

Original Research Article

A study on trans generational anthropometric patterns and its epidemiological determinants among females in Thrissur district

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ABSTRACT

Background: As the global burden of non-communicable is increasing, people are falling prey to metabolic diseases due to incorporation of unhealthy lifestyle in daily life. Assessing anthropometric measurements of mothers and daughters helps to identify non-communicable diseases such as type 2 diabetes mellitus, obesity, cardiovascular diseases at an early stage. This study assesses the transgenerational anthropometric patterns and epidemiological determinants in females in Thrissur district and compare the anthropometric patterns between mothers and daughters.

Methods: A cross sectional study was conducted between mothers and daughters in Thrissur district, Kerala, March 2020 to May 2022. Systemic random sampling technique was used and 92 daughters and their mothers were included in the study. Data was collected using an interviewer-administered questionnaire consisting of socio demographic variables, anthropometric measurements, physical activity and nutritional assessment.

Results: The mean height, weight and other anthropometric measurements of both mothers and daughters were found to be very close to each other. Sedentary lifestyle such as no exercise habit, low duration of exercise, spending greater screen time hours, consuming less than 3 meals/day was observed. A significant association exists with daughters' waist circumference with the mothers' (p value =0.002), waist height ratio of daughters' with mothers' (p value =0.009) and waist hip ratio (p value =0.032).

Conclusions: The study concluded that correlation between mother's and daughter's BMI are not statistically significant. It was also observed that mothers anthropometric pattern (except BMI) play a vital role in daughter's anthropometric patterns.

Keywords: Anthropometric pattern, Epidemiological determinants, Lifestyle, Non communicable diseases, Obesity, Thrissur

INTRODUCTION

Anthropometry is a science that quantitatively deals with non-invasive measurement techniques of the human body.¹ Anthropometric measurement are useful in assessment of data for physical fitness for a heterogeneous population, starting from children to athletes and to the geriatrics. One of the most useful

clinical applications of anthropometric data is to explain obesity. Obesity is a substantial modifiable risk factor for stroke, cardiovascular disease, diabetes mellitus, hypertension, and dyslipidemia. Body mass index (BMI) is the most sensible choice owing to its long history of use waist-to-height ratio, waist circumference, and waist-to-hip ratio are other methods for determining obesity.² A larger anthropometric measurement resulted in a higher chances ratio for hyperglycemia, dyslipidemia, and

hypertension.² While anthropometric data can be used to determine obesity in adults, it cannot be used to assess nutritional status in children.

Childhood obesity is a major public health issue all over the world.^{3,4} Understanding the causes of obesity is critical for establishing successful preventative programs. Recent studies proved that obesity is prevalent among south Indian females.⁵ Added to this, the concept of same-sex role modelling supports the greater influence that could be brought on female children than their male counterparts by mothers. Epidemiological determinants are the causes and other factors that influence the disease occurrence and health related event such as (genetic factor, physical activity, socio-economic status, eating habits. Frequent anthropometric measurements comprise of height, weight, mid-upper arm circumference (MUAC), skinfold and head circumference.⁶ Some anthropometric measures used to assess obesity include BMI, hip circumference (HC), waist circumference (WC), waist-to-hip ratio (WHR; ratio between WC and HC), waist-to-stature ratio (WSR; ratio between WC and height), and body adiposity index (BAI; HC divided by height 1.5 and subtracting 18 from the result).⁷ In clinical practice, indicators based on height and weight measures, such as BMI or weight for height, are used to determine overweight and obesity.

Global obesity index falls short of being the best predictor of risk factors for non-communicable diseases. Studies have shown that the waist circumference is a more accurate indicator of adult high-risk status than the sex- and age-specific BMI.⁸ A higher incidence of obesity is found in the rural women population of Kerala. There is a knowledge gap that exists between the understanding of transgenerational anthropometric patterns and its determinant among females. Not enough evidence is available to support for the same in Kerala. The primary objectives of the study were to assess the anthropometric patterns (height, weight, body mass index, waist-height ratio, waist hip ratio, conicity- index) among adolescent girls, and their mothers in Thrissur district and then to investigate the epidemiological factors associated with anthropometric patterns among adolescent girls and their mothers. Finally, to determine the correlation between anthropometric patterns of adolescent girls, and their mothers in Thrissur district. As overweight and obesity are highly preventable, an earlier identification of problems if addressed, increases the possibility of treatment and success in ameliorating other health related consequences.

