**Association between Family Sociodemographic Characteristics and Anthropometric Measurements of Preschool Children in Nagram, Lucknow, India**

**Abstract:**

The aim of this study is to examine the relationship between family sociodemographic characteristics (such as parental education, income, occupation, and family size) and the anthropometric measurements (such as height, weight, mid-upper arm circumference, head circumference, and waist circumference) of preschool children. The findings are expected to contribute to a better understanding of the factors affecting childhood growth and to inform interventions aimed at improving child health outcomes. Objectives: (a) Evaluate Anthropometric Measurements. (b) Analyze Socioeconomic and Demographic Factors. (c) Identify Disparities in children. Methods: This study based on Cross-sectional study design of sample size of 385 of Preschool children aged 3-5 years from diverse socioeconomic backgrounds. Data is collected through anthropometric measurements: Height, weight, head circumference, mid-upper arm circumference waist circumference and BMI recorded using standardized procedures and questionnaires is used to gather information on family income, parental education levels, household size, and other demographic factors. Conclusion: The majority of the respondents were educated, with 98.2% of their family members being literate and other socio-demographic status. Family factors such as parental education, income, family structure, and cultural influences can have a significant impact on a child's growth, nutritional status, and overall health. By addressing these sociodemographic factors, policies and interventions can be designed to improve the health and development of preschool children, particularly in vulnerable populations.

***Keywords:***Anthropometric Measurements, Pre-school children, Questionnaire, Socioeconomic

**Introduction**:

Preschoolers are a significant population for nutritional and health assessments because the formative years of a child's life are crucial for their growth and development. Anthropometric parameters including height, weight, and BMI are important measures of a child's general health and nutritional status. These metrics not only show the state of health today, but they also forecast health outcomes in the future and possible problems with development. It is crucial to comprehend the variables influencing these anthropometric measurements in order to create public health interventions that are successful. Preschoolers’ health and nutritional condition are greatly influenced by socioeconomic and demographic characteristics, such as family income, parental education, and size of the household [7,8]. These elements frequently lead to differences in a child's growth and development, with children from lower socioeconomic backgrounds typically having worse health outcomes [9,10,11].

A child's growth and development are influenced by a variety of factors, including socioeconomic status (SES), which can impact access to resources like wholesome food, healthcare, and educational opportunities [9,10,11]. A superior anthropometric outcome is generally linked to a higher family income and better access to healthcare services and a balanced diet [2]. On the other hand, a child's development may be adversely affected by reduced economic levels, which may lead to food insecurity and restricted access to healthcare.

Another important factor influencing a child's health is parental education [7,8]. Higher educated parents are typically more informed about nutrition and health practices, which can help their kids make healthier food choices and lifestyle choices. Parents with higher levels of education are also more likely to take preventative health care and make use of healthcare resources.

The size of a household affects a child's nutrition as well [12]. Larger homes could have more people sharing limited food and attention due to resource constraints. This may result in inadequate nutrient intake and stunted growth in kids. The purpose of this study was to investigate the association between preschoolers' anthropometric measurements and socioeconomic and demographic characteristics. The research aims to inform public health initiatives and interventions focused at improving the nutritional quality and general health of preschool children, especially those from poor homes, by detecting patterns and discrepancies in growth measures. The results of the study will shed important information on the ways that children's growth and development are influenced by socioeconomic and demographic factors, emphasizing the need for focused policies and initiatives to close these gaps. Ultimately, this research will contribute to the broader goal of ensuring all children have the opportunity to achieve optimal growth and health, regardless of their socioeconomic or demographic background.

**Methodology:**

1. Area of the Study:

Nagram is an area of study for the survey which is situated in Lucknow, Uttar Pradesh. Current estimated population of Lucknow in 2024 is approximately 5,870,000. The Nagram Nagar Panchayat has population of 10,648. Population of Children with age of 0-6 is 1551 which is 14.57 % of total population of Nagram.

