

Influence of School Location within Districts of Terengganu on Body Weight Status among School Adolescents

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Abstract

Rapid development in the urbanisation process is linked to a shift in dietary intake and lifestyle. The locality may also determine the differences in socio-demographic and environmental factors related to nutrition between the rural and urban populations. The present study aimed to determine prevalence of obesity and to compare the body weight status on body weight status among school adolescents aged 10 to 17 years within districts of Terengganu. A cross sectional survey involving school adolescents aged 10 to 17 years from all government school in seven districts in Terengganu were carried out. Anthropometrics data were obtained from National Fitness Standard (SEGAK) assessment which was uploaded into specific developed database Health Monitoring System (HEMS) and BMI were classified using WHO BMI-for-age z-score. A total of 62,567 school adolescents were involved in this study. Girls had significantly higher BMI than boys in age groups of 13 to 15 and 16 to 17 years old. There were significant differences in mean BMI between rural and urban school locations school adolescents in all age groups ($P < 0.001$) among boys and girls. Significant differences were also found between rural and urban school location in 10 to 12 years old in Dungun and Marang, whilst Kemaman and Kuala Terengganu districts had significant difference between rural and urban in 16 to 17 years old age group. Marang had the highest obesity prevalence

within urban 15.3% school location whilst rural school location within Kuala Terengganu had the highest prevalence of obesity (14.1%). The obesity prevalence increased substantially regardless of school locations compared to previous years. School adolescents in both rural and urban have an equal prevalence of obesity suggesting that intervention and prevention programme should be targeting in both locations. Future studies should look at the association between the potential risk factors to tackle this problem from the origin.

Keywords: Body Weight Status, School Adolescents, Rural, Urban, Terengganu

Introduction

Obesity is often cited as the most pressing health problem among children these days (Reilly and Kelly 2011). Previously, children and adolescents suffered from diseases related to nutrient deficiency, however, the trend has now shifted to overconsumption, poor diet quality and food choices leading to obesity problem. Indeed, obese children and adolescents are at risk of becoming obese during adulthood (Guo et al. 2002) and are predisposed to many negative health outcomes secondary to their childhood obesity including cardiovascular disease, dyslipidaemia, hypertension, diabetes mellitus, and sleep apnoea (Ng et al. 2014).

Obesity development involves multifaceted lifestyle factors. The key contributing factor is the chronic excessive energy intake with reduced energy expenditure. Increased reliance on outside food intake, higher frequency consumption of sugar-sweetened beverages and energy-dense fast foods and decreased physical activity levels are known as the lifestyles that contribute to obesity prevalence (Gupta et al. 2012). Indeed, these unhealthy lifestyles were likely to be moderated by obesogenic environment as a result of rapid urbanization and development. Moreover, Willms et al. (2003) suggested that different level of urbanization within geographical and demographical area might have different impact on obesity prevalence especially on children and adolescents. Terengganu is a state that is experiencing urbanization and development despite certain rural part that were least exposed to development as compared to the urban counterpart.

Previous studies had attempted to investigate the difference in body weight status between urban and rural adolescents in Malaysia (Moy et al. 2004). Naidu et al. (2013) and Lee et al. (2014) reported higher BMI among urban adolescents as compared to rural counterpart. However, study exploring the influence of rural and urban school location on body weight status in East Coast region especially in Terengganu is still lacking. A broader understanding of the influence of geographical and demographical on obesity prevalence may provide public health implication especially for Terengganu population. Therefore, the purpose of the present study was therefore to identify influence of school location within districts of Terengganu on body weight status among 10 to 17 years old school adolescents.

Methodology

Study Design and Subjects

The present cross-sectional baseline study was conducted from November 2014 to June 2015 involving 62,567 (92.7%) school adolescents (31,708 boys and 30,859 girls) aged 10 to 17 years, attending 366 primary schools ($n=35,460$) and 146 secondary schools ($n=27,107$) from all seven districts of Terengganu. From a total of 67,519 data collected from school adolescents, 62,567 were included in this study. Subjects were grouped into three school age groups, 10 to 12 years (Upper Primary), 13 to 15 years (Lower Secondary) and 16 to 17 years (Upper Secondary) based on the standard Malaysian public school staging system. In addition, subjects were also grouped according to school location and area of living district. The

classification of schools within districts as rural or urban was based on the Terengganu State Education Department (JPNT). Terengganu is located within the East Coast of Peninsular Malaysia. The seven districts in Terengganu State were Besut, Dungun, Hulu Terengganu, Kemaman, Kuala Terengganu, Marang and Setiu. This study was ethically approved by UniSZA Human Research Ethic (UHREC) and Terengganu State Education Department (JPNT) and was supported by the Ministry of Higher Education (MOHE).