METHODS

Study design

A cross sectional study was conducted at a sub center and in Thrissur district for a period of March 2020 to May 2022. Adolescent girls and their mothers at the sub center were included. Exclusion criteria include history of

endocrine disorders, surgical operations, myocardial infarction, cerebrovascular accidents with in last three months, persons on corticosteroid, insulin or oral contraceptive pills, people undergoing any type of specific diet and pregnancy.

Sample size

Sample size was calculated from the cross-sectional analytical study mother- daughter correlation of central obesity and other non-communicable disease using tehran lipid and glucose study, waist height ratio between mother and daughter the correlation value was found to be 0.28.⁹ BMI is determined by dividing the body weight, stated in kilos, by the square of the height, expressed in meters (kg/m²).¹⁰ Waist height ratio (WHtR) is calculated by dividing the waist circumference measurement (in cm) by the height (in cm) and waist hip ratio (WHR) is calculated by waist circumference (cm) divided by hip circumference (cm). Sample size calculated was 92 in each group.

$$N = \frac{(Z_{1-\beta} + Z_{1-\alpha/2})^2}{r^2 \cdot 1 - r^2}$$

where; r= correlation coefficient = 0.28, $Z_{1-\alpha/2} = 1.96$ at Desired confidence level=95% $1 - \beta = 0.84$ at power 80%

=92 each.

$$\text{Conicity index} = \frac{\text{waist circumference(m)}}{0.109 \sqrt{\text{Weight (kg)/Height (m)}}}$$

Sampling technique

The study subject was selected from the sub center using systematic random sampling. The list of adolescent girls was obtained from sub center Junior Public Health Nurse (JPHN) listed number of adolescent girls -498 (data from survey 2019). Sample size calculated was 92 each. The sampling interval k, 4.5~ 4. One street was randomly selected from the study area and first house was identified by currency method. If the selected house didn't have sample unit adjacent house was screened till, we reached the first sampling unit. Fourth house from the first selected house was the next sample. Sampling was continued till we reached required sample size.

Methods of data collection

After obtaining written informed consent from the participants' data was collected using a pretested standard questionnaire by interview schedule and anthropometric measurements was obtained using standard scales. A structured questionnaire consisting of three parts- socio-demographic data, anthropometric measurement and physical activity and nutritional assessment was used. Weight and height was measured using weighing scale and stadiometer respectively. Waist circumference, hip

circumference measurements were assessed using a flexible anthropometric inelastic fiberglass tape. For measuring weight, candidate was asked to stand on the base of the weighing scale barefoot, upright, and upper limbs hanging beside the body. With the aid of a cursor the distance between the plantar region and the vertex was determined. The candidate was asked to remain in inspiratory apnea, head aligned in Frankfurt plane parallel to the ground. Waist circumference measurements was determined in standing position, relaxed abdomen and arms hanging beside the body. Tape was positioned in the horizontal plane, encircling the natural waist line, coincident point between the last costal arch and the iliac crest, without skin compression was noted. Hip circumference was taken using the tape placed at the maximum extension of the buttocks.

Data analysis

The data obtained was coded and entered in Microsoft Excel sheet and analyzed using the statistical software, Statistical Package for Social Sciences (SPSS Version-23). Results was expressed in percentage. Mean with a standard deviation (SD) of each of the anthropometric measures were estimated. The correlation between anthropometric measurement was analysed by correlation co-efficient and linear regression. The epidemiological factors contributing anthropometric measurement were assessed by logistic regression.

Ethical consideration

Institutional research committee and ethical committee clearance was obtained prior to starting the study (11/IEC/21/AIMS-01 dated 18-02-2021). Permission to conduct the study was obtained from the health authorities of the study area. The informed and written consent was obtained from each of the study participant. During data collection and throughout the research process the ethical conduct was maintained. Strict confidentiality of information was maintained.

