ASSESSMENT OF PHYSICAL ACTIVITY SCORE AND NUTRIENT INTAKE AMONG INSTITUTIONALISED AND NON-INSTITUTIONALISED ADOLESCENTS AGED 16-18 YEARS IN MUMBAI, INDIA - A COMPARATIVE STUDY

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ABSTRACT

Methodology: The study involved 125 adolescents, 70 from an institutional setting and 55 from a non-institutional setting. Baseline characteristics and anthropometric measurements were recorded. Physical activity levels were assessed using a questionnaire, and a 24-hour diet recall was conducted to understand nutrient intake. Data were collected, coded, and analyzed using SPSS software and ANOVA. Fisher's exact test was employed.
Results: Among the 125 participants (70 institutionalized, 55 non-institutionalized), institutionalized males were lighter and shorter than their non-institutionalized counterparts, while institutionalized females were taller with higher BMI. No significant differences in physical activity levels were observed. Normal-weight participants were more active. Institutionalized males had lower carbohydrate and fat intake compared to non-institutionalized males, while institutionalized females had higher energy, carbohydrate, and fat intake but comparable protein intake.
Conclusion: Higher physical activity scores were associated with better nutrient consumption and fitness levels. Among females, being overweight negatively impacted physical activity scores. Increased physical activity correlated with better academic performance, likely leading to healthier food choices.
Keyword: - *Physical activity, Nutrient intake, Institutionalized adolescents, Non-institutionalized adolescents*

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1. INTRODUCTION

The World Health Organization (WHO) defines adolescence as 10–19 years *(Madhavi Bhargava, 2020)*. Adolescence represents a critical life stage characterized by significant changes in body composition *(Dravid Crawford, 2019).* Institutional care settings encompass orphanages, nursing homes, residential facilities, and rehabilitation centers *(Elizabeth Ghalik, 2017).* The demographic cohort constitutes a substantial 16% of the global population, with Asia being home to over half of the world's adolescents *(Madhavi Bhargava, 2020)*. In India, according to the 2011 Census data, a remarkable one-fifth of the nation's populace falls within the adolescent age bracket, underscoring the significance of this transitional phase. During adolescence, individuals experience a significant growth spurt, with a rapid increase in height and weight *(Sonika Sharma, 2018)*. Institution-reared adolescents are adolescents who all experience separation from or loss of their birth parents and other caregivers *(Paula Mena, 2019)*. Researchers have emphasized that individuals with lower levels across all health-related physical fitness components are at a higher risk of developing metabolic syndrome *(Moreira et al., 2017). Ruiz et al. (2020)* and *Stigman et al. (2019)* have highlighted the connection between decreasing insulin resistance, cardiovascular fitness, and the occurrence of metabolic syndrome, particularly in relation to abdominal muscle lipidosis. The majority of existing studies have focused on physical activity levels among adolescents residing in traditional family settings, with very less studies conducted for the adolescents residing in the institutional settings and very few studies have been conducted on the Indian context. However, physical activity plays an important role in building the overall physical and mental health of all adolescents, including those living in institutional settings, who may face different challenges compared to those raised in traditional families. Due to limited resources, such as staffing, time, fiscal constraints, and poor healthcare facilities, institutions often struggle to address the individual needs of children for healthy and holistic development, beyond providing basic care. While a few quantitative studies have explored the physical activity levels among institutionalized children, no research has specifically investigated the physical activities of adolescents living in institutional settings in India. To address this gap, the study endeavored to contrast and compare the physical activity scores and nutrient intake among the institutionalized and non-institutionalized adolescents aged 16 - 18 years in Mumbai, Maharashtra.

