Indonesians, and one prior study reported that higher consumption of meat and dairy was associated with a higher prevalence of obesity in Indonesia [7]. Prior evidence from Indonesia and the Southeast Asia region also suggests widespread consumption of ultra-processed foods and a positive association between consumption of processed foods, meat, dairy, and

"Western foods" and overweight prevalence among children and adults [6–8]. Second, economic development and urbanization also result in decreased physical activity and the Indonesian population is increasingly adopting a more sedentary lifestyle [9–12]. In part, this is due to changes in technology, which have led to more mechanized agricultural production and shifts away from agricultural-based employment. In addition, Indonesians perceive that increased motorized transport and rapid changes in the built environment have resulted in reduced physical activity [13]. Limited data also suggest that there are few bike lanes, sidewalks, or parks in Indonesia [6].

The objectives of this study were two-fold. First, we document the changes in overweight prevalence that have occurred in Indonesia, between 1993 and 2014, among adults (aged ≥ 19 years), adolescents (aged 13-18 years), school-aged children (aged 6-12 years), and young children (aged 0-5 years). Second, this study provides a comprehensive examination of risk factors for overweight, by age, using regression-based methods. We believe the evidence will be useful for future advocacy efforts on obesity prevention and to inform relevant policy dialogues and program design.

METHODS

Study Context

Indonesia is the world's fourth most populous country, home to approximately 260 million individuals, and is the largest economy in Southeast Asia [14]. Indonesia's gross domestic product per capita has steadily risen, from $807 in the year 2000 to $3,877 in 2018 [15]. Over the last forty years, Indonesia has experienced a process of rapid urbanization and industrialization, which have contributed to Indonesia's changing infrastructure. More than half of the population now live in an urban area and urbanization is increasing at a rate of 2.3% annually. Economic development and urbanization are related to changes in diet and physical activity. At the same time, the

demographic transition (i.e. the shift from a pattern of high fertility and high mortality to one of low fertility and low mortality) affects and is affected by nutritional change. Indonesia is in the middle phase of their demographic transition, expecting to harness the peak of demographic dividend between 2020 and 2030 [16].

Survey Design and Study Population

These analyses utilized the publicly available Indonesian Family Life Survey (IFLS), which has previously been detailed elsewhere [17,18]. The IFLS is a longitudinal, home-based survey that collected socioeconomic and health data on individual respondents including children aged 0-18 years and adults ≥ 19, and their households over time. The survey was first fielded in 1993 and there have been four subsequent rounds of data collection (1997, 2000, 2007, 2014). Follow-up surveys were fielded on the full sample and split-off households. Therefore, new members were added to the panel during each subsequent survey wave.

As described in detail elsewhere [17], the original, multi-stage sampling frame was based on households from 13 out of 27 Indonesian provinces: North Sumatra, West Sumatra, South Sumatra, Lampung, DKI Jakarta, West Java, Central Java, Yogyakarta, East Java, Bali, West Nusa Tenggara, South Kalimantan, and South Sulawesi. These provinces were selected to maximize representation of the population, capture the cultural and socioeconomic diversity of Indonesia, and be cost-effective. The sample represented approximately 83% of the Indonesian population in 1993 [17]. Within each of the 13 provinces, 321 enumeration areas were randomly chosen from the nationally representative sample frame used in the 1993 National Socioeconomic Survey. Urban areas were over-sampled in the original survey; 20 households were randomly selected from each urban enumeration area and 30 households were randomly selected from each rural

enumeration area. Original and split-off households were re-contacted in subsequent survey waves. Indonesia now has 34 provinces, as eight have been added since 1999. As individuals moved between provinces within Indonesia over time, additional provinces were represented in the survey. In 2014, 24 provinces were represented.

The IFLS was approved by Institutional Review Boards in the United States at RAND Corporation and in Indonesia at the University of Gadjah Mada. Survey participants provided written informed consent. A parent or guardian (typically the mother) provided informed consent for children younger than age 11 [19]. The data used for this study are retrospective and the authors did not have access to any identifying information. As such, ethical approval was not required.

Survey Questions

Many questions were consistently asked during each survey wave, but some were added or eliminated over the 20-year survey period to reflect the changing economic context. The household questionnaire collected information on household characteristics such as its size, physical infrastructure, access to sanitation and water sources, assets, and food expenditures (see Supplemental Table 1). Each adult respondent was asked about characteristics related to demographics (e.g. marital status, age), socioeconomic status (e.g. educational attainment, occupation) and health history (e.g. smoking). Beginning in 2000, adults were also asked about their food intake in the past week; specifically, respondents indicated whether they ate each food type (e.g. in the last week, did you eat any [....]) and the frequency of consumption (e.g. how many days in a week did you eat [...] in the last week). In 2000 and 2007, self-reported diet questions focused on staple foods (e.g. rice, eggs, dairy) and iron- and vitamin-A rich foods (e.g. meat, green leafy vegetables, carrots, sweet potatoes). Ultra-processed (instant noodles, fast food, soft drinks,

fried snacks) were added in 2014. In addition, married women were asked about their reproductive history and breastfeeding and complementary feeding practices for children born within the five years prior to the survey.

In 2007 and 2014, adults were asked about the type, duration (< 2 hours or ≥ 2 hours), and number of days of physical activities they engaged during the last week. Activity type included vigorous activity, moderate activity, and walking, using a modified version of the International Survey on Physical Activities. Vigorous physical activity was defined as any activities that make you breathe much harder than normal (e.g. heavy lifting, digging, cycling with loads). Moderate physical activity was defined as any activities that make you breathe somewhat harder than normal (e.g. carrying light loads, bicycling, or mopping the floor). Walking included at work and at home, walking from place to place, and walking for recreation.

The child questionnaire paralleled the adult questionnaire, with age-appropriate modifications. Specifically, information was collected on age, gender, educational attainment, morbidities, and food frequency. Physical activity was not collected among children. For children younger than 11, the mother, female guardian, or household caretaker answered the questions. Children aged ≥ 11 years were allowed to respond for themselves.

Height and weight were measured for adults and children by trained interviewers, using a rigorous research protocol [17]. Interviewers completed both didactic and hands-on anthropometric training and after completing each questionnaire and measurements in the field, interviewers checked for completeness and errors, using a computer assisted program. Supervisors randomly observed interviewers to ensure that measurements were being performed according to the training instructions. Height was measured to the nearest millimeter using a Seca plastic height

board. Recumbent height was measured among children aged < 24 months. Weight was measured to the nearest one-tenth of a kilogram using a Camry model EB1003 scale.

Statistical Analysis

Overweight served as our *a priori* primary endpoint. Among adults (aged ≥ 19 years), overweight was defined as body mass index (BMI) ≥ 25 kg/m^2. Among children and adolescents aged 6-18 years, overweight was defined as BMI-for-age z-score > 1 using the World Health Organization (WHO) reference [20]. Among children aged 0-5 years, overweight was defined as weight-for-height [WHZ] z-score > 2 using the Multicentre Growth Reference Study Standard [21].

Appropriate cutoffs were applied to create dichotomous or categorical variables for age, educational attainment, and occupation. Urban/rural residence, diet, and physical activity data were modelled as binary variables. Household wealth quintiles were created using principal component analysis, using following variables: type of floor material, type of toilet, type of cooking fuel and ownership of assets including: land, livestock, vehicle(s), household appliances, furniture and utensils, jewelry, and monetary savings. Dichotomous variables were created from the aforementioned categorical variables and a frequency test was run for each of the new variables to ensure that those variables with a variance of zero were removed. The wealth score was then split into quintiles based on the distribution of the data in a given survey year.

Household food expenditures on rice and cooking oil represented the household-level expenditure on each item as a percentage of the households' total expenditures on food. Food expenditures were then dichotomized as lower and higher based on the mean value in each survey year. Rice was selected as it is a key staple food in Indonesia. Cooking oil was also selected because it has been shown to perpetuate energy imbalance.

Descriptive statistics are presented as percentages for categorical variables or means for continuous variables. The distribution of overweight by gender (adult women and adult men aged and ≥ 19 years) and age (0-5 years, 6-12 years, 13-18 years) was detailed for each survey year. Then, we described individuals who were overweight, by the aforementioned characteristics (e.g. education, wealth), from 1993 to 2014. Finally, we described the distribution of the consumption of ultra-processed foods (2014) and of physical activity among adults (2007, 2014).

Prior conceptual models [2,22,23], along with the availability of data in the IFLS were used to identify plausible determinants of the obesity endemic in Indonesia. In order to create a parsimonious model, univariate analyses first explored risk factors and their association with overweight, using cross-sectional logistic regression models, for five groups in 2014: adult women, adult men, children aged 0-5 years, children aged 6-12 years, and children aged 13-18 years. Largely, variables were included in multivariable models if they were statistically significantly associated with the dependent variable in univariate models (defined as $p < 0.05$). Age, gender, urban/rural residence, and wealth were included in the multivariable logistic regression models irrespective of statistical significance. Pregnant women were excluded from analyses. We assessed multicollinearity in all models.

In sensitivity analyses, we explored the association between selected risk-factors and overweight among adults, over time (1993-2014), using modified Poisson models [24]. These longitudinal models were considered sensitivity analyses because individual-level consumption of ultra-processed foods and physical activity data were not available in prior years. Alpha was set to 0.05 to determine statistical significance. All analyses employed sampling weights, which account for the survey design and were performed using Stata 15.1 (StataCorp LP, College Station, TX).

Patient and Public Involvement

Neither patients nor the public were involved in this secondary data analysis.

RESULTS

Between 1993 and 2014 the prevalence of overweight among adults doubled from 17.1% to 33.0% (Figure 1). The prevalence of overweight among children under-five years increased from 4.2% to 9.4% between 1993 and 2007, but since then, remained relatively stagnant. Among children aged 6-12 years and 13-18 years, the prevalence of overweight increased from 5.1% to 15.6% and from 7.1% to 14.1% between 1993 and 2014, respectively.