1. Study Subject:

According to WHO and NIN (National Institute of Nutrition), 3–5 years-old age group of children is considered as preschool children. The sample taken was 3-5 years old children as they are at the age of play-school and primary school going children.

1. Sample Size:

Table 1: According to 2011 census study area population and household of study area:-

|  |  |  |  |
| --- | --- | --- | --- |
| Area of Study | Total Population | Number of Household | LGD (Local Government Directory) Code |
| Nagram | 10648 | 2662 | 143753 |
| Katra Nagram | 1 | 1 | 143757 |
| Sekhanapur | 1044 | 261 | 143627 |

Table 2: According to expected 2024 census population and household of study area:-

|  |  |  |  |
| --- | --- | --- | --- |
| Area of Study | Total Population | Number of Household | LGD (Local Government Directory) Code |
| Nagram | 15000 | 3750 | 143753 |
| Katra Nagram | 6000 | 1500 | 143757 |
| Sekhanapur | 7000 | 1750 | 143627 |

To calculate the sample size for a population of (15000+6000+7000) 28,000 for descriptive purposes, you need to determine the level of confidence, margin of error, and the population proportion (if applicable). Typically, statisticians use a confidence level of 95% and a margin of error of 5% for descriptive studies. Here's how to calculate it:

1. Determine the confidence level (CL):
* Standard value for CL is often 95%.
1. Determine the margin of error (E):
* Standard value for E is often 5%.
1. Use the following formula to calculate the sample size (N):

 Z2​ X p X (1 – p)

N = --------------------

 E2

Where:

* Z is the Z-score corresponding to the confidence level.
* p is the estimated population proportion (if unknown, use 0.5 for maximum variability).
* E is the margin of error.

Given:

* Confidence level (CL) = 95% → Z-score ≈ 1.96 (standard value for 95% CL)
* Margin of error (E) = 5% = 0.05
* Population (N) = 28,000
* We'll use 𝑝 = 0.5 for maximum variability since the population proportion is not given.

Plugging the values into the formula:

 (1.96)2 X 0.5 X (1 – 0.5)

N = -----------------------------

 (0.05)2

* 1. X 0.25

N = -----------------

 0.0025

 0.9604

N = --------

 0.0025

N = 384.16 = 385 (approx.)

The sample size for descriptive purposes is approximately 385. So, a sample size of approximately 385 would be needed for descriptive analysis with a population of 28,000, a confidence level of 95%, and a margin of error of 5%.

1. Study Design:

The approach adopted for this study was purposively one. Purposive sampling is a non-probability sampling technique used in research to select individuals or groups of individuals that meet specific criteria relevant to the research question or objective. This sampling technique is also known as judgmental sampling or selective sampling, and it is often used when the population being studied is too small, too difficult to access, or too heterogeneous to use probability sampling methods [4,6].



**Figure 1: Flow chart of sampling size**

1. Inclusion Criteria
* Age: Preschool children aged between 3 to 5 years.
* Location: Children residing in a specific geographical area or community.
* Socioeconomic Status: Children from diverse socioeconomic backgrounds to capture a range of dietary habits.
1. Exclusion Criteria
* Age: Children outside the specified age range (e.g., below 3 years or above 5 years).
* Residency**:** Children residing outside the designated study area.
* Unwillingness to Participate: Families or caregivers unwilling to participate in the study or provide necessary information.
1. Anthropometric Measurements

Anthropometric measurements are non-invasive quantitative measurements of the body. The core elements of anthropometry are height, weight, head circumference, body mass index (BMI), body circumferences to assess for adiposity (waist, hip, and limbs), and skinfold thickness.