RESULTS

Sociodemographic profile of maternal and daughter population

The socio-demographic profile of the maternal and daughter population is discussed with regard to age, education, occupation, religion, type of family, socioeconomic status, age at marriage and occupation. A total of 184 participants were included in the study comprising of 92 mothers and 92 daughters. 70.7% maternal population belonged to 41-50 years while the 77.2% of daughter population belonged to 17-19 years' age group. Around 25 (27.2%) participants belonged to Upper class while 18 (19.6%) participants belonged to lower class. More than half of the participants (60.9%) were unemployed while only 31 (33.7%) participants were skilled professionals. 45.7% mothers were having a

PG professional degree. The age group of mother at the time of child birth of their daughter was in the range of 26-35 years in 52%, 18-25 years in 41.1% and 36-45 years in 2.4%. 73.9% of daughters had birthweight range between 2.5-4.2 kg while 34.8% were less than 2.5kg.

Anthropometric measurements of the study population

The values of anthropometric measurements of mother and daughter are very close to each other. In physical activity and nutritional assessment, around 34 (37%) mothers and 31 (33.7%) daughters had the habit of performing physical activity while 58 (63%) mothers and 61 (66.3%) daughters do not have the habit of performing physical activity. 58 (63%) mothers and 61 (66.3%) daughters did not do any exercise. A total number of 43 (46.7%) daughters had screen time of 4-7 hours while 55 (59.8%) mothers had screen time of 1-3 hours. In nutrition and dietary assessment, there were 74 (80.4%) mothers and 61 (66.3%) daughters who consumed less than three meals a day. While measuring the frequency of snacks per day, evening snacks were consumed by 70 (76.1%) mothers and 58 (63%) daughters every day 11 (12%) mothers and 19 (20.7%) daughters snacked in between all meals, while 8 (8.7%) daughters had the habit of grazing food throughout the day. Eating disorderly (eating late night, Breakfast in afternoon) (39.1%) and sometimes eating while watching TV (42.4%) was prominent among maternal population. The eating behavior of daughters reveals a different result where sometimes while watching TV, sometimes eating when bored and sometimes disorderly eating (late night, Breakfast in afternoon) habits is attributed to 51 (55.4%), 50 (54.4%) and 41 (44.6%) respectively. Diet intake of mother have a greater intake of dairy 48 (52.2%), fruits 60 (67.4%), vegetables 62 (67.4%) per week compared to daughters, while daughters consume more non veg items 62 (67.4%) per week. 78.2% mothers consumed fried snacks less than once a week from outside which was more in comparison to the daughters (64.1%). Consumption of fried food at home 1-3 times per week is 44.6% among mothers and 37% in daughters. Both the mothers and daughters had the habit of eating breakfast, lunch and dinner at home rather than eating outside. 82.6% of mothers and 87% of daughters had a calorie intake of 1200-2500 J/kcal. Habit of taking supplementation among daughter population was 13 (14.1%). Both 77 (83.7%) mothers and 64 (69.6%) daughters had adequate sleep duration of 5-9 hours per day.

Correlation between mother's and daughter's anthropometric pattern was investigated. The correlation analysis reports mother height and daughter height ($r=0.329$, p value=0.001), mother weight and daughter weight ($r=0.218$, p value=0.036), mother waist circumference and daughter waist circumference ($r=0.432$, p value=0.001), mother hip circumference and daughter hip circumference ($r=0.370$, p value=0.001), mother waist hip ratio and daughter waist hip ratio

($r=0.531$, p value= 0.001), mother waist–height ratio and daughter waist-height ratio ($r=0.354$, p value= 0.001) and mothers conicity index and daughter conicity index

($r=0.427$, p value= 0.001) as statistically significant (Table 1).

Table 1: Correlation analysis between mothers' and daughters' anthropometric pattern.

Correlation b/w mothers' and daughters' anthropometric pattern	Pearson correlation analysis		Linear regression analysis	
	Correlation Coefficient(r)	P value	Beta coefficient	P value
Mothers' height and daughters' height	0.329	0.001	0.449	0.001
Mothers' weight and daughters' weight	0.218	0.036	0.239	0.036
Mothers' BMI and daughters' BMI	0.134	0.204	0.107	0.204
Mothers' waist and daughters' waist circumference	0.432	0.001	0.386	0.001
Mothers' hip circumference and daughters' hip circumference	0.370	0.001	0.266	0.001
Mothers' waist hip ratio and daughters' waist hip ratio	0.531	.001	0.429	0.001
Mothers' waist - height ratio and daughters' waist - height ratio	0.354	.001	0.328	0.001
Mothers' conicity index and daughters' conicity index	0.427	.001	0.392	0.001

Table 2: Bivariate analysis of factors contributing to daughters' BMI.