The characteristics of overweight individuals are presented in Tables 1-4 and in Supplemental Tables 2-4. More women and men over 40 years old (versus younger ages) were overweight over the study period (Tables 1-2). Most overweight women and men had at least primary school education, and more than half lived in urban areas. The distribution of wealth among overweight adults varied over time. In 1993, the largest percentage of overweight women (29.4%) was in the wealthiest households, whereas in 2014, wealth was evenly distributed (~20%). Trends were similar for men.

Table 1. Percent Distribution of Selected Characteristics Among Overweight Adult Women Aged 19 + in Indonesia Over Time

	1993[1,2]		1997[1,2]		2000[1,2]		2007[1,2]		2014[1,2]	
	n	%	n	%	n	%	n	%	n	%
Age										
19-29 y	97	18.9	248	18.7	423	14.7	848	15.6	1,197	10.9
30-39 y	253	38.1	531	32.6	728	30.5	1,167	24.8	1,937	19.6
40-49 y	178	25.4	473	27.0	699	29.9	1,044	31.1	1,511	31.9
50-59 y	97	14.3	255	13.2	342	15.4	618	17.6	996	24.4
≥ 60 y	24	3.3	169	8.6	254	9.6	389	10.9	551	13.2
Education										

No Education	39	7.3	225	14.5	276	11.2	279	9.1	263	6.9
Primary	415	66.7	832	61.7	1,232	54.6	1,702	53.7	2,198	50.4
Junior or Senior	152	20.3	308	19.4	711	27.0	1,109	28.6	2,077	32.8
University	43	5.7	69	4.4	172	7.2	335	8.6	623	9.9
Parity[3]										
≤ 2	16	15.2	20	43.1	71	20.1	56	20.1	428	35.8
3-4	19	17.7	8	14.2	72	18.4	76	24.9	230	29.9
≥ 5	84	67.1	20	42.7	254	61.5	191	55.0	306	34.4
Smoking Status										
Non-Smoker	614	96.7	1,553	95.6	2,311	96.1	3,889	97.5	6,027	97.4
Smoker	25	3.3	73	4.4	99	3.9	101	2.5	134	2.6
Marital Status										
Never Married	10	2.8	85	5.0	146	4.8	237	4.9	291	3.1
Married	582	89.1	1,336	82.7	1,926	80.4	3,298	81.9	5,185	81.7
Other	49	8.1	220	12.3	351	14.8	475	13.2	714	15.2
Employment										
Not working	362	57.0	803	50.8	969	39.8	1,527	37.6	2,178	35.2
Agriculture	27	5.5	135	8.8	260	11.6	517	14.5	816	15.6
Skilled Manual[4]	44	6.2	141	9.3	201	9.3	315	8.2	479	8.4
Skilled[5]	202	31.3	545	31.1	956	39.2	1,616	39.7	2,618	40.8
Residence										
Rural	150	33.4	583	43.0	893	41.5	1,604	47.3	2,286	46.0
Urban	499	66.6	1,093	57.0	1,553	58.5	2,462	52.7	3,906	54.0
Wealth										
Lowest	81	14.4	238	17.3	323	15.2	603	16.3	1,095	23.0
Second	64	10.3	233	16.9	388	19.5	875	27.6	1,087	22.7
Middle	163	21.0	312	23.4	430	20.9	521	15.8	781	17.3
Fourth	203	24.9	270	19.9	426	20.8	679	20.4	894	18.7
Highest	645	29.4	330	22.5	475	23.5	645	19.9	848	18.3
Family Size										
≤ 4	249	40.2	533	33.3	1,161	48.8	1,274	30.2	3,898	65.3
> 4	400	59.8	1,143	66.7	1,285	51.2	2,792	69.8	2,294	34.7
Province										

Bali	78	18.6	213	13.0	305	14.0	522	16.8	774	17.0
Central Java	107	26.0	243	22.7	369	24.2	576	24.3	885	25.1
West Java	92	20.4	272	23.5	416	25.6	606	19.4	955	19.8
Other	372	36.7	948	46.8	1,353	40.2	2171	42.1	3,232	40.8
Food Expenditures[6]										
Rice										
Lowest	186	49.5	880	53.1	1,242	51.6	2,114	53.2	3,137	53.0
Highest	205	50.5	790	46.9	1,198	48.4	1,951	46.8	3,051	47.0
Cooking oil										
Lowest	198	42.5	786	49.3	1,174	48.6	1,827	45.4	3,562	58.6
Highest	340	57.5	882	50.7	1,266	51.4	2,238	54.6	2,625	41.4

[1] Overweight is defined as body mass index ≥ 25kg/m^2. Percentages are weighted to be representative of the population of Indonesia in the given survey year
[2] Excludes women who are currently pregnant
[3] Parity is only queried among ever-married women
[4] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction
[5] Skilled labor combines the following employment sectors: retail and service, transportation
[6] Represents the household level expenditure on each item as a percentage of the households' total expenditures on food

Table 2. Percent Distribution of Selected Characteristics Among Overweight Men Aged 19 + in Indonesia Over Time

	1993[1]		1997[1]		2000[1]		2007[1]		2014[1]	
	n	%	n	%	n	%	n	%	n	%
Age										
19-29 y	27	7.3	88	13.4	224	14.1	419	15.6	573	16.5
30-39 y	117	34.3	196	30.7	356	28.7	698	24.6	1,048	21.7
40-49 y	121	33.4	215	32.0	336	31.8	549	30.6	885	25.4
50-59 y	52	14.4	123	16.1	184	17.2	326	20.7	514	25.0
≥ 60 y	35	10.6	62	7.8	99	8.2	164	8.5	262	11.4
Education										
No Education	6	2.0	24	3.8	32	2.5	32	1.8	39	1.8
Primary	153	44.6	227	40.8	385	34.2	553	34.5	725	32.4
Junior or Senior	124	37.9	210	35.6	519	43.0	805	42.6	1,288	45.0
University	68	15.5	112	19.8	247	20.3	386	21.1	612	20.8
Smoking Status										
Non-Smoker	163	44.9	289	41.3	527	44.8	897	43.6	1,481	46.5
Smoker	181	55.1	371	58.7	651	55.2	1,212	56.4	1,779	53.5
Marital Status										
Never Married	4	3.0	54	8.2	131	8.6	218	8.9	353	9.6
Married	342	96.8	605	90.4	1,031	89.7	1,850	88.2	2,833	87.1

Other	1	0.2	11	1.4	22	1.7	56	2.9	95	3.3
Employment										
Not working	34	12.4	70	9.8	84	7.4	165	8.7	248	8.7
Agriculture	27	9.9	100	15.2	179	15.8	328	16.1	500	16.7
Skilled Manual[2]	87	25.8	123	19.7	199	17.5	377	17.7	598	18.8
Skilled Labour[3]	185	51.9	366	55.4	687	59.4	1,231	57.6	1,874	55.9
Residence										
Rural	73	33.5	211	35.7	381	36.0	717	39.0	987	37.4
Urban	279	66.5	473	64.3	818	64.0	1,439	61.0	2,294	62.6
Wealth										
Lowest	22	7.3	82	11.8	130	10.9	324	15.6	547	19.9
Second	26	6.7	88	14.1	166	16.1	460	23.9	562	20.1
Middle	61	18.7	135	22.5	214	19.4	304	15.5	445	17.0
Fourth	72	20.6	118	19.7	267	23.8	418	22.1	554	19.9
Highest	169	46.6	205	31.9	315	29.8	418	22.9	661	23.1
Family Size										
≤ 4	128	36.9	218	32.7	579	50.0	712	30.9	2,061	63.9
> 4	224	63.1	466	67.3	620	50.0	1,444	69.1	1,220	36.1
Province										
Bali	38	16.5	70	9.7	116	10.8	227	14.4	369	14.0
Central Java	58	29.6	88	20.3	162	22.6	289	23.2	457	24.2
West Java	38	17.2	100	23.2	195	26.4	308	20.3	433	21.0
Other	141	36.7	313	46.8	540	40.2	980	42.1	1531	40.8
Food Expenditures[4]										
Rice										
Lowest	83	43.0	365	53.5	627	52.0	1,135	53.5	1,709	54.5
Highest	103	57.0	314	46.5	564	48.0	1,016	46.5	1,561	45.5
Cooking oil										
Lowest	89	34.5	290	43.6	525	45.2	936	42.8	1,811	56.6
Highest	203	65.5	388	56.4	665	54.8	1,215	57.2	1,459	43.4

[1] Overweight is defined as body mass index ≥ 25kg/m^2. Percentages are weighted to be representative of the population of Indonesia in the given survey year

[2] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[3] Skilled labor combines the following employment sectors: retail and service, transportation

[4] Represents the household level expenditure on each item as a percentage of the households' total expenditures on food

Nearly equal proportions of boys and girls aged 0-19 years were overweight and a majority had a parent with at least primary school education (Supplemental Tables 2-4). Across all groups, the proportion of overweight children who had an overweight mother increased between 1993 and 2014. The distribution of urban/rural residence among overweight children also changed over time, with more overweight young- and school-aged children residing in urban areas by 2014 (~60%) compared to 1993. The distribution of wealth among overweight children and adolescents also varied over time, but like adults, by 2014, there was an even distribution of overweight children in each wealth quintile (~20%).

Distribution of Consumption of Ultra-Processed Food and Physical Activity

In 2014, approximately 60% of adults reported consuming instant noodles during the last week (Table 3). Likewise, about 65% of adults reported consuming fried snacks, for 4.0 days on average. Smaller proportions of adults regularly consumed fast food or soda.

Trends were similar among children. Nearly 60% of children aged 6-59 months consumed instant noodles during the last week, as did three-quarters of children aged 6-12 years (77.5%) and 13-18 years (78.3%). Half (50.4%) of children aged 6-59 months and about two-thirds of children aged 6-18 years regularly consumed fried snacks. Similar proportions of children regularly consumed fast food (~15%), irrespective of age. All age groups of children consumed soda an average of 2 days per week.