2. METHODOLOGY

The study employed a cross-sectional, comparative design. The sample consisted of institutional and non-institutional adolescents aged 16-18 years, with a total sample size of 125 participants. Of these, 70 were institutional adolescents (35 males and 35 females), while 55 were non-institutional adolescents (35 males and 20 females). The sampling method used was convenience sampling. The inclusion criteria were adolescents aged 16-18 years, either living with their families or residing in orphanages. The participants were informed about the study conducted, its design and the purpose of the study. Ethical clearance was obtained from the Intersystem Biomedica Ethics Committee (ISBEC). The different aspects which included in the questionnaire were General Information, Socio Demographic data, Physical activity score using physical activity questionnaire- adolescents and dietary recall using multiple pass approach method.

2.1 Statistical Analysis

Analysis was done using Statistical Package for Social Sciences (SPSS) software (version 20. SPSS Inc., Chicago, IL, USA). The analysis included t-test, chi-square test and ANOVA p values of less than 0.05 were considered statistically significant.

3. RESULTS AND DISCUSSION

A total of 125 adolescents from the age group of 16 -18 years were recruited for the study. 57.7% of the male participants from the institutionalized settings belonged to the age of 16 years while the remaining of 42.9 % and 50% belonged to the age of 17 and 18 years respectively. 57.1 % of females from the institutionalized settings belonged to the age of 17 years. 70 % of the male participants belonged to the age of 14 years and 43.8% of the female participants belonged to the age of 17 years non-institutionalized. (Table no. 1.A.)

Table 1. A. Age distribution of the participants

Age	Institutional (n=70)		Non institutional (n=55)	
	Male (n= 35)	Female (n= 35)	Male (n = 35)	Female (n = 20)
16	15 (57.7%)	11 (42.3%)	14 (70.0%)	6 (30.0%)
17	12 (42.9%)	16 (57.1%)	9 (56.3%)	7 (43.8%)
18	8 (50%)	8 (50%)	12 (63.2%)	7 (36.8%)

Among the institutional group (n=70), none of the participants followed a vegetarian or ovo-vegetarian dietary habit, and all of them (100%) were non-vegetarians. In the non-institutional group (n=55), 5 participants (9.1%) were vegetarians, another 5 participants (9.1%) were ovo-vegetarians, and the remaining 45 participants (81.8%) were non-vegetarians. (Table no. 1.B.)

Table 1. B. Food preferences of the participants

Dietary habits	Institutional (n=70)	Non institutional (n=55)
Vegetarian	0 (0%)	5 (9.1 %)
Ovo-vegetarian	0(0%)	5 (9.1 %)
Non-vegetarian	70 (100 %)	45 (81.8%)

The distribution of BMI categories showed some variations between the institutional and non-institutional groups, as well as between genders. Among the institutional group (n=70), 7 males (70%) and 3 females (30%) were underweighted, while in the non-institutional group (n=55), 5 males (41.7%) and 7 females (58.3%) were underweighted. The difference in the proportion of underweight individuals between the two groups was not statistically significant (p-value = 0.211). For the normal BMI category, the institutional group had 23 males (51.1%) and 22 females (48.9%), whereas the non-institutional group had 23 males (67.6%) and 11 females (32.4%). The overweight category in the institutional group comprised 5 males (33.3%) and 10 females (66.7%), while in the non-institutional group, 7 males (77.8%) and 2 females (22.2%) were overweight. The data suggests that there may be some variations in the distribution of BMI categories between the institutional and non-institutional groups, as well as between genders. (Table 2)

Table 2. BMI Categories of the participants

BMI Categories	Institutional (n=70)		Non institutional (n=55)		p-value
	Male (n= 35)	Female (n= 35)	Male (n = 35)	Female (n = 20)	
Underweight	7 (70 %)	3 (30 %)	5 (41.7%)	7 (58.3%)	**0.211**
Normal	23 (51.1%)	22 (48.9 %)	23 (67.6%)	11 (32.4%)	
Overweight	5 (33.3 %)	10 (66.7 %)	7 (77.8 %)	2 (22.2%)	