Data Collection

Height, weight, gender, and age data were obtained from the first school term of 2015 National Fitness Standard (SEGAK) assessment test. SEGAK assessment refers to a comprehensive battery of physical fitness assessments devised by Ministry of Education (MOE) in 2005 and was fully implemented nationally in 2008. The SEGAK programme includes primary and secondary school adolescents and is carried out twice a year (i.e. in March and August) by physical/ health education (PE) teacher at schools. Five main components included in the assessments are measurement of BMI, step up, push-ups, partial curl-ups and, sit and reach test. The data of each student that completed the SEGAK test throughout Terengganu state were uploaded according to school by PE teacher into a web portal named Health Monitoring and Surveillance System (HEMS) (Fadzli et al. 2016). The web-based system was developed with an automated data pre-processing and analysis system to aid in SEGAK data collection especially in Terengganu state.

Anthropometry Assessments

Measurements of height and weight were conducted by PE teachers based on measurement protocol stipulated in the SEGAK manual (Ministry of Education, 2008), which took place within the school compound. The completed data of each student were uploaded into the specifically developed database in the HEMS web portal. Height and weight were measured using calibrated analogue health scales to the nearest 0.1 kg and 0.1 cm respectively. Data on height, weight, gender, and age were used to compute the BMI-for-age Z-score using WHO AnthroPlus software (World Health Organisation, 2009). Age of each subjects were calculated to the precise day by subtracting the date of birth from the date of measurement while the BMI were calculated by dividing body weight in kilograms (kg) by height in metre squared (m^2). All subjects were apparently healthy during data collection, and all measurements were taken in light sports attire without shoes during mornings or early afternoons i.e. between 8.30 am to 12.00 pm. BMI categories were defined using age- and sex- specific cut-off points relative to WHO 2007 classifications (World Health Organization, 2007) where z-score $> +1SD$ were classified as overweight, whilst obesity as having z-score $> +2SD$ and thinness as having z-score $< -2SD$.

Statistical Analyses

Data were analysed using SPSS-IBM (version 22.0) (IBM Corporation, New York, USA). A two-sided *P*-value of less than 0.05 was considered as statistically significant. Due to inappropriate data entry by the PE teachers, data on SEGAK assessment from several schools were not available. For analysis purposes, results which reported BMI value of below $-5SD$ or exceeded $+5SD$ were excluded as these data were the arbitrary cut points by NHMS (Institute of Public Health, 2011). Descriptive statistics were presented as means with their standard deviation or percentage of prevalence. Independent sample *t*-test was used to test the difference in mean of BMI between genders and school locations (rural vs. urban).

Results

Table 1 reports subjects' distribution in genders, age groups, school locations and districts. This cross-sectional study was performed among 62,567 school adolescents (50.7% boys and 49.2% girls) living in seven districts in Terengganu, Malaysia, representing 81.1% from total population of school adolescents aged 10 to 17 years in Terengganu. In total, 53.8% of school adolescents were from urban and 46.2% were from the rural schools. The highest number of school adolescents (41.3%) were from the capital district (Kuala Terengganu) followed by Kemaman (13.9%), Besut (12.0%), Dungun (11.0%), Marang (7.4%), Hulu Terengganu (7.3%) and Setiu (7.0%).

In all age groups, the mean BMI of both genders corresponded to the age and gender-specific normal z-score of WHO cut-off points (Table 2). There was a significant correlation between age and BMI among these adolescents ($P < 0.001$). Girls in 13 to 15 and 16 to 17 years old age groups had significantly higher BMI than boys ($P < 0.001$) but no significant difference was found in 10 to 12 years old age group. Significant difference was found in mean BMI of overall subjects between urban and rural school locations ($P < 0.001$). Post-hoc analysis indicated that BMI was higher among both boys and girls age 10 to 12 years in urban ($18.2 \pm 4.3 \text{ kg/m}^2$ and $18.2 \pm 4.2 \text{ kg/m}^2$) compared to rural ($17.9 \pm 4.2 \text{ kg/m}^2$ and $17.8 \pm 4.1 \text{ kg/m}^2$) school locations ($P < 0.001$). There was no significant difference in mean BMI between rural and urban locations in other age groups. Mean BMI within the rural and urban school locations was also significantly different between boys and girls in age groups of 13 to 15 and 16 to 17 years old ($P < 0.001$), however no difference was found in 10 to 12 years old age group.