1. Height: **-**For children who can stand, a stadiometer was used [14].

Table 3: Height (cm) of preschool children (3-5 years) reported from World Health Organization (WHO) child growth standards: -

|  |  |  |
| --- | --- | --- |
| Age (Years) | Boys (cm)  | Girls (cm) |
| 3 | 94.9 | 93.9 |
| 4 | 102.9 | 101.6 |
| 5 | 109.9 | 108.4 |

1. Weight: - For children less than two years of age, use a calibrated beam or a digital infant scale [14].

Table 4: Body weight (kg) of preschool children (3-5 years) reported from World Health Organization (WHO) child growth standards:

|  |  |  |
| --- | --- | --- |
| Age (Years) | Boys (Kg)  | Girls (Kg) |
| 3 | 15.3 | 15.0 |
| 4 | 16.5 | 16.0 |
| 5 | 18.5 | 18.3 |

1. Mid- Upper Arm Circumference: - MUAC is an accurate way to measure fat- free mass. This factor helps determine the development of muscles that is a good tool for screen and determining the risk of mortality in children [14].

Table 5: Mid- Upper Arm Circumference (MUAC) of preschool children reported from World Health Organization under Child Growth Standards:

|  |  |  |
| --- | --- | --- |
| Age (Years) | Boys (MUAC) | Girls (MUAC) |
| 2  | 15.2 cm | 14.9 cm |
| 3  | 15.7 cm | 15.6 cm |
| 4  | 16.1 cm | 16.2 cm |
| 5  | 16.5 cm | 16.9 cm |

1. Head circumference: Head circumference was taken by round of head. The child was asked to stand stately [14].

Table 6: Head Circumference of preschool children reported from World Health Organization under Child Growth Standards:

|  |  |  |
| --- | --- | --- |
| Age (Years) | Boys (Head Circumference) | Girls (Head Circumference) |
| 2  | 48.3 cm | 48.7 cm |
| 3  | 49.3 cm | 48.5 cm |
| 4  | 50.2 cm | 49.3 cm |
| 5  | 50.7 cm | 49.9 cm |

1. Waist Circumference: - To measure waist circumference, patients should stand with their arms crossed on the contralateral shoulders [13].

Table 7: Waist Circumference of preschool children reported from World Health Organization (WHO) child growth Standards:

|  |  |  |
| --- | --- | --- |
| Age (Years) | Boys (Waist Circumference) | Girls (Waist Circumference) |
| 2  | 45.5 - 48.5 cm | 45.0 - 47.5 cm |
| 3  | 46.0 - 49.0 cm | 46.0 - 48.0 cm |
| 4  | 47.0 - 50.0 cm | 47.0 - 49.0 cm |
| 5  | 48.0 - 51.0 cm | 48.0 - 50.0 cm |

1. Body Mass Index (BMI): - BMI is a calculation based on the height and weight of the child and is recommended by the CHDP guidelines for all children older than two years of age [14]. The formulas for the calculation of BMI in children are as follows:

 BMI = Weight (kg) / Height (m2)

Table 8: Body Mass Index (BMI) of preschool children reported from National Institute Nutrition (NIN) growth Standards:

|  |  |  |
| --- | --- | --- |
| Age (Years) | Boys (BMI in kg/m²) | Girls (BMI in kg/m²) |
| 2  | 14.5 - 16.5 | 14.5 - 16.5 |
| 3  | 15.0 - 17.0 | 15.0 - 17.0 |
| 4  | 15.5 - 17.5 | 15.5 - 17.5 |
| 5  | 16.0 - 18.0 | 16.0 - 18.0 |

**Results and Discussion:**

The analysis and interpretation of the data of the study are based on the collected data through self-structured questionnaire on (A) demographic and socioeconomic status and (B) Anthropometric measurements of preschool children (3-5 years).

1. **Demographic and socio-economic status of preschool children**

This section of the present study discusses the demographic profile under various parameters such as age, gender, family size, educational status of the family etc. further socioeconomic status of the study subject was assessed on the kuppuswamy scale that contains aspects such as family income, working members of family etc [1,9].