Factors	B	Odds (Unadjusted)	95% C.I. of odd		
			Lower	Upper	P value
Exercise regularly	-6.185	0.002	0.000	5.067	0.121
Hours of exercise	1.633	5.117	0.968	27.036	0.055
Screen time	0.001	1.001	0.995	1.007	0.792
Meals/day	-1.115	0.328	0.115	0.935	0.037
Skip meal	-0.135	0.873	0.155	4.932	0.878
Frequency of snacking	-2.179	0.113	0.01	0.769	0.026
Having fried snacks	0.133	1.143	0.063	20.757	0.928
Having sweets	5.012	150.154	1.322	17058.919	0.038
Eat while standing	1.389	4.010	0.979	16.423	0.053
Eat while watching TV	1.121	3.067	0.713	13.180	0.132
Eat when bored	1.392	4.021	0.737	21.945	0.108
Eat when angry	-2.021	0.133	0.023	0.768	0.024
Eat disorderly (eat late at night	-1.111	0.329	0.105	1.033	0.057
Dairy serving/week	-0.017	0.983	0.787	1.227	0.879
Fruits serving/week	-0.202	0.817	0.546	1.223	0.326
Vegetable serving/week	-0.153	0.858	0.669	1.101	0.230
Nonveg serving/week	-0.099	0.906	0.705	1.164	0.439
Fried food at home	-0.181	0.834	0.251	2.774	0.768
Fried food outside	1.566	4.786	0.637	35.975	0.128
Lunch at home	4.161	64.130	0.380	1.832.256	0.112
24hour dietary recall	-0.001	0.999	0.997	1.002	0.027
Nutrient supplementation	0.773	2.167	0.567	8.152	0.253
Sleep duration	0.088	1.092	0.254	4.693	0.906
BMI of mother	0.037	1.038	0.809	1.331	0.771
Dinner from home	-6.659	0.001	0.000	0.547	0.031
Social class	-0.206	0.814	0.574	1.154	0.248

Bivariate analysis of factors contributing to daughters' BMI were determined. The bivariate analysis revealed various factors that are contributing to the daughters BMI such as meals/day (odds= 0.328, 95% CI: [0.115-0.935], p value= 0.037), snacking frequency (odds= 0.113, 95% CI: [0.017-0.769], p value= 0.026), having sweets (odds= 150.154, 95% CI: [1.322-17058.919], p value= 0.038),

eating in angry mood (odds= 0.133, 95% [CI: 0.023-0.768], p value= 0.024) and dinner at home (odds= 0.001, 95% [CI: 0.000-0.547], p value=0.031) (Table 2). The multivariate analysis reveals that sweet consumption is significant (odds=5.843, 95% [CI: 1.253-23.98], p -value= 0.024) (Table 3). Numerous factors affecting daughters' waist circumference by using bivariate analysis such as

waist circumference of mother (odds= 0.920, 95% CI: 0.865, 0.979, p value= 0.008), average screen time (odds= 0.997, 95% [CI: 0.995-1.001], p value= 0.045), skipping

meals (odds= 5.806, 95% [CI: 1.403-24.028], p value= 0.015) and sleep duration (odds= 0.173, 95% [CI: 0.058-0.518], p value= 0.002) (Table 4).

Table 3: Multivariate analysis of factors contributing to daughters' BMI.

Factors	B	Odds ratio (Adjusted)	95% C.I. for Odds ratio		P value
			Lower	Upper	
24 hour dietary recall	-0.001	0.999	0.997	1.000	0.104
Eat when angry	-0.455	0.635	0.323	1.247	0.187
Sweet	1.702	5.483	1.253	23.980	0.024
Frequency of snacking	-0.428	0.652	0.308	1.380	0.264
Meals/day	-0.759	0.468	0.145	1.507	0.203
Dinner from home/week	-0.270	0.763	0.109	5.324	0.785
Sleep duration	0.486	1.626	0.753	3.511	0.216

Table 4: Bivariate analysis of factors contributing to daughters' waist circumference.