Overall, by school location within districts, Dungun, Setiu, and Marang showed significant difference in mean BMI between rural and urban ($P < 0.001$) (Table 3). Urban schools in Dungun, Hulu Terengganu, Setiu and Marang reported significant higher mean BMI as compared to rural schools among adolescents age 10 to 12 years old. Whilst, urban schools in Kemaman and Kuala Terengganu reported higher mean BMI as compared to the rural counterpart among 16 to 17 years old adolescents. In addition, boy from urban schools within Hulu Terengganu, Setiu and Kuala Terengganu districts and boys from rural schools within Kemaman reported higher mean BMI than their counterparts among 10 to 12 years old. As for female, girls of 13 to 15 years old from rural schools in Kuala Terengganu reported higher mean BMI than urban schools, while girls of 16 to 17 years old from urban schools were found to have higher mean BMI than the rural schools.

Table 1:
Subjects distribution

Variables	10 – 12 years			13 – 15 years			16 – 17 years			Overall		
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
School location												
Rural	8393 (51.0)	805 (49. 0)	164 49	410 (51. 3)	388 (48. 7)	798 9	202 (45. 1)	246 (54. 9)	448 9	1451 (50. 2)	144 (49. 8)	28927
Urban	9738 (51.2)	927 (48. 8)	190 11	451 (53. 0)	401 (47. 0)	852 8	293 (48. 1)	316 (51. 9)	610 1	1719 (51. 1)	164 (48. 9)	33640

District

Besut	2124	207		116	109	226	498	532	103	3789	370	7495
	(50.6)	5	419	7	9	6	(48.3)	(51.7)	0	(50.6)	6	(49.4)
Rural	1284	129		908	866	177	345	385	730	2537	254	5086
	(49.7)	8	258	(51.2)	(48.8)	4	(47.3)	(52.7)		(49.9)	9	(50.1)
Urban	840	777	161	259	233	492	153	147	300	1252	115	2409
	(51.9)	(48.1)	7	(52.6)	(47.4)		(51.0)	(49.0)		(52.0)	7	(48.0)
Dungun	1870	183	370	992	966	195	629	624	125	3491	342	6913
	(50.5)	2	2	(50.7)	(49.3)	8	(50.2)	(49.8)	3	(50.5)	2	(49.5)
Rural	911	870	178	295	290	585	181	171	352	1387	133	2718
	(51.2)	(48.8)	1	(50.4)	(49.6)		(51.4)	(48.6)		(51.0)	1	(49.0)
Urban	959	962	192	697	676	137	448	453	901	2104	209	4195
	(49.9)	(50.1)	1	(50.8)	(49.2)	3	(49.7)	(50.3)		(50.2)	1	(49.8)
Hulu Terengganu	1111	100	212	784	644	142	532	516	104	2427	216	4596
	(52.4)	9	0	(54.9)	(45.1)	8	(50.8)	(49.2)	8	(52.8)	9	(47.2)
Rural	770	687	145	574	485	106	370	383	753	1714	155	3269
	(52.8)	(47.2)	7	(54.2)	(45.8)	9	(49.1)	(50.9)		(52.4)	5	(47.6)
Urban	341	322	663	210	159	369	162	133	295	713	614	1327
	(51.4)	(48.6)		(56.9)	(43.1)		(54.9)	(45.1)		(53.7)	3	(46.3)
Kemaman	2905	280	571	904	936	184	497	621	111	4306	436	8671
	(50.8)	8	3	(49.1)	(50.9)	0	(44.5)	(55.5)	8	(49.7)	5	(50.3)
Rural	1736	170	344	542	620	116	269	363	632	2547	268	5236
	(50.4)	6	2	(46.6)	(53.4)	2	(42.6)	(57.4)		(48.6)	9	(51.4)