Higher proportions of men were engaged in vigorous physical activity (38.0%) compared to women (10.7%). More than half adults reported being engaged in moderate physical activity and approximately 70% reported walking during the last week. Physical activity levels decreased, among both women and men, between 2007 and 2014 (2007 data not shown).

Table 3. Distribution and Frequency of Consumption of Ultra-Processed Foods and Physical Activity in Indonesia, 2014

	Women		Men		Children Aged 6 mo-5 years		Children Aged 6-12 years		Children Aged 13-18 years	
	n	% or Mean	n	% or Mean	n	% or Mean	n	% or Mean	n	% or Mean
Instant Noodles										
Last Week[1]	9,818	60.0	8,703	63.7	2,674	56.8	5,467	77.5	2,084	78.3
Mean Days[2]		2.5		2.6		2.7		3.0		2.9
Fast Food										
Last Week[1]	1,718	9.0	1,291	8.8	685	14.5	1,357	18.8	450	16.3
Mean Days[2]		1.8		1.7		2.4		2.5		2.1
Soda										
Last Week[1]	1,956	10.7	3,281	22.6	278	5.0	1,075	14.5	647	23.0
Mean Days[2]		1.8		2.0		2.0		2.1		2.0
Fried Snacks										
Last Week[1]	9,706	65.4	8,668	68.8	2,282	50.4	4,530	66.4	1,841	72.0
Mean Days[2]		4.0		3.9		3.3		3.9		4.1
Vigorous Activity[3]										
Last Week	15,191	10.7	13,148	38.0		na		na		na
Mean Days		3.9		4.2		na		na		na
Moderate Activity[3]										
Last Week	15,191	58.1	13,148	54.2		na		na		na
Mean Days		4.8		4.4		na		na		na
Walking[3]										
Last Week	15,191	68.8	13,148	72.4		na		na		na
Mean Days		5.1		5.1		na		na		na

na = not applicable

[1] Percent distribution, weighted to be representative of the population of Indonesia in the given survey year. n represents the number of respondents that consumed a particular item during the last week.

[2] The average number of days an individual consumed each food is queried only if the respondent reported that they consumed the item in the last week.

[3] Defined using the International Physical Activity Questionnaire. Respondents are asked about each type of physical activity (i.e. vigorous, moderate, walking) separately and therefore, should be interpreted as mutually exclusive categories. The percent distribution is weighted to be representative of the population of Indonesia in the given survey year.

Regression-based Analyses Among Adults

Figure 2 summarizes all associations between hypothesized risk factors and overweight in multivariable models (see Supplemental Tables 5-6 for univariable models). Among women, older age, higher education, living in an urban area, and higher wealth were associated with higher odds of overweight in 2014 (Table 4). Married women, versus never married, also had higher odds of overweight (odds ratio [OR]=2.39; 95% confidence interval [CI]: 1.88, 2.98). Working in a skilled labor position, versus not working, was associated with 17% higher odds of overweight among women (OR=1.17; 95% CI: 1.04, 1.33) whereas working in agriculture-based labor, a physically demanding occupation, was associated with an approximately 30% lower odds of overweight (OR=0.66; 95% CI: 0.56, 0.78). Household expenditures on cooking oil (OR=1.24; 95% CI: 1.12, 1.38) and individual's consumption of fried snacks (versus no consumption) (OR=1.12; 95% CI: 1.00, 1.25) were associated with higher odds of overweight.

Table 4. Multivariable Logistic Regression Investigating the Association Between Selected Characteristics and Overweight Among Adults Aged 19 + in Indonesia in 2014

	Women[1,2]		Men[1,2]	
	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
	N=9,073		N=5,775	
Age				
19-29 y	2,403	Reference	1,441	Reference
30-39 y	2,630	2.03 (1.75, 2.34) *	1,807	1.79 (1.40, 2.30) *
40-49 y	1,943	2.83 (2.41, 3.31) *	1,320	2.37 (1.83, 3.08) *
50-59 y	1,357	2.36 (1.97, 2.83) *	719	2.37 (1.76, 3.20) *
60+ y	740	1.68 (1.34, 2.12) *	488	0.92 (0.62, 1.36)
Education				
No Education	511	Reference	106	Reference
Primary	3,562	2.04 (1.59, 2.60) *	2,029	1.76 (0.87, 3.57)
Junior or Senior	3,809	1.89 (1.46, 2.46) *	2,854	2.47 (1.21, 5.04) *
University	1,191	1.67 (1.24, 2.26) *	786	3.66 (1.75, 7.65) *
Smoking Status				

Non-Smoker	8,881	Reference	1,849	Reference
Smoker	192	0.78 (0.55, 1.10)	3,926	0.51 (0.43, 0.60) *
Marital Status				
Never Married	683	Reference	774	Reference
Married	7,909	2.39 (1.88, 2.98) *	4,931	2.04 (1.48, 2.82) *
Other	481	1.54 (1.10, 2.15) *	70	1.59 (0.77, 3.27)
Employment				
Not Working	3,227	Reference	371	Reference
Agriculture	1,585	0.66 (0.56, 0.78) *	1,483	0.50 (0.35, 0.73) *
Skilled Manual[3]	794	0.92 (0.76, 1.12)	1,290	0.73 (0.51, 1.06)
Skilled[4]	3,467	1.17 (1.04, 1.33) *	2,631	1.15 (0.82, 1.61)
Physical Activity[5]:				
No Vigorous Activity		na	3,624	Reference
Vigorous Activity		na	2,151	0.93 (0.79, 1.10)
No Moderate Activity	3,663	Reference		na
Moderate Activity	5,410	1.10 (0.99, 1.22)		na
Consumed Last Week:				
Instant Noodles				
No	3,218	Reference		na
Yes	5,855	1.10 (0.98, 1.25)		na
Fast Food				
No	8,116	Reference	5,172	Reference
Yes	957	1.02 (0.85, 1.27)	603	1.34 (1.06, 1.69) *
Soda				
No		na	4,196	Reference
Yes		na	1,579	1.10 (0.92, 1.30)
Fried Snacks				
No	3,236	Reference	1,782	Reference
Yes	5,837	1.12 (1.00, 1.25) *	3,993	1.06 (0.89, 1.25)
Mean Number of Days Consumed in the Last Week[6]:				
Instant Noodles		na	5,775	0.99 (0.95, 1.04)

Household Level Food Expenditures[7]					
	Rice				
	Lowest	4,408	Reference		na
	Highest	4,665	1.02 (0.91, 1.13)		na
	Cooking oil				
	Lowest	5,256	Reference	3,378	Reference
	Highest	3,817	1.24 (1.12, 1.38) *	2,397	1.19 (1.02, 1.39) *
Residence					
	Rural	3,803	Reference	2,401	Reference
	Urban	5,270	1.21 (1.08, 1.35) *	3,374	1.26 (1.06, 1.50) *
Wealth					
	Lowest	2,289	Reference	1,354	Reference
	Second	2,017	1.23 (1.06, 1.44) *	1,271	0.95 (0.76, 1.20)
	Middle	1,455	1.23 (1.03, 1.45) *	964	0.99 (0.77, 1.26)
	Fourth	1,696	1.06 (0.90, 1.25)	1,127	1.06 (0.84, 1.34)
	Highest	1,616	1.12 (0.95, 1.32)	1,059	1.17 (0.92, 1.48)

CI = confidence interval, na = not applicable, not included in multivariable model

[1] Overweight is defined as body mass index ≥ 25 kg/m^2

[2] Odds ratios and confidence intervals are estimated using logistic regression and are weighted to account for the survey design. Pregnant women are excluded

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

[5] Defined using the International Physical Activity Questionnaire

[6] Modelled as a continuous variable, the average number of days consumed is queried if the respondent reported that they consumed item during the last week

[7] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

* $p < 0.05$

Similarly, among men, older age, higher educational attainment, and living in an urban area were associated with higher overweight (Table 4). Wealth was not associated with overweight among men. Married men, versus never married, had two-fold higher odds of overweight (OR=2.04; 95% CI: 1.48, 2.82). Consuming fast food, compared to not consuming fast food, was associated with 34% higher odds of overweight among men (OR=1.34; 95% CI: 1.06, 1.69). Current smokers (versus non-smokers) (OR=0.51; 95% CI: 0.43, 0.60) and men who had an agriculture-based occupation (versus not working) (OR=0.50; 95% CI: 0.35, 0.73) had 50% lower

odds of overweight. Results were similar when investigating associations among adults in longitudinal models (Supplemental Tables 7 and 8).

Regression-based Analyses Among Children

In multivariable models for children aged 6 months to 5 years, consuming fast food (OR=1.48; 95% CI: 1.00, 2.19), urban residence (OR=1.64; 95% CI: 1.14, 2.35) and higher household wealth (OR=1.70; 95% CI: 1.03, 2.81) were associated with higher odds of overweight (Table 5). Among children aged 6-12 years, every 1-year increase in age was associated with 6% higher odds of overweight (OR=1.06; 95% CI: 1.01, 1.11). Having an overweight mother (OR=1.92; 95% CI: 1.59, 2.32), living in an urban area (OR=1.55; 95% CI: 1.26, 1.91), and higher household wealth were associated with higher odds of overweight. On the contrary, parental employment in agriculture-based (OR=0.61; 95% CI: 0.44, 0.85) or skilled manual labor (OR=0.50; 95% CI: 0.33, 0.74) and living in households with > 4 people (OR=0.82; 95% CI: 0.68, 0.99) were associated with lower odds of overweight.

Having an overweight mother was associated with 92% higher odds of being overweight among adolescents (OR=1.92; 95% CI: 1.53, 2.43). Living in an urban area also predicted higher odds of overweight among this age group (OR=1.74; 95% CI: 1.33, 2.27). On the contrary, having a parent employed in agriculture-based labor (OR=0.64; 95% CI: 0.43, 0.96), skilled manual labor (OR=0.52; 95% CI: 0.33, 0.83) or skilled labor (OR=0.70; 95% CI: 0.53, 0.91), compared to not working, was associated with lower odds of overweight among adolescents.