A standardized and validated Physical Activity Score questionnaire for adolescents was used to find out the physical activity levels among the participants. The PAQ-A can be administered in a classroom setting and provides a summary physical activity score derived from eight items, each scored on a 5-point scale. Table 3 shows the distribution of physical activity scores among individuals based on their residential stay and gender. Among those residing in institutional settings, males exhibited varied activity levels, with 51.4% categorized as high, followed by 28.6% in moderate, and 14.3% each in very low and very high categories. Institutional males were involved in football on a daily basis for more than 2 hours as that would be their play activity. For females in institutional residences, 34.3% showed high activity levels, while 31.4% fell into the very high category. Institutional females were involved in dance and aerobics to pass out their time as screen exposure was not the part of the institutional norms. In non-institutional settings, males demonstrated diverse activity levels, with 40% falling into the high category mainly engaged in cricket or volleyball and 25.7% in moderate. Females in non-institutional settings displayed predominantly moderate activity (50%), with fewer in high (25%) and very low (5%) categories. Non-institutional females and males had more screen time which decreased their physical activity scores. Statistical analysis using Fisher Exact test yielded a p-value of 0.114, indicating no significant difference in physical activity scores between institutional and non-institutional participants.

This is consistent with the well-established inverse relationship between physical activity and BMI observed in the general population. Research suggests that adolescents living in institutional settings, such as orphanages, residential care facilities, or boarding schools, may have limited opportunities for physical activity compared to their non-institutional counterparts (Rashmi et al., 2021; Myint et al., 2018). Several studies have reported lower levels of physical activity and higher levels of sedentary behavior among institutionalized adolescents (Srivastava et al., 2013; Sharma et al., 2017).

For non-institutional adolescents, physical activity levels can be influenced by various factors, including access to recreational facilities, participation in organized sports, active transportation, and parental support (Larson et al., 2016; Douglas et al., 2019). Research suggests that non-institutional adolescents generally have higher levels of physical activity compared to their institutionalized counterparts (Mishra & Thakur, 2016; Kaur et al., 2019).

Physical activity levels among non-institutional adolescents are still suboptimal, particularly in urban areas with limited access to safe outdoor spaces or in lower socioeconomic communities with fewer resources for physical activity opportunities (Dougkas et al., 2019).

Table 3. Physical activity scores of the participants

Residential stay	Gender	Physical activity score					Total (N=125)	Fisher Exact test, p-value
		Very low	Low	Moderate	High	Very high		
Institutional (n=70)	Male (n= 35)	5	0	10	18	2	35	0.114
	Female (n= 35)	5	5	2	12	11	35	
Non institutional (n=55)	Male (n = 35)	3	4	9	14	5	35	
	Female (n = 20)	1	1	10	5	3	20	

Table 4. Correlation between Physical activity scores and BMI categories of the participants

Residential stay	BMI Category	Physical activity score					Fisher Exact test, p-value
		Very low	Low	Moderate	High	Very high	
Institutional (n=70)	Underweight	0	0	3	7	0	0.1
	Normal	0	0	9	23	13	
	Overweight	10	5	0	0	0	
Non institutional (n=55)	Underweight	0	0	5	7	0	0.1
	Normal	0	0	14	12	8	
	Overweight	4	5	0	0	0	

Table 4. presents the relationship between BMI categories, physical activity scores, and residential stays. In institutional settings, individuals classified as overweight showed minimal physical activity, with 10 falling into the very low category and 5 in the low category. Meanwhile, those categorized as normal weight demonstrated higher levels of activity, with 23 individuals in the high category and 13 in the very high category. Among those in non-institutional settings, normal-weight individuals displayed a similar pattern, with 12 in the high activity category and 8 in the very high category. Statistical analysis using Fisher Exact test did not reveal a significant difference in physical activity scores based on residential stays.