Urban	1169	110	227	362	316	678	228	258	486	1759	167	3435
	(51.5)	2	1	(53.4)	(46.6)		(46.9)	(53.1)		(51.2)	6	
Kuala Terengganu	7780	746	152	344	288	633	196	232	429	1319	126	25869
	(51.0)	6	46	(54.4)	(45.6)	0	7	6	3	1	78	(49.0)
Rural	1973	191	388	797	606	140	312	486	798	3082	300	6084
	(50.8)	0	3	(56.8)	(43.2)	3	(39.1)	(60.9)		(50.7)	2	(49.3)
Urban	5807	555	113	246	228	492	165	184	349	1010	967	19785
	(51.1)	6	63	(53.7)	(46.3)	7	5	0	5	9	6	(48.9)
Setiu	1222	113	235	511	620	113	426	495	921	2159	224	4406
	(51.9)	2	4	(45.2)	(54.8)	1	(46.3)	(53.7)		(49.0)	7	(51.0)
Rural	976	901	187	170	272	442	136	161	297	1282	133	2616
	(52.0)	0	7	(38.5)	(61.5)		(45.8)	(54.2)		(49.0)	4	(51.0)
Urban	246	231	477	341	348	689	290	334	634	877	913	1790
	(51.6)	4		(49.5)	(50.5)		(46.5)	(53.5)		(49.0)	0	(51.0)
Marang	1119	100	212	816	748	156	410	517	927	2345	227	4617
	(52.6)	7	6	(52.2)	(47.8)	4	(44.2)	(55.8)		(50.8)	2	(49.2)
Rural	743	684	142	816	748	156	410	417	927	1969	194	3918
	(52.1)	9	7	(52.2)	(47.8)	4	(44.2)	(55.8)		(50.3)	9	(49.7)
Urban	376	323	699	0	0	0	0	0		376	323	699
	(53.8)	2								(53.8)	(46.2)	
Total	181	173	354	861	789	165	495	563	105	3170	308	62567
	31(51.1)	29	60	(52.8)	(47.8)	17	(46.9)	(53.1)	90	(50.8)	59	(49.3)

Data are n (%).

Percentage of BMI categories by age groups within school location in each district are presented in Table 4. Overall, the highest prevalence of obesity in total, boys and girls within urban school location were found in Marang 15.3%, 17.8% and 15.3%, respectively. Contrarily,

rural school location within Kuala Terengganu had the highest prevalence of obesity in total, boys and girl subjects were subjected to 14.1%, 16.3% and 11.9% respectively. As for overweight, rural Marang had the highest prevalence (15.2%) while Setiu had the highest prevalence for urban school location (16.1%). Percentage of overweight were found to be higher in girls while boys reported higher percentage of obesity in rural schools in Besut, Hulu Terengganu, Kemaman and Kuala Terengganu districts; and urban schools in Dungun, Kemaman and Kuala Terengganu districts among 10 to 12 years old adolescents. Similar trends were reported among 13 to 15 years old adolescents in rural schools in Besut and Kemaman districts, and in urban schools in Dungun and Kuala Terengganu districts. Besides, girls aged 13 to 15 years from rural schools in Kuala Terengganu and Marang districts reported higher percentage of overweight and obesity as compared to boys. In addition, girls reported higher percentage of overweight while boys reported higher percentage of obesity in rural schools in Hulu Terengganu, Kemaman and Marang districts and urban schools in Kuala Terengganu among adolescents aged 16 to 17 years old.

Table 2:

Anthropometric measurements by gender and age groups

	10 – 12 years			13 – 15 years			16 – 17 years			All		
	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls	All
Age (year)										12.7 ± 12.8	12.7	
										2.2 ± 2.3	± 2.3	± 2.3
Height (cm)	137.4 ± 8.7	138.8 ± 9.1	138.1 ± 8.9	155.9 ± 9.9	151.9 ± 6.6	154.0 ± 8.8	165.0 ± 7.2	154.9 ± 5.9	159.6 ± 8.2	146.7 ± 14.3	145.1 ± 10.8	145.9 ± 12.7
Weight (kg)	34.5 ± 10.9	35.2 ± 10.8	34.9 ± 10.8	49.3 ± 14.2	48.0 ± 11.9	48.7 ± 13.1	57.9 ± 13.6	51.8 ± 11.7	54.7 ± 13.0	42.2 ± 15.4	41.5 ± 13.4	41.9 ± 14.4
BMI (kg/m²)	18.0 ± 4.3	18.0 ± 4.2	18.0 ± 4.2	20.1 ± 4.6	20.7 ± 4.6 ^a	20.4 ± 4.6	21.2 ± 4.5	21.5 ± 4.4 ^a	21.4 ± 4.5	19.1 ± 4.6	19.3 ± 4.6 ^a	19.2 ± 4.6
School location												
Rural												
Height (cm)	137.2 ± 8.7	138.6 ± 9.1	137.9 ± 8.9	155.9 ± 9.9	151.9 ± 6.6	154.0 ± 8.7	165.7 ± 7.1	154.8 ± 5.9	159.7 ± 8.4	146.5 ± 14.3	145.0 ± 10.8	145.7 ± 12.7
Weight (kg)	34.2 ± 10.8	34.7 ± 10.6	34.5 ± 10.7	49.4 ± 14.0	48.1 ± 11.7	48.7 ± 13.0	58.5 ± 14.0	51.7 ± 11.9	54.8 ± 13.3	41.9 ± 15.4	41.2 ± 13.4	41.6 ± 14.5
BMI (kg/m ²)	17.9 ± 4.2 ^b	17.8 ± 4.1 ^b	17.9 ± 4.2	20.1 ± 4.6 ^a	20.7 ± 4.6	20.4 ± 4.6	21.2 ± 4.6 ^a	21.5 ± 4.5	21.4 ± 4.5	19.0 ± 4.6 ^{ab}	19.2 ± 4.6 ^b	19.1 ± 4.6
Urban												
Height (cm)	137.5 ± 8.7	139.0 ± 9.1	138.2 ± 8.9	155.9 ± 10.0	151.9 ± 6.6	154.0 ± 8.8	164.5 ± 7.3	155.1 ± 5.8	159.6 ± 8.1	146.9 ± 14.2	145.2 ± 10.7	146.1 ± 12.7
Weight (kg)	34.8 ± 11.0	35.6 ± 10.9	35.2 ± 10.9	49.2 ± 14.3	48.0 ± 12.0	48.6 ± 13.3	57.4 ± 13.4	51.9 ± 11.6	54.6 ± 12.8	42.5 ± 15.4	41.8 ± 13.3	42.1 ± 14.4

BMI (kg/m ²)	18.2 ± 4.3	18.2 ± 4.2	18.2 ± 4.3	20.1 ± 4.7 ^a	20.7 ± 4.6	20.4 ± 4.7	21.2 ± 4.4 ^a	21.5 ± 4.4	21.4 ± 4.4	19.2 ± 4.6 ^a	19.4 ± 4.6	19.3 ± 4.6
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Data are mean ± SD

^a Significant difference in mean of BMI between genders in age groups (Independent sample t-test)

^b Significant difference in mean of BMI between school locations within genders in age groups (Independent sample t-test)

Table 3:

Mean of BMI between school location within districts and gender within age groups