Table 5. Multivariable Logistic Regression Models Investigating the Association Between Selected Characteristics and Overweight Among Children in Indonesia, 2014

	6 months - 5 years[1]		6 – 12 years[2]		13 – 18 years[2]	
	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
		N=3,424		N=4,791		N=3,186
Mean Age[3]	3,424	1.01 (0.88, 1.16)	4,791	1.06 (1.01, 1.11) *	3,186	0.84 (0.79, 0.91) *
Gender						
Boys	1,767	Reference	2,455	Reference	1,648	Reference
Girls	1,657	0.78 (0.58, 1.08)	2,336	0.96 (0.79, 1.15)	1,538	1.06 (0.85, 1.33)
Parental Education[4]						
No Education	188	Reference	313	Reference	264	Reference
Primary	1,234	0.97 (0.40, 2.36)	1,980	0.73 (0.48, 1.11)	1,505	1.01 (0.62, 1.66)
Junior or Senior	1,568	1.12 (0.47, 2.65)	1,997	0.84 (0.55, 1.27)	1,173	1.18 (0.71, 1.94)
University	434	1.12 (0.44, 2.87)	501	1.34 (0.84, 2.14)	244	1.38 (0.76, 2.49)
Parental Employment[4]						
Not Working	1,780	Reference	1,989	Reference	1,239	Reference
Agriculture	433	0.61 (0.31, 1.21)	821	0.61 (0.44, 0.85) *	581	0.64 (0.43, 0.96) *
Skilled Manual[5]	208	0.98 (0.52, 1.84)	371	0.50 (0.33, 0.74) *	264	0.52 (0.33, 0.83) *
Skilled[6]	1,003	1.15 (0.82, 1.63)	1,610	0.91 (0.73, 1.13)	1,102	0.70 (0.53, 0.91) *
Maternal Overweight						
Not Overweight	2,238	Reference	2,894	Reference	1,834	Reference
Overweight	1,186	1.20 (0.89, 1.62)	1,897	1.92 (1.59, 2.32) *	1,352	1.92 (1.53, 2.43) *
Consumed Last Week:						
Instant Noodles						
No	1,525	Reference		na		na
Yes	1,899	0.79 (0.57, 1.11)		na		na
Fast Food						

	No	2,952	Reference	3,909	Reference		na
	Yes	472	1.48 (1.00, 2.19) *	882	1.16 (0.93, 1.45)		na
Residence							
	Rural	1,478	Reference	2,053	Reference	1,323	Reference
	Urban	1,946	1.64 (1.14, 2.35) *	2,738	1.55 (1.26, 1.91) *	1,863	1.74 (1.33, 2.27) *
Wealth							
	Lowest	830	Reference[7]	1,109	Reference	799	Reference
	Second	807	1.54 (0.94, 2.53)	1,056	1.43 (1.06, 1.92) *	735	1.11 (0.80, 1.54)
	Middle	565	1.43 (0.83, 2.48)	812	1.73 (1.26, 2.36) *	513	0.95 (0.66, 1.37)
	Fourth	671	1.70 (1.03, 2.81) *	931	1.45 (1.07, 1.95) *	574	0.95 (0.65, 1.37)
	Highest	551	1.61 (0.96, 2.70)	883	1.55 (1.14, 2.11) *	565	0.94 (0.66, 1.33)
Family Size							
	≤ 4		na	2,105	Reference	1,225	Reference
	> 4		na	2,686	0.82 (0.68, 0.99) *	1,961	0.87 (0.69, 1.10)

CI = confidence interval, na= not applicable, not included in multivariable model

[1] Overweight is defined as weight-for-height z-score > 2 using the MGRS Standard, estimated using logistic regression models and are weighted to account for the survey design

[2] Overweight is defined body mass index z-score > 1 using the WHO reference, estimated using logistic regression models and weighted to account for the survey design

[3] Modelled as a continuous variable

[4] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data.

[5] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[6] Skilled labor combines the following employment sectors: retail and service, transportation

[7] Wealth was not significant in the univariable model but is included in the multivariable model due to previously-established associations

* $p < 0.05$

DISCUSSION

Several aspects of our results paint an alarming picture of obesity-related health in Indonesia. Increases in overweight prevalence were observed among all groups. Between 1993 and 2014 the prevalence of overweight increased by 100% and 88%, among women and men, respectively. Similarly, among school-aged children and adolescents, the prevalence of overweight increased by more than 100% between 1993 and 2014. Over the past two decades, more rural than urban residents became overweight, and in 2014, the proportions of overweight adults were evenly distributed among across wealth quintiles, suggesting that overweight is now prevalent among the poor. Moreover, consuming instant noodles (high in sodium) and fried snacks (high in fat) are now regularly consumed among adults and children in Indonesia and consuming fast food and fried snacks were associated with higher odds of overweight. At the same time, the rate of overweight has remained stagnant among young children, between 2007 and 2014, and being employed in a physically demanding job (i.e. agriculture-based labor) remains protective against overweight.

More than half of Indonesians now live in an urban area and living in an urban area was associated with higher odds of overweight. Several other analyses have also reported higher rates of overweight in urban areas in lower-income countries [25,26] and in Indonesia specifically [27–30]. Urbanization alters supply-side factors, such as the food system and the rapid spread of supermarkets in low- and middle-income countries (LMIC), which makes low-cost, convenient, and highly processed foods more available and accessible [31–33]. Simulations suggest that a shift in the urban population from 25% to 75% is associated with a 4-percentage point increase of total energy from fat and an additional 12- percentage points of energy from sugar [34]. In addition, urbanization leads to lower physical activity, in part because the jobs that become available tend to be more sedentary.

Paralleling increased country-level economic development, the within country socioeconomic context has changed in Indonesia. Poverty has dramatically decreased over the last 20-years, while educational attainment has increased; in 2016, approximately 34% of Indonesians had at least completed upper secondary school, compared to only 26% in 2006 [14,35]. Relatedly, we found that higher education was associated with higher odds of overweight among both men and women. Higher wealth was also associated with 25% higher odds of being overweight among women and a 70%, 55%, and 74% higher odds of overweight among young children, school-age children, and adolescents, respectively. Higher education [7] and higher wealth or income [7,27] have been shown to be associated with higher overweight among adults and children in prior studies conducted in Indonesia. But importantly, descriptive statistics in our study also show a growing prevalence of overweight among lower-wealth groups. For example, the percent of overweight women in the poorest and second wealth quintiles grew by 60% and 120%, respectively. This is consistent with prior studies, which have documented an increasing burden of overweight among women with lower education and in poorer households in Indonesia and other LMIC [36–39].

For both adults and children, consuming ultra-processed foods (instant noodles, fried snacks, fast food) was associated with higher odds of overweight. Prior literature on the consumption of ultra-processed foods in Indonesia is limited. But these results are generally consistent with prior findings that reported that the percent of total energy coming from fat has increased in this context [27,40] and one recent survey conducted in Asia that suggested that the consumption of palm oil, “Western” foods, and processed foods are widespread [6].

As Indonesia has continued to economically develop, more women are entering the labor force and less of the population is employed in agriculture-based labor. Currently, about 50% of

Indonesia's labor force is employed in the service sector, compared to 30% in agriculture and 20% in industry [14]. Similar to prior literature, employment was associated with overweight in this sample [41,42]. We found that skilled occupations were associated with higher odds of overweight whereas agriculture-based employment was associated with lower odds of overweight. This is likely related to occupation-related physical activity; Monda and colleagues provide empirical evidence of a reduction in the intensity of occupational activity with economic development in China [43]. In fact, reduced physical activity likely represents the most important cause of rapid overweight increases between 1990 and 2010 in most LMIC (with dietary factors playing a more major role from 2010-present) [44].

Similar to our results, Rachmi and colleagues report that overweight prevalence is higher among younger-aged boys versus girls in Indonesia [7]. Finally, having an overweight mother was strongly associated with higher odds of overweight among school-age children and adolescents. Although the importance of intergenerational nutrition is often a concern for undernutrition, it warrants consideration for overnutrition as well. Pre-pregnancy maternal overweight puts infants at increased risk of being born large-for-gestational-age and subsequently overweight during childhood [45–50]. A child born to a mother who is overweight is twice as likely to be overweight as a child, compared to a child whose mother was normal weight [48,49] .

A recent report by the Economist Intelligence Unit reviewed obesity policies and interventions that are being/have been tested in Southeast Asian countries [6]. Interventions that targeted food intake showed the most promise to reduce obesity. Traditionally, nutrition programs have focused on women and young children. But our findings call for urgent action to mitigate overweight among all age-groups in Indonesia and highlights that need for prevention strategies that also target men and boys, as well as individuals in rural areas. A multipronged strategy would

include approaches that aim to enhance the food environment, improve the food system, and provide effective social behavior change communication [51,52]. Fiscal measures, such as food- and beverage-related taxes, to reduce the consumption of unhealthy items and subsidies for fruits and vegetables production and consumption, may be effective in improving the overall food environment and are a feasible approach for targeting most segments of the population in Indonesia [52–55]. Regulatory measures to control warning labelling systems and marketing of unhealthy foods and beverages may also improve the obesogenic environment [52,56,57]. It is also important to address overweight early, as child and adolescent obesity tracks into adulthood [58,59]; interventions aimed at improving nutrition literary and eating and physical activity behaviors through school-based nutrition education and effective social and behavior change communication to mobilize the support of the entire community also warrant consideration [52,60,61]. Using technology-based platforms, such as social media, to deliver obesity-prevention messages may be a promising strategy in Indonesia given that population is quite young. A multi-pronged strategy that utilizes a number of delivery platforms (e.g. policy, healthcare system, schools) is needed in order to mitigate the obesity epidemic among all age groups in Indonesia.