Several studies have investigated the relationship between BMI and physical activity levels in institutionalized adolescents. Research suggests that institutionalized adolescents with higher levels of physical activity tend to have lower BMI values and a lower prevalence of overweight or obesity (Rashmi et al., 2021; Sharma et al., 2017). For non-institutional adolescents, research has consistently shown an inverse relationship between physical activity levels and BMI (Larson et al., 2016; Dougkas et al., 2019). Adolescents who engage in regular physical activity, including both structured exercise and leisure-time activities, tend to have lower BMI values and a lower risk of overweight or obesity compared to their less active counterparts

For underweight individuals, the mean energy, protein, carbohydrate, and fat intakes were relatively low at around 2023 Kcal, 23.4g protein, 401.7g carbohydrates, and 21.4g fat respectively. Those in the normal BMI range had higher mean intakes of 2365 Kcal energy, 38.0g protein, 454.8g carbohydrates, and 42.2g fat. The overweight group exhibited the highest mean nutrient consumption, with 3800 Kcal energy, 58.0g protein, 520.0g carbohydrates, and 67.0g fat. The standard deviations for the overweight category were 0 across all nutrients for both institutional and non-institutional males, suggesting very little variation in intake within this BMI group. Nutrient consumption in both the groups did not show much difference although both the groups presented with consistent patterns of increased energy intakes. Majority of the calories for institutional participants were through consumption of simple carbohydrates in more than required portions. While for non-institute majority of the consumption were either through street food or processed food items. (Table 5.A)

Table 5.A. Correlation between Nutrient intake and BMI Categories of the male participants

BMI Categories		Nutrient intake of Institutional Males (n= 55)				Nutrient intake of Non -Institutional Males (n= 55)			
		Energy (Kcal)	**Protein (g)**	**Carbohydrate (g)**	**Fats (g)**	**Energy (Kcal)**	**Protein (g)**	**Carbohydrate (g)**	**Fats (g)**
Under weight	Mean	2023	23.4	401.7	21.4	2023	23.4	401.7	21.4
	Std. Deviation	39.0	1.1	4.5	1.1	39.0	1.1	4.5	1.1
Normal	Mean	2365	38.0	454.8	42.2	2365	38.0	454.8	42.2
	Std. Deviation	282.1	12.2	42.3	16.5	282.1	12.2	42.3	16.5
Over weight	Mean	3800	58.0	520.0	67.0	3800	58.0	520.0	67.0
	Std. Deviation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Underweight individuals, institutional females had a higher mean intake of 1880 Kcal energy, 28.0g protein, 298.0g carbohydrates, and 35.0g fat compared to 1657 Kcal, 25.1g protein, 226.6g carbohydrates, and 25.0g fat for non-institutional females. In the normal BMI range, institutional females consumed more calories (2362 Kcal vs 2509 Kcal) but less protein (40.7g vs 44.2g), carbohydrates (418.5g vs 458.9g), and fats (52.5g vs 59.4g) on average than their non-institutional counterparts. Overweight females had identical mean intakes of 3140 Kcal energy, 64.0g protein, 546.0g carbohydrates, and 80.0g fat across both groups. However, the standard deviations were noticeably higher for non-institutional overweight females across all nutrients except fats, indicating greater variation in intake within this group compared to the institutional population. Overall, while some differences existed, the general trend of increasing nutrient consumption with higher BMI was observed in both institutional and non-institutional female cohorts. (Table 5.B).

Table 5.B. Correlation between Nutrient intake and BMI Categories of the female participants

BMI Categories		Nutrient intake of Institutional Females (n= 55)				Nutrient intake of Non -Institutional Females (n= 20)			
		Energy (Kcal)	**Protein (g)**	**Carbohydrate (g)**	**Fats (g)**	**Energy (Kcal)**	**Protein (g)**	**Carbohydrate (g)**	**Fats (g)**
Under weight	Mean	1880	28.0	298.0	35.0	1657	25.1	226.6	25.0
	Std. Deviation	0.0	0.0	0.0	0.0	76.1	1.6	39.3	5.5
Normal	Mean	2362	40.7	418.5	52.5	2509	44.2	458.9	59.4
	Std. Deviation	402.2	11.5	84.9	15.7	351.5	10.3	67.9	15.5
Over weight	Mean	3140	64.0	546.0	80.0	3140	64.0	546.0	80.0
	Std. Deviation	63.2	2.1	6.3	1.1	84.9	2.8	8.5	1.4

In Institutional setting, increased calorie consumption was a result of food insecurity. Food insecurity refers to the limited or uncertain availability of nutritionally adequate and safe foods or the inability to acquire acceptable foods in socially acceptable ways (Coleman-Jensen et al., 2019). This was due to inadequate access to nutritious meals or reliance on calorie-dense, nutrient-poor foods.

