Identification of Adolescent Health Status in Kumbakonam Taluk, Tamil Nadu, India: A Geo-Spatial Study

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Abstract

Background: In India the total population of adolescent are 177.7 million in 1991, 225.1 million in 2001 and 253.2 million in 2011. Accordingly they are 21.2, 21.9 and 20.9 percent in 1991, 2001 and 2011 respectively. The share of adolescents in Tamil Nadu is 17.2 per cent (2011) to the nation. As a result, the adolescent population are continuously increasing. In contrast their nutritional and health status is not satisfactory. According to National Family Health Survey-2, the high percentages of anaemic adolescents are living mainly in eastern part of the Tamil Nadu.

Objective: To identify the spatial pattern of adolescent health status through geospatial mapping in Kumbakonam taluk.

Methods: In 2017, 2790 rural adolescents aged 13-19 years in Kumbakonam taluk, Tamil Nadu, India were selected from 93 villages by stratified random sampling procedure. The mean and Z score values was extracted for Gross Calorie Consumed/Day, Calorie Burnt/Day (CBD), Net Calorie Retained/Day (NCRD), Body Mass Index (BMI) and Wealth index (WI) using SPSS. These attributes are added in ArcGIS9.1 software to depict raster maps. These maps are classified, reclassified, using weighted weighted overlay technique.

Results: The overlay map identified the spatial pattern of very poor, poor, moderate, good and very good health status of adolescent in rural areas of Kumbakonam taluk. The present study has justified that the adolescent health status is not uniform and varying with place to place in this region. However, 75.0 per cent of the areas adolescent are living in good to very good health status in general.

Key Words: Adolescent health, Nutritional health, Health status, GIS

Introduction

Spatial analysis is the central part of Geographic Information Science (GIS). Raju, P.L.N (2015), stated that the generation of maps and generation of tabular reports are fundamental functions of GIS. The spatial information are organized in a GIS, it is able to answer complex questions regarding space. Hence, this present study able to provide the health status of adolescent.

Healthy eating behaviour during adolescence is a fundamental prerequisite for physical growth, psychosocial development and cognitive performance. The children in developing countries presently suffer from malnutrition and over-nutrition. The prevalence of obesity is increasing faster in developing countries because of declining level of physical activity as well as consumption of a diet with high fat, sugar and refined foods and low in fibre.

In India the total population of adolescent are 177.7 million in 1991, 225.1 million in 2001 and 253.2 million in 2011. Accordingly they are 21.2, 21.9 and 20.9 percent in 1991, 2001 and 2011 respectively. The share of adolescents in Tamil Nadu is 17.2 per cent (2011) to the nation. As a result, the adolescent population are continuously increasing. In contrast their nutritional and health status is not satisfactory. According to National Family Health Survey-2, the high percentages of anaemic adolescents are living mainly in eastern part of the Tamil Nadu. With this background, the present study was undertaken with the objective to identify the spatial pattern of adolescent health status.

Overview

Health geography is the application of geographical information, perspectives, and methods to the study of health, disease, and healthcare. Initially it was referred to as medical geography (Andrews, 2002). Discipline of Geography is broadly defined as "the study of the earth's surface as the space within which the human population lives" (Haggett, 1990). Geographers of health have done much to emphasize the importance of relationships between health and the places and spaces which produce and reproduce experiences of health or are constructed through policy to respond to ill-health (Jones and Moon 1993; Litva and Eyles 1995; Kearns and Moon 2002). Contemporary research includes identification of determinants of spatial inequalities in health (Graham 2000; Curtis et al. 2002, 2004; Boyle et al. 2004; Fagg et al. 2006), the importance of particular spaces and places such as neighbourhoods (Cummins and Macintyre 2002; Diez-Roux 2003) or therapeutic landscapes (Andrews 2004; Gesler et al. 2004; Milligan et al. 2004; Conradson 2005; Smyth 2005) impacts of different health experiences on the construction of places (Bush et al. 2001; Smith and Easterlow 2005; Wakefield and McMullan 2005) and contextualized analyses of policy responses (Moon and Brown 2001; Atkinson 2002; Kearns and Barnett 2002). Geographic Information Systems (GIS) play a major role in health care, surveillance of infectious diseases and mapping and monitoring of the spatial and temporal distributions of vectors of infection (Shaw, 2012). GIS combine sophisticated algorithms, spatial analysis, geo-statistics and modelling, making GIS technology a powerful tool for the prediction of disease patterns and parasite ecology associations (Higgs, 2004; Guo et al. 2005; García-Rangel and Pettorelli, 2013).