1. **Age**

Table 9: Distribution of the respondent according to Age

|  |
| --- |
| **Age of Preschool Child** |
|   Years | Frequency N=385 | Percent | Valid Percent | Cumulative Percent |
| 3  | 81 | 21 | 21 | 21 |
| 4  | 185 | 48.1 | 48.1 | 69.1 |
| 5  | 119 | 30.9 | 30.9 | 100 |
| Total | 385 | 100 | 100 |   |

The furnished data in table (9) indicated that 21.0 % of the children were belonging to the age of 3 years old, 48.1 % of the children were belonging to the age of 4 years old and 30.9 % of the children were belonging to the age of 5 years old. Thus, it was found that the majority (48.1%) of respondent were in the age group of 4 years old. This information is crucial for accurate and meaningful analyses, allowing researchers to identify demographic trends, target specific age groups for interventions or marketing strategies, and explore age-related factors influencing outcomes within the dataset. The observed distribution emphasizes the importance of considering age as a relevant demographic variable in research studies, as different age groups may exhibit distinct behaviors, preferences, or responses to stimuli, necessitating tailored approaches in data interpretation and decision-making. In conclusion, the frequency and cumulative frequency distribution provide valuable insights into the age composition of the participant sample, enabling researchers to draw meaningful conclusions and formulate targeted strategies based on age-related trends within the data set.

1. **Gender**

Table 10: Distribution of the respondent according to Gender

|  |
| --- |
| **Gender of Preschool Child** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Male | 211 | 54.8 | 54.8 | 54.8 |
| Female | 174 | 45.2 | 45.2 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished result in table (10) indicates that majority of 54.8 % of the respondent sample were male and 45.2 % of respondent sample were female in the age group of 3-5 years old. This highlights potential gender-related biases or disparities in recruitment, participation, or representation. Also, this distribution provides valuable insights into the gender representation within the surveyed population. Understanding the gender composition of the sample is crucial for ensuring the validity and generalizability of study findings, especially in fields where gender-related factors play a significant role. Gender-specific analyses can provide valuable insights into gender related phenomena and inform gender-sensitive interventions or policies. Ethical considerations should also be considered, as acknowledging and addressing gender disparities in research is essential for producing valid, reliable, and socially responsible findings that accurately reflect diverse perspectives and experiences. Ensuring fairness and equity in participant recruitment and representation is essential for upholding ethical standards in research practices. Understanding these demographics is crucial for interpreting the results accurately and drawing meaningful conclusions from the data.

1. **Family type of respondent**

Table 11: Distribution of the family type of respondent

|  |
| --- |
| **Type of Family** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Joint Family | 66 | 17.1 | 17.1 | 17.1 |
| Nuclear Family | 319 | 82.9 | 82.9 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

 The furnished result in table (11) indicates that majority of 17.1 % of the respondent family type were belonging to the joint family and 82.9 % of the respondent family type were belonging to the nuclear family.

1. **Number of family members**

Table 12: Distribution of family members

|  |
| --- |
| **Family Members** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 2 members | 92 | 23.9 | 23.9 | 23.9 |
| 3 members | 117 | 30.4 | 30.4 | 54.3 |
| 4 members | 175 | 45.5 | 45.5 | 99.7 |
| 6 members | 1 | .3 | .3 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished data in table (12) indicated that 23.9 % of the family members were belong to the category of 2 members, 30.4 % of the family members were belong to the category of 3 members, 45.5 % of the family members were belong to the category of 4 members and 0.3 % of the family members were belong to the category of 6 members. Thus, it was found that the majority (45.5%) of the family members were belong to the category of 4 members.

1. **Education of family members**

Table 13: Distribution of education of family members

|  |
| --- |
| **Literacy of Family Member** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Literate | 378 | 98.2 | 98.2 | 98.2 |
| Illiterate | 7 | 1.8 | 1.8 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished data in table (13) indicated that 98.2 % of the family members education were belong to the category of literate and 1.8 % of the family members education were belong to the category of illiterate. Thus, it was found that the majority (98.2%) of the family members education were belong to the category of literate.