These findings and recommendations should be interpreted while keeping in mind the limitations of our study. First, we largely employ cross-sectional data, therefore, we cannot infer any causal associations and there may be unmeasured confounding. Data on the consumption of a select number of ultra-processed foods was only collected in 2014, which limits our ability to make inferences about the association between ultra-processed foods and overweight over time. Physical activity levels were based on respondent recall. These limitations in the IFLS and the potential for unmeasured confounding with a cross-sectional study design may have attenuated some associations related to food consumption and physical activity. Finally, these findings may not be

generalizable beyond Indonesia. Despite some limitations, we are able to compare overweight trends over time among all age groups, explore the consumption of ultra-processed foods and physical activity, and investigate hypothesized risk factors for overweight using regression-based methods, using a recent dataset that is nationally representative of Indonesia.

Indonesia is undergoing nutrition transition, as evidenced by the increasing prevalence of overweight, the ubiquitous consumption of ultra-processed foods, and decreasing levels of physical activity. These data suggest urgent program and policy action is needed to reduce and prevent overweight among all age groups. In addition, these data highlight the need for prevention strategies that also target males, as well as the increasing prevalence of overweight among rural and poorer populations. Multi-sectoral, multi-stakeholder actions and solutions are needed to improve the food environment in Indonesia.

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Conflict of Interest Statement

The authors do not have any conflicts of interest to declare.

Author Contributions

VMO, MM, and JHR conceptualized the research question and jointly developed the analytic plan. MM acquired the publicly available data. VMO took the primary role in data analysis, interpretation of findings, and drafting of the manuscript. MM and JHR also provided critical input on the interpretation of the findings and provided input on all manuscript drafts. VMO, MM, and JHR approved the final version of the manuscript.

Data Statement

Data are publicly available at https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html

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Figure 1. Percent Distribution of Overweight in Indonesia, 1993-2014 [1-4]

[see attached Figure 1]

[1] Percentages are weighted to be representative of the population of Indonesia in the given survey year
[2] Adults: excludes women who are currently pregnant. Overweight/obesity defined as body mass index ≥ 25 kg/m^2
[3] Children Aged 0-5 years: overweight/obesity defined as weight-for-height z-score > 2 using the MGRS Standard
[4] Children Aged 6-18 years: overweight/obesity as body mass index-for-age z-score > 1 using the WHO Reference

Figure 2. Summary of Associations between Selected Characteristics and Overweight in Multivariable Models

[See Attached Figure 2]

-- not applicable; ns = not significant
Associated with higher odds of overweight in multivariable models
Associated with lower odds of overweight in multivariable models
Direction of association with overweight is mixed in multivariable models
[1] Parental characteristic for child models

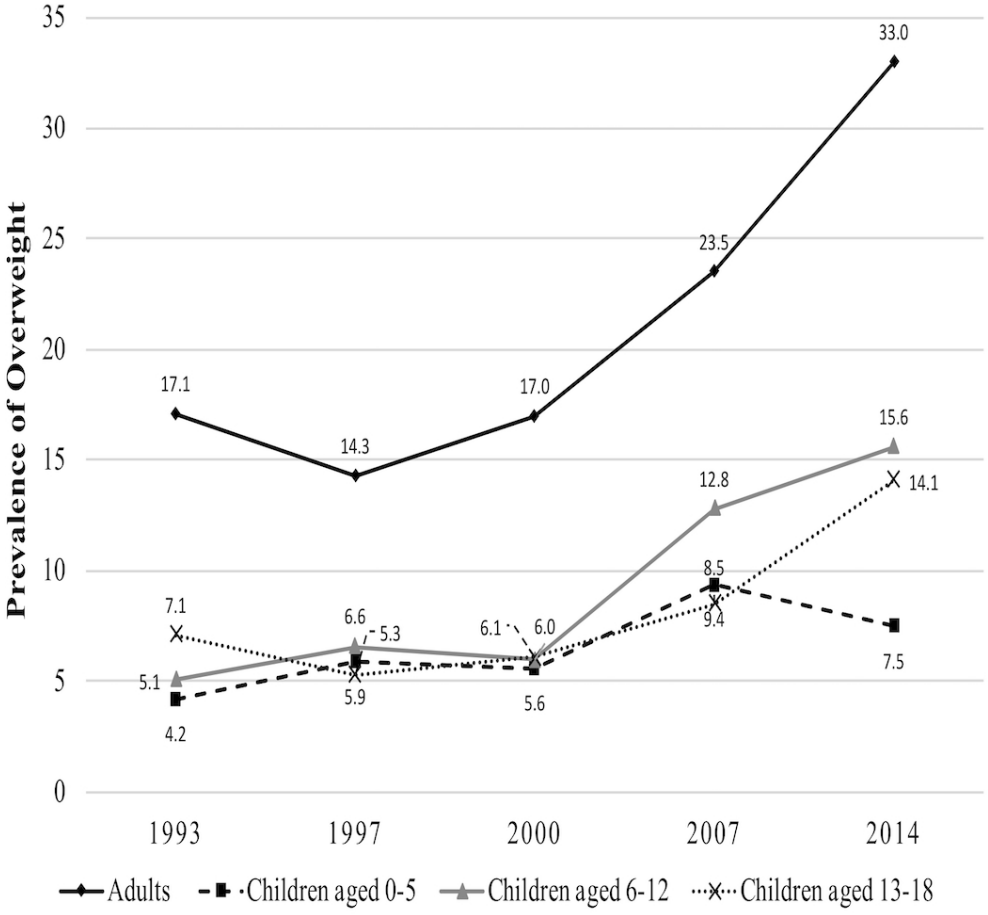

Figure 1

90x90mm (300 x 300 DPI)

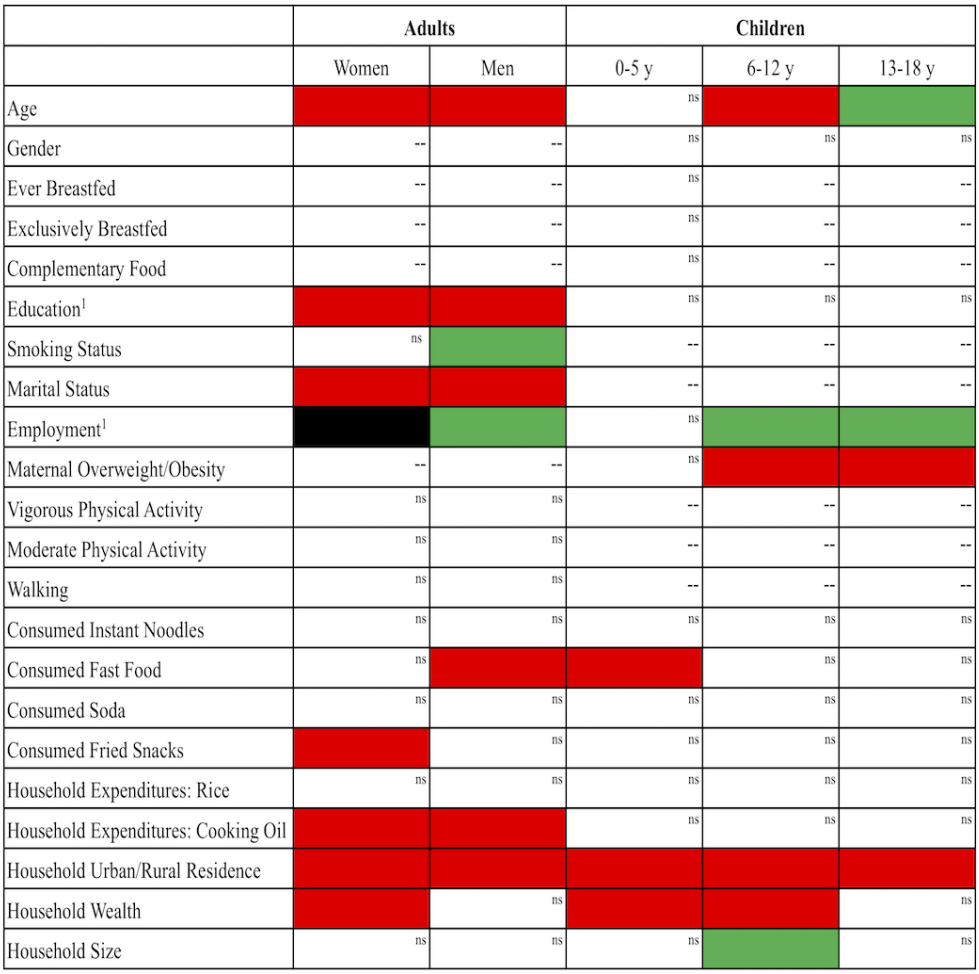

Figure 2

90x90mm (300 x 300 DPI)

Online Supplemental Material

Supplemental Table 1. Obesity Related Factors Available in the Indonesian Family Life Survey

		1993	1997	2000	2007	2014
Household-Level Factors						
Urbanization	Urban/Rural	*	*	*	*	*
Wealth	Asset type	*	*	*	*	*
Expenditures	Soda, snacks, cooking oil, rice	*	*	*	*	*
Family Size	Number in household	*	*	*	*	*
Individual-Level Factors						
Adults						
Demographics	Age, Gender, Marital Status	*	*	*	*	*
Education	Highest education attained	*	*	*	*	*
Employment	Worked in last week, occupation	*	*	*	*	*
Parity	Among ever married women	*	*	*	*	*
Smoking	Ever smoker, currently smoking	*	*	*	*	*
Physical Activity	Vigorous, moderate, walking, last 7d	---	---	---	*	*
Children						
Demographics	Age, gender	*	*	*	*	*
Parental Characteristics	Education, employment, overweight	*	*	*	*	*
Early Life Nutrition[1]	Ever breastfed, exclusively breastfed	*	*	*	*	*
Diet						
Instant noodles	Days per week, mean number days	---	---	---	---	*
Soft drink (e.g. coca cola, sprite)	Days per week, mean number days	---	---	---	---	*
Fried snacks (e.g. tempe, tahu)	Days per week, mean number days	---	---	---	---	*
Fast Food	Days per week, mean number days	---	---	---	---	*
Staple Foods (e.g. rice, eggs)	Days per week, mean number days	---	---	*	*	*
Anthropometry and Health						
Height		*	*	*	*	*
Weight		*	*	*	*	*
Waist Circumference		---	---	*	*	*
Blood Pressure		---	*	*	*	*
Pulse		---	*	*	*	*
Medication Use		---	---	*	*	*
Dried Blood Spots[1]		---	---	---	*	*