Factors	B	Odds (Unadjusted)	95% C.I. for odds		P value
			Lower	Upper	
Waist circumference of mother	-0.084	0.920	0.865	0.979	0.008
Exercise regularly	0.274	1.315	0.041	41.910	0.877
Hours of exercise	-0.133	0.876	0.477	1.606	0.668
Screen time	-0.003	0.997	0.995	1.001	0.045
Meals/day	-0.907	0.404	0.088	1.857	0.244
Skip meal	1.759	5.806	1.403	24.028	0.015
Frequency of snacking	-0.658	0.518	0.181	1.483	0.220
Fried snacks	-0.154	0.857	0.134	5.487	0.871
Sweets	-0.434	0.648	0.121	3.461	0.612
Eat while standing	-0.478	0.620	0.260	1.481	0.282
Eat while watching TV	0.179	1.196	0.482	2.969	0.700
Eat when bored	-0.425	0.654	0.292	1.465	0.302
Eat disorderly (eat late at night)	0.309	1.362	0.736	2.518	0.325
Dairy serving/week	-0.061	0.941	0.831	1.065	0.335
Fruits serving/week	-0.015	0.985	0.815	1.191	0.875
Vegetable serving/week	0.079	1.082	0.945	1.239	0.255
Nonveg serving/week	-0.120	0.887	0.729	1.078	0.229
Fried food at home	1.225	3.406	1.501	7.727	0.003
Fried food outside	-0.033	0.967	0.385	2.429	0.943
Breakfast from home/week	-1.198	0.302	0.001	67.480	0.664
Lunch from home/week	-3.610	0.027	0.000	2.491	0.118
Dinner from home/week	3.531	34.148	0.900	1295.867	0.057
24hour dietary recall	0.001	1.001	0.999	1.002	0.484
Nutrient supplementation	2.911	18.374	0.928	363.756	0.056
Sleep duration	-1.756	0.173	0.058	0.518	0.002
Social class	0.274	1.315	0.981	1.764	0.067

The multivariate analysis reveals daughters' waist circumference is correlated with sleep duration (odds= 0.374, 95% [CI: 0.189-0.739], p value= 0.005), waist circumference of mother (odds= 0.926, 95% [CI: 0.882-0.973], p value= 0.002), screen time (odds= 0.996, 95% [CI: 0.993-0.999], p value= 0.008) and home cooked fried food (odds=2.153, 95% [CI: 1.177-3.937], p value= 0.013) (Table 5). The bivariate analysis reported sleep duration (p value= 0.010), waist height ratio of mother (p-value= 0.009) as statistically significant. Other factors

that contribute to daughter waist-height ratio are non-veg serving/week (odds= 1.238, 95% [CI: 1.042-1.471], p value= 0.015), sleep duration (odds= 2.996, 95% [CI: 1.303-6.890], p value= 0.010) a waist-height ratio of mother (odds= 20.886, 95% [CI: 20.229-208.429], p-value= 0.009) as statistically significant (Table 6).

The multivariate analysis reported waist-height ratio of mother (p value= 0.009) and duration of sleep (p value= 0.032) as statistically significant (Table 7).

Table 5: Multivariate analysis of factors contributing to daughters' waist circumference.

Factors	B	Odds ratio (Adjusted)	95% C.I. for Odds ratio		P value
			Lower	Upper	
Sleep duration	-0.983	0.374	0.189	0.739	0.005
Waist circumference of mother	-0.076	0.926	0.882	0.973	0.002
Screen time	-0.004	0.996	0.993	0.999	0.008
Fried food at home	0.767	2.153	1.177	3.937	0.013
Skip meal	0.046	1.047	0.452	2.424	0.915

Table 6: Bivariate analysis of factors contributing to daughters' waist height ratio.