Methodology

Study Area

Kumbakonam taluk is located in Thanjavur District and important religious places are located in this area. According to the 2011 census, this taluk had a population of 435,962 with 216, 186 males and 219,776 females. There were 1017 women for every 1000 men. The taluk had a literacy rate of 78.05. The total number of households was 91,470. All Panchayat (93) Villages in Kumbakonam Taluk is chosen for present study. This rural area is well known for its agricultural activities (Granary of Tamil Nadu).

Study Population

The questionnaire scheduled survey was carried out during the year 2016 and 2017 to examine the nutritional health status of adolescents (boys and girls) aged between 13-19 years. 30 adolescents were selected from each (93) village by stratified random sampling, totally (93x30) 2790. Of which, 1395 (50.0%) and 1395 (50.0%) are boys and girls respectively. They are the respondents of the present study. The purpose of the present study is to identify the spatial pattern of adolescent health status in Kumbakonam taluk.

Data Analysis

Data collected were entered and analysed using Statistical Package for Social Science (SPSS). The Wealth index is measured by their family annual income, parent's occupational and educational status (Kumar, N et al 2007; Govt. of India 2007). Gross Calorie Consumed/Day (GCCD) is calculated by type of food consumed in past 24 hours. Calorie Burnt/Day (CBD) is measured by their usual physical activity spent (hours) in a day. The subtraction of Calorie Consumed/Day (CCD) with Calorie Burnt/Day (CBD) is Net Calorie Retained/Day (NCRD). The Body Mass Index (BMI) is measured by weight (kg)/height (m^2). As a result, the health status of adolescent identified by the overlay of above quoted observed variables.
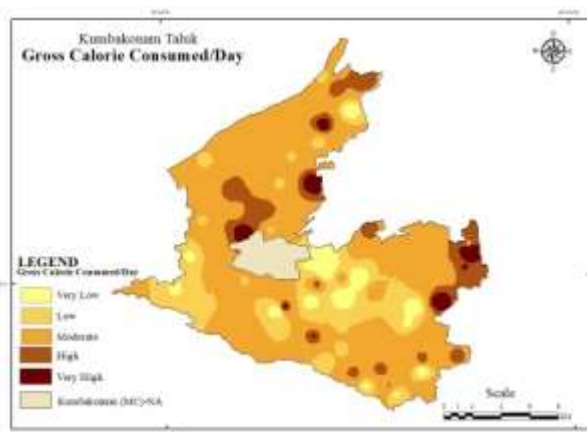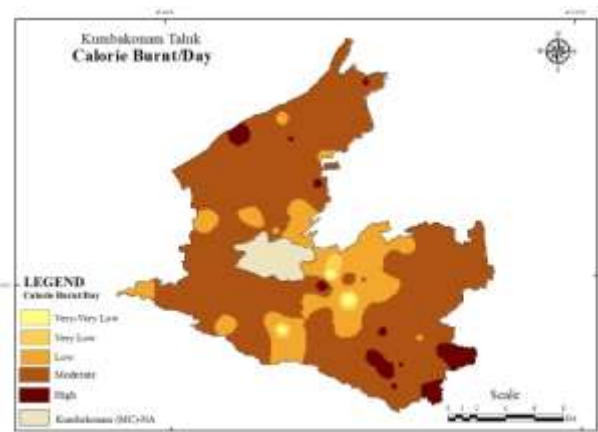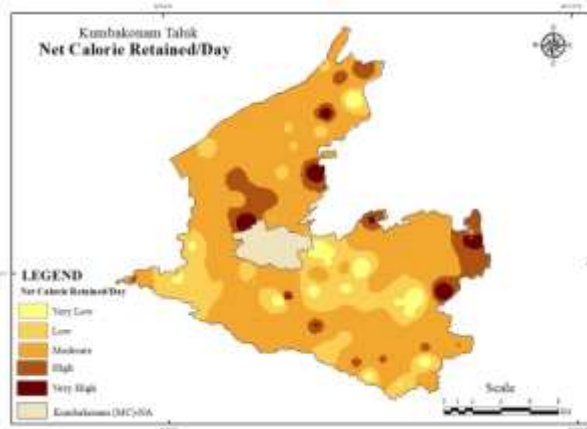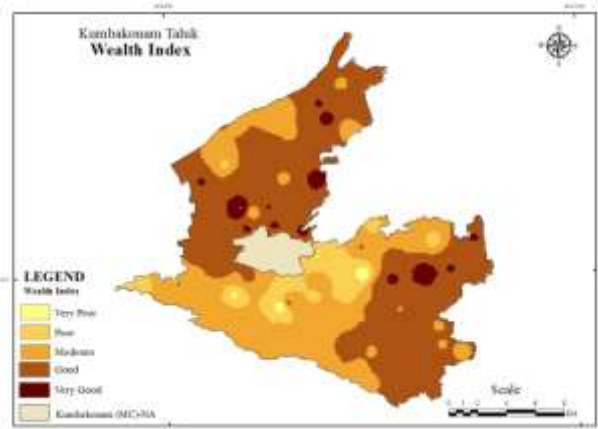
Figure 1