1. **Occupation of family members:**

Table 14: Distribution of occupation of family members of respondent

|  |
| --- |
| **Occupation of Family Member** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Employed | 231 | 60.0 | 60.0 | 60.0 |
| Unemployed | 13 | 3.4 | 3.4 | 63.4 |
| Business | 73 | 19.0 | 19.0 | 82.3 |
| Farmer | 68 | 17.7 | 17.7 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished data in table (14) indicates that 60.0 % % of the family members were belong to the category of Employed, 3.4 % of the family members were belong to the category of unemployed, 19.0 % of the family members were belong to the category of Business and 17.7 % of the family members were belong to the category of farmer. Figure (1) offers valuable insights into the occupational distribution of the respondents, providing a comprehensive understanding of the employment landscape within the surveyed population. Occupational status is a crucial determinant of socio-economic well-being, access to resources, and overall quality of life. Analysing the distribution across various occupational categories can illuminate patterns of employment, economic activity, and potential implications for social policies and interventions.

1. **Monthly household Income:**

Table 15: Distribution according to the family income per month

|  |
| --- |
| **Monthly Household Income** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Less than 5,000 Rupee | 60 | 15.6 | 15.6 | 15.6 |
| 5,000-10,000 Rupee | 228 | 59.2 | 59.2 | 74.8 |
| 10,000-15,000 Rupee | 51 | 13.2 | 13.2 | 88.1 |
| 15,000-20,000 Rupee | 46 | 11.9 | 11.9 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished data in table (15) indicates that the 15.6 % of the respondent were belong to the category of less than 5000-rupee monthly income, 59.2 % of the respondent were belong to the category of 5,000-10,000 rupees monthly income, 13.2 % of the respondent were belong to the category of 10,000-15,000 rupees monthly income and 11.9 % of the respondent were belong to the category of 15,000-20,000 rupees monthly income. Therefore, suggesting a considerable proportion transitioning into the middle-income bracket. This group may experience a slightly higher standard of living compared to the lower income brackets, with greater financial stability and access to some discretionary spending.

1. **Cultural Beliefs and Practices:**

Table 16: Distribution of the respondent according to Religion

|  |
| --- |
| **Religion of Child** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Hindu | 290 | 75.3 | 75.3 | 75.3 |
| Muslim | 95 | 24.7 | 24.7 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished data in table (16) indicates that majority of 75.3 % of the respondent sample were Hindu’s and 24.7 % of the respondent sample were Muslim’s in the age group of 3-5 years old.

1. **Anthropometric measurement of preschool children**

Anthropometric measurements are non-invasive quantitative measurements of the body, used to assess nutritional status in children and adults. They can also help determine body composition in adults, identify underlying nutritional status. The core elements of anthropometry include height, weight, head circumference, MUAC (Mid Upper Arm Circumference), waist circumference and BMI [2,3].

1. **Height:**

Height is a measure of the length of a child from the top of the head to the soles of the feet when standing straight, without shoes. It is used to assess the child’s overall growth and development, particularly to monitor if they are growing within expected ranges for their age.