Factors	B	Odds (Unadjusted)	95% C.I. for Odds		P value
			Lower	Upper	
Exercise regularly	0.220	1.246	0.086	17.996	0.872
Hours of exercise	0.125	1.133	0.714	1.797	0.596
Screen time	0.001	1.001	0.997	1.005	0.665
Meals/day	0.977	2.658	0.743	9.510	0.133
Skip meal	0.626	1.871	0.578	6.056	0.296
Frequency of snacks	0.472	1.604	0.744	3.458	0.228
Fried snacks	0.090	1.095	0.222	5.409	0.912
Sweets	0.777	2.175	0.600	7.883	0.237
Eat while standing	-0.075	0.928	0.480	1.796	0.825
Eat while watching TV	0.117	1.125	0.568	2.225	0.736
Eat when bored	0.347	1.415	0.721	2.776	0.313
Eat disorderly (eat late at night)	-0.019	0.982	0.621	1.551	0.937
Dairy serving/week	-0.026	0.974	0.875	1.084	0.631
Fruits serving/week	0.046	1.047	0.889	1.232	0.584
Nonveg serving/week	0.213	1.238	1.042	1.471	0.015
Fried at home	-0.645	0.524	0.274	1.005	0.052
Fried from outside	-0.565	0.569	0.263	1.228	0.151
Breakfast from home/week	1.409	4.091	0.094	177.144	0.464
Lunch from home/week	-1.277	0.279	0.015	5.298	0.395
24hour dietary recall	-0.001	0.999	0.997	1.000	0.146
Nutrient supplementation	-0.288	0.750	0.108	5.185	0.770
Sleep duration	1.097	2.996	1.303	6.890	0.010
Waist height ratio of mother	12.232	20.886	20.229	208.429	0.009
Social class	-0.191	0.829	0.618	1.104	0.197

Table 7: Multivariate analysis of factors contributing to daughters' waist height ratio.

Factors	S.E.	Odds ratio (Adjusted)	95% C.I. for Odds ratio		P value
			Lower	Upper	
Waist height ratio of mother	3.429	9.738	7.926	10.89	0.009
Sleep duration	0.286	1.848	1.056	3.236	0.032
Nonveg serving/week	0.063	1.108	0.980	1.252	0.102

DISCUSSION

Association between anthropometric measurements of mothers and daughters

The anthropometric measurements reveal mothers are overweight while the daughters have normal BMI. Obesity is determined by calculating BMI while there exist other methods to assess obesity such as waist circumference, waist-to-height ratio and waist-to-hip

ratio.¹¹ In our study, there is similarity between the mean height of mothers and daughters while a greater difference in weights was observed. This was attributed to lesser waist and hip circumference in the daughter population. The waist- hip ratio is greater in the daughters while waist-height ratio is greater in the maternal population. The univariate factor contributing to daughter's waist circumference is attributed to waist circumference of mother (Odds: 0.920; 95% CI: 0.865-0.979; p value: 0.008). Zahra et al reported waist

circumference as one of the simplest and better marker than age- and sex specific BMI in adults with high risk of NCDs. Another study reported that daughters had less BMI which carries a lower possibility of becoming obesity in adulthood.¹²⁻¹⁴ A strong correlation exists between mother's obesity and daughters' developing obesity at later age. This is in consistent with high prevalence of obesity in females than in the males.^{15,16} In NFHS-5 report, obesity is greater observed in the urban population than rural which attributes higher risks of developing obesity by offspring of the urban population. Another study reported that mother's obesity is associated with children's high BMI.¹⁷ A greater waist circumference of mothers has positive association with children's waist circumference. Another study reported girls of overweight parents had a greater likelihood of being overweight at the age of 13. Another study in UK reported daughter's obesity is correlated with mother's while son's by father's.¹⁰ According to Rita et al, the thickness of the subscapular skin fold was more strongly correlated with the mother's BMI in daughters than in sons (mean difference per 1SD mothers' BMI in daughters was 0.15SD (95%CI: 0.12, 0.19) and in sons was 0.12SD (0.08, 0.15), with a p for interaction of 0.07).¹⁸ A higher value of anthropometric parameters possesses a greater odds ratio of developing dyslipidemia, hypertension and hyperglycemia. Overweight pregnant women have adverse pregnancy outcomes. Studies have reported presence of hyperglycemia, hypertension during pregnancy predisposes future development of NCDs in both mothers and offspring. In this study, calculated BMI of mothers represents overweight while of the daughter is normal. This predisposes daughters to become overweight in their later years of life. One of the significant factors contributing to daughter's BMI is sweet consumption (p value- 0.038). Numerous studies have shown positive correlation between sweet consumption, obesity and metabolic diseases.^{19,20} Added sugars in diet is closely linked with excess body weight and recommendations suggest intake of added sugars should be less than <10% of total calorie intake. It is also recommended that intake of added sugars is limited to no more than 5% of daily caloric intake. This will have additional health benefits like lowering chance of developing NCDs (in particular, dental caries and excessive weight gain) in both adults and children. For an adult with a healthy body mass index, 5% of total calorie consumption is equal to about 25 g (six teaspoons or 100 kcal) of sugar per day (BMI). The multivariate analysis of one of the factors contributing to daughter is consumption of sweets which is reported quite high in the study (OR: 5.483; 95% CI: 1.253-23.980; p value- 0.024). BMI Analysis of NHANES data (2009-2012) reported low intake of added sugars as there is an underreport of self-reported dietary assessments.^{21,22} On an average children aged 2-19 years consume 80g added sugar daily. The liver possesses the capacity to regulate glucose reaching peripheral tissues. While glucose stimulates insulin secretion, conversely, fructose does not stimulate to the same extent as glucose and induces de-novo lipogenesis where saturated fatty