Based on the data provided, there appears to be a positive correlation between BMI and nutrient intake among both institutional and non-institutional adolescents, regardless of gender. As BMI increases from underweight to normal to overweight categories, the mean intake of energy, protein, carbohydrates, and fats also tends to increase.

This finding aligns with research evidence suggesting that higher calorie and nutrient intake is associated with increased body weight and BMI. Several studies have linked excess energy consumption, particularly from high-fat and high-carbohydrate foods, to weight gain and obesity (Bray & Popkin, 2018; Swinburn et al., 2019).

The data provided does not establish a causal relationship between nutrient intake and BMI. Other factors, such as physical activity levels, metabolic rates, and genetic predispositions, can also influence an individual's BMI (Hill & Melanson, 2019).

Nutrient intake data for institutional and non-institutional males across different levels of physical activity, ranging from very low to very high. For those with very low physical activity, the mean energy intake was around 3800 Kcal for institutional males and 3789 Kcal for non-institutional males, along with high protein (58.0g and 66.0g), carbohydrate (520.0g and 544.0g), and fat (67.0g and 78.0g) consumption. For both the groups participants who had low physical activity levels were found to be more binge eating and sitting idle or were engaged in some other sedentary activities. These participants exhibited low energy levels and were seen more fatigue in comparison to the other participants. As physical activity increased to low levels, mean calorie and nutrient intakes decreased slightly for both groups. Individuals with moderate physical activity had considerably lower mean intakes of around 2200 Kcal energy, 31g protein, 430g carbohydrates, and 32g fat. Those with high physical activity levels exhibited a modest increase in mean nutrient consumption compared to the moderate group. Finally, males with very high physical activity had mean intakes of approximately 2520 Kcal energy, 45g protein, 479g carbohydrates, and 55g fat, with relatively similar values observed between institutional and non-institutional participants. Among both the groups it was observed that participants with higher levels of physical activity consumed more healthier snack and beverage options in comparison to the very low or low physical activity participants. The data suggests an inverse relationship between physical activity levels and calorie/nutrient intake, but with some variations across different activity categories. (Table 6.A).

The data reveals patterns in nutrient consumption across different levels of physical activity for both institutional and non-institutional females. Those with very low physical activity had the highest mean energy intakes of 3128 Kcal for institutional females and 3080 Kcal for non-institutional females, along with elevated protein (63.6g and 62.0g), carbohydrate (544.8g and 540.0g), and fat (79.8g and 79.0g) consumption. As physical activity increased to low levels, mean calorie and most nutrient intakes remained similar for institutional females but increased slightly for non-institutional females. Females with moderate physical activity exhibited lower mean intakes of 2960 Kcal energy, 58.0g protein, 528.0g carbohydrates, and 77.0g fat in the institutional group, and even lower values of 2292 Kcal, 39.2g protein, 397.0g carbohydrates, and 50.6g fat in the non-institutional group. High physical activity was associated with considerably reduced mean nutrient consumption, with 2090 Kcal, 33.3g protein, 352.2g carbohydrates, and 42.8g fat for institutional females, and 1752 Kcal, 27.2g protein, 260.8g carbohydrates, and 29.8g fat for non-institutional females. Institutional females were more involved in dance as their primary physical activity whereas non-institutional females considered bicycling and walking as their primary physical activity. (Table 6. B)

Institutional participants had a fixed schedule for physical activity as that was the only means for entertainment. Inverse relationship has been observed between physical activity levels and nutrient intake among both institutional and non-institutional adolescents, regardless of gender.