District	10 – 12 years			13 – 15 years			16 – 17 years			All		
	ys	rls		ys	rls		ys	rls		ys	rls	
Besut	17.8 ± 4.0	17.9 ± 4.1	17.8 ± 4.0	20.3 ± 4.7	20.7 ± 4.7	20.5 ± 4.7	21.0 ± 4.2	21.4 ± 4.4	21.2 ± 4.3	19.0 ± 4.5	19.2 ± 4.6	19.1 ± 4.5
Rural	17.7 ± 4.2	17.8 ± 4.0	17.8 ± 4.1	20.4 ± 4.6	20.7 ± 4.6	20.5 ± 4.6	21.1 ± 4.3	21.2 ± 4.3	21.2 ± 4.3	19.1 ± 4.6	19.3 ± 4.5	19.2 ± 4.6 ^a
Urbar	17.8 ± 3.8	18.1 ± 4.1	18.0 ± 4.0	19.9 ± 5.0	20.9 ± 5.2	20.4 ± 5.1	20.7 ± 3.9	21.9 ± 4.7	21.3 ± 4.4	18.6 ± 4.3	19.2 ± 4.7	18.8 ± 4.5
Dungun	18.0 ± 4.0	18.2 ± 4.1	18.1 ± 4.1	20.2 ± 4.7	21.0 ± 4.6	20.6 ± 4.7	21.4 ± 4.3	21.8 ± 4.1	21.6 ± 4.2	19.2 ± 4.5	19.6 ± 4.5	19.4 ± 4.5
Rural	17.8 ± 3.9	17.9 ± 4.1 ^c	17.8 ± 3.9 ^a	20.2 ± 5.0	20.7 ± 4.6	20.5 ± 4.9	21.3 ± 4.3	21.9 ± 4.2	21.6 ± 4.3	18.8 ± 4.4	19.0 ± 4.5	18.9 ± 4.5 ^a
Urbar	18.2 ± 4.1	18.5 ± 4.2	18.4 ± 4.1	20.2 ± 4.5	21.1 ± 4.6	20.6 ± 4.6	21.4 ± 4.3	21.8 ± 4.0	21.6 ± 4.2	19.5 ± 4.5	20.1 ± 4.5	19.8 ± 4.5
Hulu Terenggar	17.5 ± 4.2	17.6 ± 3.9	17.5 ± 4.1	19.9 ± 4.4	20.6 ± 4.3	20.2 ± 4.4	21.3 ± 4.5	21.4 ± 4.6	21.4 ± 4.5	19.1 ± 4.6	19.4 ± 4.5	19.2 ± 4.6
Rural	17.3 ± 4.3 ^b	17.4 ± 3.9	17.4 ± 4.1 ^a	20 ± 4.4	20.6 ± 4.3	20.3 ± 4.3	21.3 ± 4.7	21.4 ± 4.3	21.4 ± 4.5	19.1 ± 4.7	19.4 ± 4.5	19.2 ± 4.6
Urbar	17.9 ± 3.9	17.9 ± 3.9	17.9 ± 3.9	19.5 ± 4.5	20.5 ± 4.5	19.9 ± 4.6	21.2 ± 4.1	21.5 ± 5.4	21.3 ± 4.7	19.2 ± 4.4	19.3 ± 4.7	19.2 ± 4.5
Kemaman	18.0 ± 4.3	17.9 ± 4.2	18.0 ± 4.3	20.1 ± 4.8	20.5 ± 4.5	20.3 ± 4.6	21.2 ± 4.8	21.6 ± 4.3	21.4 ± 4.5	18.8 ± 4.6	19.0 ± 4.5	18.9 ± 4.6
Rural	18.2 ± 4.2 ^b	17.8 ± 4.1	18.0 ± 4.2	20.1 ± 4.8	20.3 ± 4.2	20.2 ± 4.5	20.9 ± 5.1	21.3 ± 4.2 ^c	21.2 ± 4.6 ^a	18.9 ± 4.6	18.9 ± 4.4	18.9 ± 4.5
Urbar	17.7 ± 4.3	18.1 ± 4.4	17.9 ± 4.3	20.0 ± 4.8	20.7 ± 4.9	20.3 ± 4.8	21.5 ± 4.3	22.1 ± 4.5	21.8 ± 4.4	18.7 ± 4.6	19.2 ± 4.8	18.9 ± 4.7
Kuala Terenggar	18.3 ± 4.5	18 ± 4.3	18 ± 4.4	20.1 ± 4.7	20.7 ± 4.6	20.4 ± 4.6	21.2 ± 4.6	21.5 ± 4.5	21.4 ± 4.6	19.2 ± 4.7	19.3 ± 4.6	19.3 ± 4.7
Rural	18.4 ± 4.7	18.1 ± 4.4	18.3 ± 4.5	20.1 ± 4.1	21.1 ± 4.8 ^c	20.6 ± 4.4	21.7 ± 5.1	21.9 ± 4.9 ^c	21.9 ± 5.0 ^a	19.2 ± 4.7	19.4 ± 4.8	19.3 ± 4.8