* data are available in given year --- data not available

[1] Queried among ever married women for children they had in the last 5 years

Online Supplemental Material

Supplemental Table 2. Percent Distribution of Selected Characteristics Among Overweight Children Aged 0-5 in Indonesia Over Time

	1993[1]		1997[1]		2000[1]		2007[1]		2014[1]	
	n	%	n	%	n	%	n	%	n	%
Age (years)										
0-2	58	76.6	88	81.5	145	72.2	301	72.7	230	62.4
3-5	20	23.4	21	18.5	47	27.8	107	27.3	133	37.6
Gender										
Boys	40	52.7	56	47.9	112	58.2	236	55.1	210	57.7
Girls	38	47.3	109	52.1	80	41.8	172	44.9	153	42.3
Ever Breastfed[2]										
No	4	5.4	0	0	3	2.4	11	3.2	10	2.7
Yes	46	94.6	25	100.0	132	97.6	350	96.8	318	97.3
Exclusively Breastfed[2]										
No	49	95.4	23	88.9	131	96.1	332	92.8	274	84.4
Yes	1	4.6	2	11.1	4	3.9	29	7.2	54	19.6
Complementary Foods[2]										
< 6 mo or ≥ 8 mo	41	94.8	21	100	110	96.2	290	91.2	247	55.8
≥ 6 mo to < 8 mo	1	5.2	0	0	4	3.8	31	8.8	51	44.2
Parental Education[3]										
No Education	9	17.0	19	18.0	20	11.6	24	8.1	11	3.9
Primary	31	61.1	53	57.4	98	51.4	118	35.1	96	33.0
Junior or Senior	12	17.7	18	17.5	56	29.3	169	45.3	156	47.3
University	3	4.2	7	7.0	14	7.7	44	11.5	56	15.8
Parental Employment[3]										
Not working	30	58.1	77	71.0	118	61.2	230	57.8	185	53.7
Agriculture	5	9.3	5	3.8	18	11.3	35	9.6	22	5.6
Skilled Manual[4]	9	16.1	9	8.6	13	7.3	36	9.0	24	7.3
Skilled[5]	11	16.5	17	16.5	39	20.2	103	23.5	130	33.4
Maternal Overweight										
Not Overweight	33	79.5	88	85.1	158	88.3	288	73.3	198	58.7
Overweight	10	20.5	15	14.9	23	11.7	104	26.7	149	41.3
Residence										
Rural	46	70.6	56	55.6	91	49.0	151	44.2	123	39.2
Urban	32	29.4	53	44.4	101	51.0	257	55.8	240	60.8
Wealth										

Online Supplemental Material

Lowest	26	39.8	20	20.7	39	22.1	114	31.6	56	18.8
Second	7	7.2	15	14.8	37	21.0	80	22.4	69	25.0
Middle	12	17.0	27	25.2	34	19.9	60	19.3	43	16.3
Fourth	19	28.3	15	14.6	31	19.2	53	15.2	65	22.5
Highest	13	7.7	24	24.7	29	17.7	46	11.4	52	17.4
Family Size										
≤ 4	26	22.1	30	26.9	86	46.9	167	41.1	195	54.2
> 4	52	77.9	79	73.1	106	53.1	241	58.9	168	45.8

[1] Overweight is defined as weight-for-height z-score > 2 using the MGRS Standard. Percentages are weighted to be representative of the population of Indonesia in the given survey year

[2] Breastfeeding data are reported by the mother retrospectively. Exclusively breastfed indicates whether the child was only given breastmilk (no water or complementary foods) when the child was aged 0-6 months. Complementary foods indicate appropriate timing of complementary foods, that is, the introduction of complementary foods when the child was 6-8 months old.

[3] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data

[4] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[5] Skilled labor combines the following employment sectors: retail and service, transportation

Online Supplemental Material

Supplemental Table 3. Percent Distribution of Selected Characteristics Among Overweight Children Aged 6-12 in Indonesia Over Time

	1993[1]		1997[1]		2000[1]		2007[1]		2014[1]	
	n	%	n	%	n	%	n	%	n	%
Age (years)										
6-9	113	55.6	183	58.6	206	59.0	495	59.0	760	53.3
10-12	48	44.4	90	41.4	91	41.0	200	41.0	332	46.7
Gender										
Boys	77	44.0	144	51.4	166	54.5	387	55.1	601	53.4
Girls	84	56.0	132	48.6	133	45.5	310	44.9	492	46.6
Parental Education[2]										
No Education	10	7.5	126	27.3	42	15.2	51	9.1	46	5.4
Primary	69	70.5	49	51.9	135	44.4	230	40.4	282	32.5
Junior or Senior	23	13.0	15	14.9	91	30.5	237	37.3	441	45.4
University	14	8.9	254	5.8	25	9.9	85	13.3	182	16.8
Parental Employment[2]										
Not Working	53	46.3	162	61.0	132	44.0	317	45.3	448	42.9
Agriculture	6	6.9	32	11.3	42	14.1	76	12.9	91	9.7
Skilled Manual[3]	19	17.8	11	4.4	33	13.2	54	8.1	79	7.9
Skilled[4]	36	29.0	63	23.3	87	28.7	232	33.7	442	39.5
Maternal Overweight										
Not Overweight	60	68.9	184	72.3	186	66.2	356	56.2	454	44.9
Overweight	38	31.1	73	27.7	96	33.8	289	43.8	541	55.1
Residence										
Rural	61	56.7	129	53.8	112	39.9	255	45.3	298	37.0
Urban	100	43.3	146	46.2	187	60.1	442	54.7	795	63.0
Wealth										
Lowest	30	22.2	50	22.3	36	13.1	87	15.4	129	16.3
Second	17	16.1	37	14.4	44	18.1	142	26.0	160	21.4
Middle	36	20.5	44	19.6	45	20.4	75	13.0	141	19.3
Fourth	29	18.9	45	20.3	48	20.6	139	25.1	173	21.1
Highest	47	22.3	62	23.4	66	27.9	120	20.6	181	21.8
Family Size										
≤ 4	49	35.4	65	22.5	114	39.4	222	32.3	621	58.6
> 4	112	64.6	211	77.5	185	60.6	475	67.7	472	41.4

[1] Overweight is defined as body mass index-for-age z-score > 1 using the WHO Reference. Percentages are weighted to be representative of the population of Indonesia in the given survey year

[2] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data

Online Supplemental Material

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

Supplemental Table 4. Percent Distribution of Selected Characteristics Among Overweight Children Aged 13-18 in Indonesia Over Time

	1993[1]		1997[1]		2000[1]		2007[1]		2014[1]	
	n	%	n	%	n	%	n	%	n	%
Age (years)										
13-15	45	67.9	84	53.9	98	47.6	301	48.5	280	54.1
16-18	9	32.0	74	46.1	131	52.4	107	51.5	262	45.9
Gender										
Boys	40	52.2	90	44.9	95	35.8	150	40.7	333	48.9
Girls	43	47.8	121	55.1	179	64.2	217	59.3	374	51.1
Parental Education[2]										
No Education	7	10.8	48	27.4	45	19.5	36	10.9	36	6.5
Primary	46	72.0	96	53.7	136	56.3	164	54.6	240	42.2
Junior or Senior	9	8.0	34	15.4	47	17.0	93	27.2	265	41.0
University	3	9.2	7	3.5	14	7.2	23	7.3	72	10.3
Parental Employment[2]										
Not Working	38	64.9	112	56.8	91	36.8	132	39.9	277	45.3
Agriculture	2	4.3	14	8.1	39	16.6	43	13.7	64	11.0
Skilled Manual[3]	4	3.2	11	4.9	15	7.4	30	9.2	46	8.3
Skilled[4]	21	27.6	59	30.2	97	39.2	129	37.2	260	35.3
Maternal Overweight										
Not Overweight	28	57.2	110	54.3	132	56.3	173	54.2	256	40.7
Overweight	29	42.8	90	45.7	108	43.7	155	45.8	371	59.3
Household Level										
Residence										
Rural	20	39.7	69	37.9	114	45.5	134	42.4	204	39.5
Urban	63	60.3	142	62.1	160	54.5	233	57.6	503	60.5
Wealth										
Lowest	11	14.6	26	15.2	38	16.5	46	16.6	118	23.8
Second	5	3.3	28	13.5	40	20.0	71	25.6	119	24.0
Middle	18	30.2	44	27.8	47	21.2	33	12.5	80	16.1
Fourth	19	21.3	29	17.4	37	15.3	65	23.4	86	18.2
Highest	29	30.6	47	26.1	58	26.9	63	21.8	103	17.9
Family Size										
≤ 4	21	29.0	31	17.0	92	36.1	74	21.9	353	54.6
> 4	62	71.0	180	83.0	182	63.9	293	78.1	354	45.4

[1] Overweight is defined as body mass index-for-age z-score > 1 using the WHO Reference. Percentages are weighted to be representative of the population of Indonesia in the given survey year

[2] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

Supplemental Table 5. Univariable Logistic Regression Models Investigating the Associations Between Selected Characteristics and Overweight Among Adults in Indonesia in 2014