Several studies have demonstrated that regular physical activity can increase energy expenditure and create a negative energy balance, leading to a lower overall calorie intake (Blundell et al., 2023; Donnelly et al., 2018). This is because physical activity increases energy requirements, and individuals may adjust their calorie consumption accordingly to maintain energy balance.

Physical activity can influence appetite regulation and food preferences, potentially leading to lower calorie and nutrient intake (Stensel, 2020; Martins et al., 2018). Regular exercise has been associated with increased satiety and decreased hunger levels, which can result in reduced energy intake. The relationship between physical activity and nutrient intake can be complex and influenced by various factors, such as the type, intensity, and duration of physical activity, as well as individual differences in metabolic rates and dietary habits.

Table 6.A. Correlation between Physical activity scores and nutrient intake of the male participants

Physical activity levels		Nutrient intake of Institutional Males (n= 55)				Nutrient intake of Non -Institutional Males (n= 55)			
		Energy (Kcal)	Protein (g)	Carbohydrate (g)	Fats (g)	Energy (Kcal)	Protein (g)	Carbohydrate (g)	Fats (g)
Very low	Mean	3800	58.0	520.0	67.0	3789	66.0	544.0	78.0
	Std. Deviation	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0
Low	Mean	3152	64.4	547.2	80.2	3120	64.0	538.0	73.5
	Std. Deviation	65.7	2.2	6.6	1.1	369.5	6.9	20.8	7.5

Moderate	Mean	2200	31.1	430.0	31.9	2169	29.4	425.3	32.2
	Std. Deviation	264.7	11.0	39.7	13.6	122.9	4.8	18.4	8.9
High	Mean	2307	35.5	445.3	38.3	2343	37.2	452.0	42.1
	Std. Deviation	295.9	12.8	45.0	17.8	303.3	13.1	45.8	18.3
Very high	Mean	2520	44.5	478.0	56.0	2528	45.0	480.0	53.4
	Std. Deviation	282.8	13.4	42.4	15.6	237.3	11.2	35.4	12.1

Table 6.B. Correlation between Physical activity scores and nutrient intake of the female participants

Physical activity levels		**Nutrient intake of Institutional Females (n= 55)**				**Nutrient intake of Non -Institutional Females (n= 20)**			
		Energy (Kcal)	**Protein (g)**	**Carbohydrate (g)**	**Fats (g)**	**Energy (Kcal)**	**Protein (g)**	**Carbohydrate (g)**	**Fats (g)**
Very low	Mean	3128	63.6	544.8	79.8	3080	62.0	540.0	79.0
	Std. Deviation	65.7	2.2	6.6	1.1				
Low	Mean	3152	64.4	547.2	80.2	3200	66.0	552.0	81.0
	Std. Deviation	65.7	2.2	6.6	1.1				
Moderate	Mean	2960	58.0	528.0	77.0	2292	39.2	397.0	50.6
	Std. Deviation	0.0	0.0	0.0	0.0	512.3	12.7	133.9	22.5
High	Mean	2090	33.3	352.2	42.8	1752	27.2	260.8	29.8
	Std. Deviation	294.5	8.2	62.6	11.5	216.1	4.1	70.1	9.8
Very high	Mean	2418	42.2	438.0	53.9	2507	44.7	453.3	57.7
	Std. Deviation	387.6	11.0	84.1	15.1	482.2	14.0	93.8	19.5

4. CONCLUSIONS

In the present study no significant differences were found in physical activity levels among the institutionalized and non-institutionalized adolescents aged 16-18 years with p value being > 0.05. Although an inverse relationship was observed between the physical activity and nutrient intake Adolescents who were involved in moderate to very high physical activity levels showed better nutrient intake and BMI. Being more physically active showed improvement in academics as being active would demand healthier food choices pertaining to better nutrient consumption.

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