Urbar	18.3 ± 4.5	18.2 ± 4.3	18.2 ± 4.4	20.1 ± 4.8	20.6 ± 4.8	20.3 ± 4.7	21.1 4.5	± 21.3 ± 4.4	21.2 ± 4.5	19.2 ± 4.7	19.3 ± 4.6	19.3 ± 4.7
Setiu	17.7 ± 3.9	17.8 ± 3.9	17.8 ± 3.9	19.8 ± 4.1	20.7 ± 4.4	20.3 ± 4.3	21.0 4.1	± 21.6 ± 4.0	21.3 ± 4.1	18.9 ± 4.2	19.4 ± 4.4	19.1 ± 4.3
Rural	17.6 ± 3.8 _b	17.7 ± 3.9	17.6 ± 3.8 _a	20.2 ± 4.9	20.3 ± 4.3	20.2 ± 4.5	20.9 3.9	± 21.4 ± 4.0	21.2 ± 4.0	18.3 ± 4.2	18.7 ± 4.2	18.5 ± 4.2 _a
Urbar	18.4 ± 4.0	18.2 ± 4.0	18.3 ± 4.0	19.7 ± 3.7	21.0 ± 4.6	20.3 ± 4.2	21.0 4.2	± 21.7 ± 3.9	21.4 ± 4.1	19.8 ± 4.1	20.6 ± 4.4	20.2 ± 4.3
Marang	17.8 ± 4.0	17.8 ± 4.0	17.8 ± 4.0	19.8 ± 4.6	21.1 ± 4.8	20.4 ± 4.7	21.3 4.5	± 21.5 ± 4.7	21.4 ± 4.6	19.1 ± 4.5	19.8 ± 4.8	19.4 ± 4.7
Rural	17.5 ± 3.8 _b	17.7 ± 3.9 _c	17.6 ± 3.9 _a	19.8 ± 4.6	21.1 ± 4.8	20.4 ± 4.8	21.3 4.5	± 21.5 ± 4.7	21.4 ± 4.6	19.3 ± 4.6	20.0 ± 4.8	19.6 ± 4.7 _a
Urbar	18.3 ± 4.4	18.3 ± 4.1	18.3 ± 4.2	Data not available			Data available	not		18.3 ± 4.4	18.3 ± 4.1	18.3 ± 4.2

Data are mean ± SD

^aRural vs. urban in district within age groups (independent sample t-test)

^bRural vs. urban in boys (independent sample t-test)

^cRural vs. urban in girls (independent sample t-test)

Table 4:

Percentage of BMI categories by age group within school location

	12 years	15 years	17 years	P-value ^a (χ)
	ue ^a	ue ^a	ue ^a	
Besut				
Rural				<0.0
Thin	5)	2))	01
Norm				(30.
al				4)
Overwei				
ght				
Obese				
Urban				0.30
Thin	!))	.	5
Norm				(3.6
al				2)
Overwei				
ght				
Obese				

Dungun

Rural				0.269
Thin	.	;	↓	
)))	(3.93)
Normal				
Overweight				
Obese				
Urban				<0.001
Thin)	.	↓	
	2)	4)		(27.69)
Normal				
Overweight				
Obese				

Hulu Terengganu

Rural				<0.001
Thin	.	↓)	
	1)))	(32.47)
Normal				
Overweight				
Obese				
Urban				0.853
Thin)	;)	
)))	(0.78)
Normal				
Overweight				
Obese				

Kemaman

Rural				<0.001
Thin)1))1	
	5))	8)	(53.25)
Normal				

Overweight
Obese

^a BMI categories versus genders in age groups (Pearson's chi-square test)

Table 4: (continued)

	10 – 12 years				13 - 15 years				16 – 17 years			All				
	Boys	Girls	All	P-value ^a (χ)	Boys	Girls	All	P-value ^a (χ)	Boys	Girls	All	P-value ^a (χ)	Boys	Girls	All	P-value ^a (χ)
Kemama																
<i>Urban</i>				<0.001								0.151				<0.001
Thin	16.3	10.8	13.6	(23.32)	7.2	6.0	6.6	(0.84)	5.7	3.1	4.3	(5.31)	13.0	8.7	10.9	(27.3)
Normal	53.5	59.8	56.5		65.7	66.1	65.9		73.2	73.3	73.3		58.6	63.1	60.8	
Overweight	14.5	17.0	15.7		14.4	16.1	15.2		11.4	16.7	14.2		14.0	16.8	15.4	
Obese	15.8	12.4	14.2		12.7	11.7	12.2		9.6	7.0	8.2		14.4	11.5	13.0	
Kuala Grogganu																
<i>Rural</i>				<0.001								0.283				<0.001
Thin	10.8	9.7	10.2	(44.76)	5.8	4.5	5.2	(8.31)	6.1	3.5	4.5	(3.81)	9.0	7.6	8.3	(31.7)
Normal	55.9	62.3	59.0		68.4	62.9	66.0		70.8	75.5	73.7		60.6	64.5	62.6	
Overweight	13.3	15.5	14.4		15.9	20.0	17.7		14.1	12.6	13.2		14.0	16.0	15.0	
Obese	20.0	12.5	16.3		9.9	12.7	11.1		9.0	8.4	8.6		16.3	11.9	14.1	
<i>Urban</i>				<0.001				<0.001				0.011				<0.001
Thin	10.2	10.3	10.3	(83.7)	8.1	6.0	7.1	(22.81)	7.1	5.3	6.2	(11.4)	9.2	8.4	8.8	(109.5)
Normal	56.7	61.2	58.9		64.0	68.3	66.0		73.0	75.1	74.1		61.3	65.5	63.4	
Overweight	15.0	16.6	15.8		15.5	16.4	15.9		11.3	12.9	12.2		14.5	15.9	15.2	
Obese	18.0	11.9	15.0		12.4	9.3	10.9		8.6	6.6	7.6		15.0	10.3	12.7	
Setiu Rural																