Figure 2
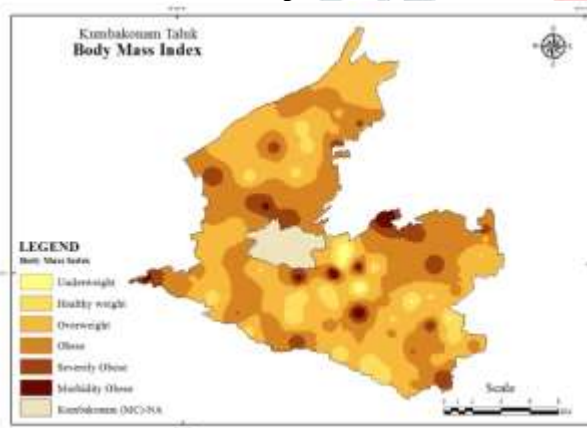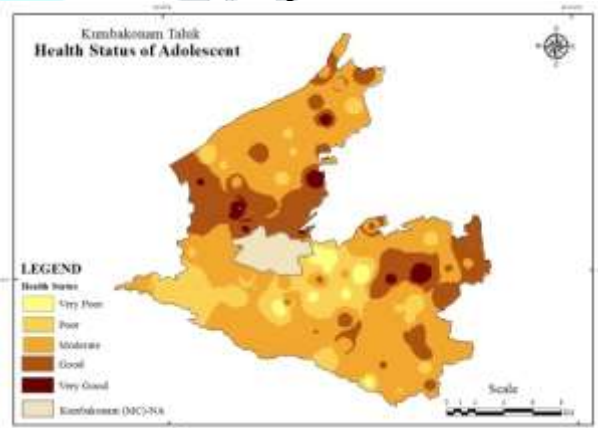

Figure 3

Figure 4

Figure 5

Figure 6

The above mentioned attributes or variables added in ArcGIS9.1 software to depict raster maps. These maps are classified, reclassified, weighted and overlay by its mean and Z-score values.

Result and Discussion

Gross Calorie Consumed/Day

According to the data set 22 adolescents are consuming <2000 gross calorie/day. The very low (Z=<-0.3) gross calorie consumption areas are scattered over eleven places (Figure 1) of the study area (5.20%) mainly in the central part and another areas are registered in south, west and northern part. The low (Z=-0.2 to -0.1) gross calorie (2001-3000) consumed per day area (19.28%) distributed around the very poor calorie consumption area particularly in the central, south and west and also few patches in the northern part of the eastern margin. The moderate (Z=0.0 to 0.2) gross calorie consumptions (3001-4000) area (63.31%) spreads over the major part from north to south except pre-quoted categorical areas (Figure 1). High (Z=0.3 to 0.4) gross calorie consumption (4001-5000) region (9.82%) located in north western part of kumbakonam town, eastern margin, northern part of the eastern margin, and few patches of southern parts. The very high (Z=>0.5) gross calorie consumption (>5001) area (2.40%) found in patches mainly eastern and northern

part. Therefore, the majority of adolescent in the study area receives moderate gross calorie consumption per day.