	Women[1,2]		Men[1,2]	
	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
Age (years)				
19-29	4,350	Reference	3,680	Reference
30-39	4,217	2.23 (2.01, 2.46) *	3,981	1.95 (1.72, 2.22) *
40-49	2,807	2.93 (2.62, 3.27) *	2,766	2.41 (2.10, 2.76) *
50-59	2,053	2.26 (2.00, 2.56) *	1,748	2.09 (1.79, 2.44) *
60+	1,858	1.04 (0.91, 1.19)	1,612	0.95 (0.79, 1.13) *
Education				
No Education	1,033	Reference	381	Reference
Primary	4,912	2.89 (2.42, 3.45) *	4,192	2.44 (1.61, 3.70) *
Junior or Senior	4,894	2.98 (2.49, 3.55) *	4,901	4.30 (2.85, 6.49) *
University	1,581	2.90 (2.36, 3.55) *	1,487	8.48 (5.55, 12.94) *
Smoking Status				
Non-Smoker	14,772	Reference	4,552	Reference
Smoker	434	0.57 (0.45, 0.72) *	9,165	0.47 (0.43, 0.52) *
Marital Status				
Never Married	1,560	Reference	2,436	Reference
Married	11,549	3.37 (2.88, 3.95) *	10,780	2.04 (1.78, 2.34) *
Other	2,172	1.78 (1.48, 2.14) *	565	1.10 (0.82, 1.46)
Employment				
Not Working	5,713	Reference	1,291	Reference
Agriculture	2,355	0.73 (0.64, 0.82) *	3,565	0.63 (0.52, 0.77) *
Skilled Manual[3]	1,312	0.94 (0.81, 1.09)	2,886	1.06 (0.88, 1.28)
Skilled[4]	5,644	1.46 (1.33, 1.60) *	5,799	2.03 (1.71, 2.41) *
Physical Activity in the Last Week[5]:				
No Vigorous Activity	13,001	Reference	8,360	Reference
Vigorous Activity	1,556	0.94 (0.82, 1.07)	4,762	0.69 (0.62, 0.77) *
No Moderate Activity	6,015	Reference	6,126	Reference
Moderate Activity	8,542	1.18 (1.09, 1.28) *	6,996	0.98 (0.89, 1.07)
No Walking	4,706	Reference	3,628	Reference

Walking	9,851	0.98 (0.90, 1.07)	9,494	1.00 (0.90, 1.11)
Consumed in the Last Week:				
Instant Noodles				
No	5,125	Reference	4,428	Reference
Yes	9,425	1.10 (1.01, 1.19) *	8,685	1.03 (0.93, 1.14)
Fast Food				
No	12,902	Reference	11,825	Reference
Yes	1,648	1.18 (1.04, 1.34) *	1,288	1.55 (1.34, 1.80) *
Soda				
No	12,620	Reference	9,838	Reference
Yes	1,930	1.05 (0.93, 1.19)	3,275	1.13 (1.01, 1.25) *
Fried Snacks				
No	5,253	Reference	4,468	Reference
Yes	9,297	1.26 (1.16, 1.37) *	8,645	1.22 (1.10, 1.35) *
Mean Number of Days Consumed in the Last Week[6]:				
Instant Noodles	9,425	1.00 (0.97, 1.03)	8,685	0.95 (0.92, 0.98) *
Fast Food	1,648	0.99 (0.91, 1.08)	1,288	0.96 (0.83, 1.11)
Soda	1,930	1.01 (0.93, 1.09)	3,275	0.95 (0.90, 1.01)
Fried Snacks	9,297	1.04 (0.99, 1.06)	8,645	1.01 (0.99, 1.04)
Food Expenditures[7]				
Rice				
Lowest	7,946	Reference	7,165	Reference
Highest	7,315	1.14 (1.05, 1.23) *	6,583	0.99 (0.90, 1.08)
Cooking oil				
Lowest	9,192	Reference	8,391	Reference
Highest	6,067	1.25 (1.15, 1.36) *	5,355	1.34 (1.21, 1.47) *
Residence				
Rural	6,242	Reference	5,688	Reference
Urban	9,043	1.39 (1.29, 1.51) *	8,097	1.92 (1.74, 2.12) *
Wealth				
Lowest	2,818	Reference	2,879	Reference
Second	2,538	1.22 (1.06, 1.39) *	2,528	1.25 (1.07, 1.47) *

	Middle	1,829	1.19 (1.03, 1.38) *	1,863	1.40 (1.18, 1.66) *
	Fourth	2,129	1.14 (0.99, 1.32)	2,104	1.54 (1.31, 1.81) *
	Highest	1,998	1.19 (1.03, 1.36) *	1,956	2.16 (1.85, 2.52) *
Family Size					
	≤ 4	9,542	Reference	8,590	Reference
	> 4	5,743	0.96 (0.89, 1.04)	5,195	0.97 (0.88, 1.07)

CI = confidence interval

[1] Overweight is defined as body mass index ≥ 25 kg/m^2

[2] Odds ratios and confidence intervals are estimated using logistic regression and are weighted to account for the survey design. Models exclude women who are currently pregnant.

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

[5] Defined using the International Physical Activity Questionnaire

[6] Modelled as a continuous variable, the average number of days consumed is queried if the respondent reported that they consumed item during the last week

[7] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

* $p < 0.05$

Supplemental Table 6. Univariable Logistic Regression Models Investigating the Associations Between Selected Characteristics and Overweight Among Children in Indonesia in 2014

		6 months - 5 years[1]		6-12 years[2]		13-18 years[2]	
		n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)	n	Odds Ratio (95% CI)
Mean Age[3]		4,965	0.88 (0.80, 0.97) *	7,012	1.06 (1.02, 1.10) *	4,868	0.87 (0.83, 0.92) *
Gender							
	Boys	2,585	Reference	3,601	Reference	2,462	Reference
	Girls	2,380	0.75 (0.59, 0.96) *	3,411	0.87 (0.76, 1.01)	2,406	1.20 (1.01, 1.44) *
Ever Breastfed[4]							
	No	140	Reference		na		na
	Yes	4,429	1.15 (0.53, 2.47)		na		na
Exclusively Breastfed[4]							
	No	3,646	Reference				
	Yes	923	0.82 (0.59, 1.15)		na		na
					na		na
Introduction of Complementary Foods[4]							
	< 6 months or ≥ 8 months	3,379	Reference		na		na
	≥ 6 months to < 8 months	840	0.82 (0.58, 1.16)		na		na
Parental Education[5]							
	No Education	251	Reference	419	Reference	353	Reference
	Primary	1,562	1.39 (0.65, 2.98)	2,449	1.11 (0.76, 1.61)	1,904	1.26 (0.83, 1.91)
	Junior or Senior	2,055	1.69 (0.80, 3.59)	2,690	1.70 (1.17, 2.46) *	1,555	1.73 (1.14, 2.63) *
	University	564	2.29 (1.04, 5.05) *	686	3.00 (2.01, 4.47) *	331	2.13 (1.31, 3.46) *

Parental Employment[5]						
Not Working	2,564	Reference	2,804	Reference	1,729	Reference
Agriculture	569	0.51 (0.30, 0.86) *	1,111	0.50 (0.38, 0.65)	737	0.51 (0.37, 0.71) *
Skilled Manual[6]	325	0.98 (0.60, 1.60)	559	0.81 (0.61, 1.08)	394	0.72 (0.50, 1.04)
Skilled[7]	1,469	1.22 (0.94, 1.59)	2,399	1.22 (1.04, 1.43) *	1,550	0.94 (0.76, 1.15)
Maternal Overweight						
Not Overweight	3,068	Reference	3,864	Reference	2,459	Reference
Overweight	1,664	1.31 (1.02, 1.67) *	2,597	2.03 (1.75, 2.37) *	1,835	2.18 (1.80, 2.64) *
Consumed in the Last Week:						
Instant Noodles						
No	2,002	Reference	1,616	Reference	581	Reference
Yes	2,613	0.69 (0.53, 0.90) *	5,382	1.03 (0.87, 1.23)	2,076	1.03 (0.78, 1.36)
Fast Food						
No	3,941	Reference	5,669	Reference	2,209	Reference
Yes	674	1.39 (1.01, 1.93) *	1,329	1.43 (1.21, 1.69) *	448	1.13 (0.85, 1.50)
Soda						
No	4,342	Reference	5,942	Reference	2,011	Reference
Yes	273	0.89 (0.50, 1.59)	1,056	1.17 (0.97, 1.42)	646	1.09 (0.84, 1.41)
Fried Snacks						
No	2,393	Reference	2,531	Reference	825	Reference
Yes	2,222	0.83 (0.64, 1.08)	4,467	1.12 (0.96, 1.31)	1,832	0.99 (0.78, 1.26)
Mean Number of Days Consumed in the Last Week[8]:						
Instant Noodles	2,613	1.00 (0.91, 1.10)	5,382	0.99 (0.95, 1.03)	2,076	0.99 (0.93, 1.05)

Fast Food	674	0.88 (0.74, 1.05)	1,329	0.91 (0.83, 1.00)	448	0.90 (0.77, 1.05)
Soda	2,222	0.89 (0.51, 1.55)	1,056	1.05 (0.96, 1.16)	646	1.10 (0.98, 1.24)
Fried Snacks	3,671	0.97 (0.89, 1.05)	4,467	0.98 (0.94, 1.01)	1,832	0.97 (0.92, 1.03)
Food Expenditures[9]						
Rice						
Lowest	2,469	Reference	3,334	Reference	2,151	Reference
Highest	2,489	1.15 (0.91, 1.46)	3,662	0.86 (0.75, 1.00)	2,704	0.93 (0.78, 1.11)
Cooking oil						
Lowest	2,992	Reference	3,993	Reference	2,785	Reference
Highest	1,966	1.23 (0.97, 1.57)	3,002	1.16 (1.00, 1.34)	2,071	1.11 (0.93, 1.33)
Residence						
Rural	2,083	Reference	2,915	Reference	1,969	Reference
Urban	2,882	1.57 (1.22, 2.02) *	4,097	2.01 (1.72, 2.35) *	2,899	1.71 (1.42, 2.07) *
Wealth						
Lowest	1,008	Reference	1,247	Reference	876	Reference
Second	964	1.37 (0.91, 2.06)	1,193	1.50 (1.14, 1.98) *	802	1.12 (0.83, 1.52)
Middle	654	1.25 (0.79, 1.98)	908	1.78 (1.34, 2.36) *	566	1.06 (0.76, 1.48)
Fourth	783	1.42 (0.93, 2.15)	1,037	1.64 (1.25, 2.15) *	617	1.08 (0.77, 1.51)
Highest	656	1.37 (0.89, 2.11)	993	1.83 (1.39, 2.40) *	617	1.12 (0.82, 1.54)
Family Size						
≤ 4	2,645	Reference	3,523	Reference	2,322	Reference
> 4	2,320	0.99 (0.78, 1.26)	3,489	0.75 (0.65, 0.87) *	2,546	0.83 (0.70, 0.99) *