Malaysia which reported higher mean BMI in girls than in boys (Adeyemi et al. 2014; Teo et al. 2014). This may be due to physiological (hormonal) and psychological (cognitive and emotional) changes that accompany the adolescents' growth spurt. Spear (2002) reported that, on average, girls begin their adolescent growth spurt at 10 years and grow at peak velocity at about 12 years old. However, these ages vary from country to country, being the lowest in developed countries and the highest in poor countries (Parent et al. 2003). However, in boys, the adolescent growth spurt starts around 12 years of age and will overtake the growth in girls in one or two years (World Health Organisation, 2006). Besides, the degree of pubertal maturation in girls could negatively influence the level of physical activity (PA). The level of physical activity during adolescents also decreases with increasing age as the probability to be inactive increase 1.5 times per year of age thus correlate with increase in body weight (Finne et al. 2011).

In agreement with the SEANUT and NHMS 2011 studies, for boys and girls, the mean BMI was higher for boys and girls in the urban compared to rural particularly in 10 to 12 years old age group (Institute of Public Health, 2011; Poh et al. 2013). Urbanization and development do not only change the environment and physical landscapes but also cause socioeconomic and nutritional trajectories leading to obesogenic lifestyle change. Different socioeconomic and occupational status might have also changed the dietary intake pattern to higher consumption of sugar-sweetened beverages, processed fast foods and higher calories-outside foods (Gupta et al. 2012). In addition, previous studies showed that, urbanised school adolescents particularly in Malaysia were also physically inactive compared to their rural counterpart (Lee et al. 2014; Wong and Parikh, 2016). Difference in built environment and security level in urban areas offer limited opportunities to engage with physical activities (Sjöberg et al. 2011). Interestingly, a recent review and meta-analysis on rural-urban difference of obesity among American children and adolescent found that rural population were 26% at higher risk of becoming obese compared to the urban population (Johnson, 2015). Nevertheless, the review also found that, obese adolescents in rural were more physically active than obese adolescents in urban population.

Based on the z-score BMI categories, the highest prevalence of obesity were from urban Marang (15.3%) and followed by rural Kuala Terengganu (14.1%) which were higher than the national prevalence and Terengganu state for 2015 (Institute of Public Health, 2015). Compared to the prevalence of obesity in Terengganu in 2015, the prevalence had increased by almost 50% in both rural and urban school locations. Finding from current study showed that prevalence of thinness was lower compared to NHMS 2015. Majority of the rural schools within districts reported higher prevalence of thinness compared to urban location except for Kemaman and Kuala Terengganu districts. The findings indicated contradicting trend compared to the national study in the prevalence of thinness which was higher in urban compared to the rural area (8.0% vs. 7.2%). Both prevalence of thinness and obesity decreased with advancing age in all districts within school location except for Besut and Hulu Terengganu districts.

This study covered all adolescents from all government schools in Terengganu. It shows the real trend in this population, thus reducing the risk of under- or over-estimation of prevalence. The fact that this study covered all students from all government schools in Terengganu, it had produced the actual prevalence of obesity and thinness among this population in each district in Terengganu. The data presented in this study were cross-sectional by nature thus casual relationships cannot be inferred from the associations presented. Anthropometric measurements conducted by PE teachers in each school may had

introduced an inter-researcher variability and inaccuracy. However, since the PE teachers conducted the anthropometry measurements during SEGAK assessment at regular basis, they were fully trained with accurate method and validated tools.

Conclusion

In summary, this school-based cross sectional study on 62,567 school adolescents in whole Terengganu had indicated a substantial increment of obesity prevalence regardless of school locations compared to previous years. The prevalence of obesity was found to be highest in urban schools in Marang district and rural schools in Kuala Terengganu district. The rapid increase in prevalence of obesity and overweight in both urban and rural locations warrant equal public health attention in both locations. In addition, this finding also suggest, obesity might show further increase as urbanisation progresses, thus broader understanding regarding underlying factors related to obesity among this population should be explored.

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