Gross Calorie Consumed/Day

Sl. No.	Gross Calorie Consumed/Day	Frequency	Z-score	Z-score Percentage	Categories	Weightage
1	<2000	22	<-0.3	5.20	Very Low	1
2	2001-3000	337	-0.2 to -0.1	19.28	Low	2
3	3001-4000	1255	0.0 to 0.2	63.31	Moderate	3
4	4001-5000	953	0.3 to 0.4	9.82	High	4
5	>5001	223	>0.5	2.40	Very High	5

Table 1

Calorie Burnt/Day

In Kumbakonam taluk very-very low (Z=<-1.2) calorie (<200) burnt/day area was found in three small patches (0.43%) in the central part of the region (Figure 2). The very low (Z=-1.1 to -0.8) calorie burnt/day (201-400) was found around the very low calorie burnt areas (0.79%). The low calorie (401-600) burnt/day (Z=-0.7 to -0.2) was established (17.61%) in the eastern part and five small areas around the Kumbakonam town. 1825 adolescents are falling in this category of low calorie burnt/day. The majority of the areas (77.05%) are in the category (Z=-0.1to -0.4) of moderate calorie (601-800) burnt/day. The high (Z=>0.5) calorie (>501) burnt/day was originated in small parts in the south eastern part and north western part. As a result, 95 per cent of the area (Table 2) adolescent in this taluk are physically less active that is why their calorie burnt/day Z scores (<-1.2 to >0.5) and categories was range from very-very low to high.

Calorie Burnt/Day

Sl. No.	Calorie Burnt/Day	Frequency	Z-score	Z-score Percentage	Categories	Weightage
1	<200	60	<-1.2	0.43	Very-Very Low	1
2	201-400	787	-1.1 to -0.8	0.79	Very Low	2
3	401-600	1825	-0.7 to -0.2	17.61	Low	3
4	601-800	111	-0.1 to -0.4	77.05	Moderate	4
5	>801	7	>0.5	4.12	High	5

Table 2

Net Calorie Retained/Day

3.69 per cent of the area's adolescent are having very low (Z=<-0.3) net calorie retained/day (<2000). They are distributed (Figure 3) in small patches particularly five in the central, three in south, two in east and one in northern part. Similarly, the low (Z=-0.2 to -0.1) net calorie retained/day (2001-3000) area (19.99%) was found around the very low calorie retained/day area of central, southern and western part of the study area and also five small areas in the northern part. The moderate (Z=0.0 to 0.2) net calorie (3001-4000) retained/ day region (65.28%) was observed established in the east, west and southern region except very low, low, high east and very high calorie retained/day area. 8.87 per cent of the area (Table 3) comes under the category (Z=0.3 to 0.4) of high net calorie consumed/day (4001 to 5000). This spots are found in the eastern margin and northern part of eastern margin and north of Kumbakonam town. The very high (Z=>0.5) net calorie (>5001) retained/day region (2.16%) are distributed in small areas of above stated high net calorie consumed/day areas.

Net Calorie Retained/Day

Sl. No.	Net Calorie Retained/Day	Frequency	Z-score	Z-score Percentage	Categories	Weightage
1	<2000	71	<-0.3	3.69	Very Low	1
2	2001-3000	574	-0.2 to -0.1	19.99	Low	2
3	3001-4000	1337	0.0 to 0.2	65.28	Moderate	3
4	4001-5000	753	0.3 to 0.4	8.87	High	4
5	>5001	55	>0.5	2.16	Very High	5

Table 3

Wealth Index

The very poor (Z=<-0.6) wealth index (<6.0) regions are located (Figure 4) in three small pockets (0.47%) of the central part of the taluk. The poor (Z=-0.7 to -0.3) wealth index (7.0 to 9.0) areas (8.69%) are

found in the centre of the taluk around the very poor wealth index area. 33.11 per cent of the areas are having moderate (Z=-0.2 to 0.0) wealth index (10.0 to 12.0) and it stretch from the south west to north east direction in the central region, small area in northern region and small pockets in the eastern margin of this study area. The high (Z=-0.1 to 0.3) wealth index (13.0 to 15.0) areas (54.69%) are spreads over in two large areas; one in the northern part from west to north east and second exist in the south eastern part along the margin of this taluk. The very high (Z=>0.4) wealth index (>16.0) areas (3.04%) are scattered over the northern and south eastern part of the region. According to the wealth index, this taluk has (90.0%) moderate to very high (Table 4) economic wealth status.