CI = confidence interval; na = not applicable

[1] Overweight is defined as weight-for-height z-score > 2 using the MGRS Standard, estimated using logistic regression models and are weighted to account for the survey design

[2] Overweight is defined as BMI z-score > 1 using the WHO reference, estimated using logistic regression models and are weighted to account for the survey design
[3] Modelled as a continuous variable
[4] Breastfeeding data are reported by the mother retrospectively. Exclusively breastfed indicates whether the child was only given breastmilk (no water or complementary foods) when the child was aged 0-6 months. Complementary foods indicate appropriate timing of complementary foods, that is, the introduction of complementary foods when the child was 6-8 months old.
[5] Parental characteristics are of the mother, when available. When not available the characteristic is based on the father's data
[6] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction
[7] Skilled labor combines the following employment sectors: retail and service, transportation
[8] Modelled as a continuous variable, the average number of days consumed is queried if the respondent reported that they consumed item during the last week
[9] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

Supplemental Table 7. Longitudinal Associations Between Selected Characteristics and Overweight Among Adult Women Aged 19 + in Indonesia 1993-2014

		Risk Ratio (95% Confidence Interval)	
		Univariate[1,2]	Multivariable[1,2]
		Risk Ratio (95% CI)	Risk Ratio (95% CI)
Age (years)	N=29,541		
19-29		Reference	Reference
30-39		2.00 (1.85, 2.17) *	1.75 (1.56, 1.97) *
40-49		2.33 (2.16, 2.51) *	2.02 (1.80, 2.27) *
50-59		1.85 (1.71, 2.00) *	1.76 (1.56, 1.98) *
60+		1.09 (1.00, 1.19) *	1.39 (1.21, 1.59) *
Education	N=25,970		
No Education		Reference	Reference
Primary		2.05 (1.89, 2.23) *	1.63 (1.47, 1.80) *
Junior or Senior		2.00 (1.82, 2.18) *	1.60 (1.42, 1.80) *
University		2.03 (1.81, 2.28) *	1.53 (1.32, 1.78) *
Smoking Status	N=28,967		
Non-Smoker		Reference	Reference
Smoker		0.58 (0.51, 0.66) *	0.75 (0.65, 0.87) *
Marital Status	N=29,055		
Never Married		Reference	Reference
Married		3.03 (2.63, 3.49) *	2.25 (1.81, 2.81) *
Other		2.01 (1.73, 2.34) *	1.60 (1.25, 2.06) *
Employment	N=28,726		
Not Working		Reference	Reference
Agriculture		0.72 (0.67, 0.77) *	0.77 (0.71, 0.84) *
Skilled Manual[3]		0.90 (0.82, 0.98) *	0.93 (0.84, 1.04)
Skilled[4]		1.30 (1.23, 1.36) *	1.13 (1.07, 1.20) *
Food Expenditures[5]			
Rice	N=28,654		
Lowest		Reference	Reference
Highest		1.12 (1.07, 1.17) *	1.00 (0.95, 1.06)
Soda	N=27,508		
Lowest		Reference	Reference
Highest		1.26 (1.19, 1.33) *	1.13 (1.06, 1.21) *

	Snacks	N=29,057		
	Lowest		Reference	Reference
	Highest		1.20 (1.15, 1.25) *	1.03 (0.98, 1.09)
	Cooking oil	N=29,172		
	Lowest		Reference	Reference
	Highest		1.31 (1.25, 1.37) *	1.17 (1.11, 1.23) *
Residence		N=29,537		
	Rural		Reference	Reference
	Urban		1.49 (1.43, 1.56) *	1.31 (1.24, 1.39) *
Wealth		N=23,055		
	Lowest		Reference	Reference
	Second		1.21 (1.11, 1.31) *	1.16 (1.06, 1.26) *
	Middle		1.26 (1.16, 1.36) *	1.17 (1.07, 1.27) *
	Fourth		1.37 (1.26, 1.48) *	1.21 (1.11, 1.32) *
	Highest		1.40 (1.30, 1.52) *	1.17 (1.07, 1.27) *
Family Size		N=29,540		
	≤ 4		Reference	Reference
	> 4		1.08 (1.03, 1.13) *	0.93 (0.88, 0.99) *

CI = confidence interval

[1] Overweight is defined as body mass index ≥ 25 kg/m^2

[2] Risk Ratios and confidence intervals are estimated using a modified Poisson model and are weighted to account for the survey design. Excludes pregnant women. N =18,018 in multivariable model

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

[5] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

* $p < 0.05$

Supplemental Table 8. Longitudinal Association Between Selected Characteristics and Overweight Among Adult Men Aged 19 + in Indonesia 1993-2014

		Univariate[1,2]	Multivariable[1,2]
		Risk Ratio (95% CI)	Risk Ratio (95% CI)
Age	N=24,169		
19-29 y		Reference	Reference
30-39 y		2.18 (1.90, 2.50) *	1.74 (1.32, 2.28) *
40-49 y		2.64 (2.32, 3.00) *	2.04 (1.57, 2.66) *
50-59 y		2.18 (1.92, 2.47) *	1.90 (1.46, 2.48) *
60+ y		1.13 (0.98, 1.30)	1.24 (0.94, 1.65)
Education	N=21,072		
No Education		Reference	Reference
Primary		2.26 (1.74, 2.94) *	1.56 (1.17, 2.08) *
Junior or Senior		4.06 (3.11, 5.29) *	2.39 (1.77, 3.22) *
University		6.80 (5.18, 8.94) *	2.82 (2.07, 3.85) *
Smoking Status	N=23,764		
Non-smoker		Reference	Reference
Smoker		0.54 (0.50, 0.58) *	0.66 (0.60, 0.72) *
Marital Status	N=23,846		
Never Married		Reference	Reference
Married		2.07 (1.80, 2.38) *	1.87 (1.38, 2.53) *
Other		1.35 (1.02, 1.78) *	1.41 (0.85, 2.33)
Employment	N=23,463		
Not Working		Reference	Reference
Agriculture		0.65 (0.55, 0.76) *	0.60 (0.50, 0.72) *
Skilled Manual[3]		1.19 (1.02, 1.38) *	0.92 (0.76, 1.10)
Skilled[4]		2.10 (1.85, 2.39) *	1.30 (1.12, 1.52) *
Food Expenditures[5]			
Rice	N=23,310		
Lowest		Reference	na
Highest		1.01 (0.93, 1.09)	na
Soda	N=22,283		
Lowest		Reference	Reference
Highest		1.56 (1.43, 1.71) *	1.15 (1.05, 1.27) *

	Snacks	N=23,703		
	Lowest		Reference	Reference
	Highest		1.58 (1.46, 1.71) *	1.11 (1.01, 1.22) *
	Cooking oil	N=23,797		
	Lowest		Reference	Reference
	Highest		1.55 (1.44, 1.68) *	1.23 (1.12, 1.34) *
Residence		N=24,168		
	Rural		Reference	Reference
	Urban		1.97 (1.82, 2.14) *	1.27 (1.15, 1.40) *
Wealth		N=21,036		
	Lowest		Reference	Reference
	Second		1.26 (1.09, 1.46) *	1.10 (0.94, 1.29) *
	Middle		1.56 (1.35, 1.80) *	1.30 (1.12, 1.52) *
	Fourth		1.79 (1.56, 2.06) *	1.30 (1.12, 1.51) *
	Highest		2.44 (2.14, 2.79) *	1.39 (1.20, 1.62) *
Family Size		N=24,169		
	≤ 4		Reference	Reference
	> 4		1.11 (1.02, 1.20) *	1.02 (0.93, 1.12)

CI = confidence interval; na = not applicable

[1] Overweight is defined as BMI ≥ 25 kg/m^2

[2] Risk Ratios and confidence intervals are estimated using a modified Poisson model and are weighted to account for the survey design. N=16,519 in multivariable model

[3] Skilled manual labor combines the following employment sectors: mining, manufacturing, electric, gas, water maintenance, and construction

[4] Skilled labor combines the following employment sectors: retail and service, transportation

[5] Indicates the household level expenditure on each item as a percentage of the households' total expenditures on food

* $p < 0.05$

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page Number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 5
Methods			
Study design	4	Present key elements of study design early in the paper	Pages 5,9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Pages 5,9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Pages 7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Pages 5-7
Bias	9	Describe any efforts to address potential sources of bias	Page 9
Study size	10	Explain how the study size was arrived at	Page 9, see flow chart
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Pages 8-9
		(*b*) Describe any methods used to examine subgroups and interactions	Page 9
		(*c*) Explain how missing data were addressed	Not applicable
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Page 9
		(*e*) Describe any sensitivity analyses	Page 9
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	For this secondary data analysis, individuals were included if they had complete data for the exposure, outcome, and confounders.

		(b) Give reasons for non-participation at each stage	For this secondary data analysis, individuals were included if they had complete data for the exposure, outcome, and confounders.
		(c) Consider use of a flow diagram	See Supplemental Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Pages 9-11
		(b) Indicate number of participants with missing data for each variable of interest	See Supplemental Figure 1. For this secondary data analysis, individuals were included if they had complete data for the exposure, outcome, and confounders.
Outcome data	15*	Report numbers of outcome events or summary measures	Pages 9, Figure 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Provided in supplemental material
		(*b*) Report category boundaries when continuous variables were categorized	Page 8, Tables 1-6
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Supplemental Tables 4 and 5
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 13-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 13-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Not applicable

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.