acids are produced causing obesity and greater risks of cardiovascular diseases and other NCDs.²³

Transgenerational anthropometric measurements

Researches have reported that a direct relation exists between mother's obesity and children's BMI.¹⁷ In our study, similar anthropometric measurements exist between mothers and daughters in relation to height, hip circumference, waist hip ratio and waist height ratio. There are environmental factors that influences body composition of children.¹⁰ The HUNT study reported that a direct association between parents and children exists when both the parents were overweight.²⁴ In our study, a direct correlation exists between mothers' waist circumference and daughters' waist circumference (p value= 0.001), mothers' hip circumference and daughters' hip circumference (p value= 0.001), mothers' waist-height ratio and daughters' waist height ratio (p value= 0.001) and mothers' conicity index and daughters' conicity index (p value= 0.001). The results from our study is consistent with a study conducted in UK where association of anthropometric measurements is related to gender. In other words, obesity of daughters has correlation with obesity of mothers.

There were a few limitations of the study which were as follows. Most of the mothers and adolescent girls were not willing to do measurement in minimal dressing, as anthropometric measurement was done in minimal dressing. Fewer responses were obtained through online google forms. The study was carried out during the Covid-19 pandemic, few of the study participants did their measurements at home by themselves. The study area was confined to only one district of Kerala (Thrissur) and hence the findings cannot be generalized to a bigger population.

CONCLUSION

The study was conducted to understand the trans-generational anthropometric patterns and its epidemiological determinants among females in Thrissur district. 92 daughters and their mothers were included in this study. The study reported the similarity of the heights of mothers and daughters while a great variation of weight was observed in the daughters. A greater difference in mean waist circumference was observed between mothers and daughters. However other anthropometric measurements of mothers were observed to be more than the daughters. There is statistically significant association between daughters' BMI with meals/day, frequency of snacking, consumption of sweets, eating when angry, 24 hours of dietary recall (calorie intake) and having dinner at home. The waist circumference of daughters proved statistical significant association with the mothers' waist circumference (p value 0.008), screen time (p value 0.045), meal skipping (p value 0.015), consumption of fried food (p value 0.003) and sleep duration (p value 0.002). The daughters'

waist-hip ratio also shows a statistically significant relation with waist-hip ratio of mother (p value 0.032) and number of meals per day (p value 0.018). The daughter's waist height ratio is affected by various factors such as waist height ratio of mothers (p value 0.009), nonveg serving/week (p value 0.015) and duration of sleep (p value 0.010). Our study concluded that correlation between mother's and daughter's BMI are not statistically significant. Even though daughters had normal BMI in the early stages of life, they are at greater chances of developing obesity in later years if healthy lifestyle habits are not incorporated. It is also observed that mother's anthropometric pattern (except BMI) plays a vital role in daughter's anthropometric patterns.

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