Wealth Index

Sl. No.	Wealth Index	Frequency	Z-score	Z-score Percentage	Categories	Weightage
1	< 6.0	78	<-0.6	0.47	Very Poor	1
2	7.0 to 9.0	397	-0.7 to -0.3	8.69	Poor	2
3	10.0 to12.0	754	-0.2 to 0.0	33.11	Moderate	3
4	13.0 to15.0	587	0.1 to 0.3	54.69	High	4
5	> 16.0	974	>0.4	3.04	Very High	5

Table 4

Body Mass Index

The underweight (BMI <18.50) adolescent (Z=<-0.4) is well distributed (Figure 5) in the small pockets of central region of this taluk (0.62%). 7.32 per cent of the study area is occupied by the healthy weight (BMI 18.51-24.99) adolescent (Z=-0.4 to -0.2) and mostly they lives in the south central and northern part of the region. It is very interesting to note that 43.87 per cent (Table 5) of the areas are represented by the overweight (BMI 25.00-29.99) adolescent (Z=-0.2 to 0.0) and they spread over two broader areas in the north and south. Similarly, the obese (BMI 30.00-34.99) adolescent (Z=0.0 to 0.2) stretches from central east to west and southern part of this taluk (40.06%). The severely obese (BMI 35.00-39.99) adolescent (Z=-0.2 to 0.4) lives in the 7.04 per cent of the study area and they are dispersed in ten small pockets all over the central part of the taluk. The morbidity obese (BMI >40.) adolescent (Z=>0.4) are registered in small patches (1.09%) around the Kumbakonam municipal town area. Hence, nearly 92.0 per cent of the adolescent in this taluk are overweight to morbidity obese condition.

Body Mass Index

Sl. No.	Body Mass Index	Frequency	Z-score	Z-score Percentage	Categories
1	<18.50	37	<-0.4	0.62	Underweight
2	18.51-24.99	650	-0.4 to -0.2	7.32	Healthy weight
3	25.00-29.99	1464	-0.2 to 0.0	43.87	Overweight
4	30.00-34.99	592	0 to 0.2	40.06	Obese
5	35.00-39.99	42	0.2 to 0.4	7.04	Severely Obese
6	>40	5	>0.4	1.09	Morbidity Obese

Table 5

Adolescent Health Status

The adolescent health status (figure 6) is the results (overlay) of above discussed calorie consumed/day, calorie burnt/day, net calorie retained/day, wealth index and the body mass index variables. Accordingly, 2.6 per cent of the areas (Table 6) adolescent are having very poor health status (Z=<5) and they are in the south eastern out-skirts of Kumbakonam town areas. Nearly, 20.0 per cent of the area in this taluk has poor health adolescent (Z=6-7) and they lives around the poor health status areas and in the eastern margins of the region. 46.4 per cent of the study areas adolescent are registered in moderate health status (Z=8-9). They exist in the broader areas of northern and southern part of Kumbakonam taluk. The good health statuses adolescent (Z=10-11) are living in 28.4 per cent of the area. They spread over in the centre, east and northern part of region. However, 2.7 per cent of the areas adolescent (Z->12) are having very good health status and they lives in the centre, east and northern part of the study area. Therefore, nearly 77.0 per cent of the area's adolescent are having moderate to very good and the remaining 23.0 per cent of the area was occupied by the very poor to poor health adolescent in this region.

Adolescent Health Status

S. No	Z-score	Z-score	Categories

		Percentage	
1	<5	2.6	Very Poor
2	6 to 7	20.0	Poor
3	8 to 9	46.4	Moderate
4	10 to 11	28.4	Good
5	>12	2.7	Very Good

Table 6

Conclusion

This present study exhibited the spatial pattern of rural adolescent health status in Kumbakonam taluk. Therefore, the study concludes that 25.0 per cent of the areas adolescent are consuming very less calorie/day; 95 per cent of the area adolescent's calorie burnt/day is very small; nearly 75.0 per cent of the areas adolescent's net calorie retained/day is more. 90.0 per cent of the areas wealth statuses are in the satisfactory level and almost 92.0 per cent of the areas are registered in overweight to morbidity obese condition. Thus, the present study has justified that the adolescent health status is not uniform and varying with place to place in this region. However, 75.0 per cent of the areas adolescent are living in good to very good health status in general.

Limitation

This study was linked with dietary behaviour, economic condition and anthropometric measurements of rural adolescent in Kumbakonam taluk. However, this study failed to address with age specific, sex wise and any clinical observation of adolescent health status.

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