Table 17: Distribution of height of respondent

|  |
| --- |
| **Height of the Child in Centimetres** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 88 | 4 | 1.0 | 1.0 | 1.0 |
| 92 | 4 | 1.0 | 1.0 | 2.1 |
| 98 | 4 | 1.0 | 1.0 | 3.1 |
| 100 | 12 | 3.1 | 3.1 | 6.2 |
| 101 | 18 | 4.7 | 4.7 | 10.9 |
| 102 | 12 | 3.1 | 3.1 | 14.0 |
| 103 | 26 | 6.8 | 6.8 | 20.8 |
| 104 | 58 | 15.1 | 15.1 | 35.8 |
| 105 | 40 | 10.4 | 10.4 | 46.2 |
| 106 | 23 | 6.0 | 6.0 | 52.2 |
| 107 | 41 | 10.6 | 10.6 | 62.9 |
| 108 | 12 | 3.1 | 3.1 | 66.0 |
| 109 | 25 | 6.5 | 6.5 | 72.5 |
| 110 | 4 | 1.0 | 1.0 | 73.5 |
| 111 | 27 | 7.0 | 7.0 | 80.5 |
| 112 | 28 | 7.3 | 7.3 | 87.8 |
| 113 | 19 | 4.9 | 4.9 | 92.7 |
| 114 | 4 | 1.0 | 1.0 | 93.8 |
| 115 | 4 | 1.0 | 1.0 | 94.8 |
| 116 | 4 | 1.0 | 1.0 | 95.8 |
| 117 | 16 | 4.2 | 4.2 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished data in table (17) contributes that 1 % of the respondent belong to the category of 88 cm of height, 1% of the respondent belong to the category of 92 cm of height, 1 % of the 98 cm of height, 3.1 % of the respondent belong to the category of 100 cm of height, 4.7 % of the respondent belong to the category of 101 cm of height, 3.1 % of the respondent belong to the category of 102 cm of height, 6.8 % of the respondent belong to the category of 103 cm of height, 15.1 % of the respondent belong to the category of 104 cm of height, 10.4 % of the respondent belong to the category of 105 cm of height, 6.0 % of the respondent belong to the category of 106 cm of height, 10.6 % of the respondent belong to the category of 107 cm of height, 3.1 % of the respondent belong to the category of 108 cm of height, 6.5 % of the respondent belong to the category of 109 cm of height, 1.0 % of the respondent belong to the category of 110 cm of height, 7.0 % of the respondent belong to the category of 111 cm of height, 7.3 % of the respondent belong to the category of 112 cm of height, 4.9 % of the respondent belong to the category of 113 cm of height, 1.0 % of the respondent belong to the category of 114 cm of height, 1.0 % of the respondent belong to the category of 115 cm of height, 1.0 % of the respondent belong to the category of 116 cm of height and 4.2 % of the respondent belong to the category of 117 cm of height. The study presents the demographic profile of the population, focusing on the total number of individuals surveyed and their height distribution. Future research could explore the relationship between height and socio-economic or health indicators.

1. **Weight:**

Weight is the measure of a child’s mass, usually taken with a calibrated scale. Weight is an important indicator of nutritional status. Significant deviations from expected weight ranges can indicate undernutrition, overnutrition, or health conditions.

Table 18: Distribution of weight of respondent

|  |
| --- |
| **Weight** |
| **Kg** | **Frequency (N=385)** | **Percentage (%)** |
| 12 | 7 | 1.8 |
| 13 | 16 | 4.2 |
| 14 | 54 | 14 |
| 15 | 133 | 34.5 |
| 16 | 119 | 31.1 |
| 17 | 44 | 11.4 |
| 18 | 4 | 1 |
| 19 | 4 | 1 |
| 20 | 4 | 1 |

The furnished data in table (18) contributes that the 1.8 % respondent belongs to the category of 12 kg of weight, 4.2 % respondent belongs to the category of 13 kg of weight, 14 % respondent belongs to the category of 14 kg of weight, 34.5 % respondent belongs to the category of 15 kg of weight, 31.1 % respondent belongs to the category of 16 kg of weight, 11.4 % respondent belongs to the category of 17 kg of weight, 1 % respondent belongs to the category of 18 kg of weight, 1 % respondent belongs to the category of 19 kg of weight and 1 % respondent belongs to the category of 20 kg of weight. Potential health implications of different weight categories among preschool children, including risks associated with underweight, overweight, and obesity. Consider short-term and long-term consequences for physical health, psychosocial well-being, and development. Also, promoting healthy weight status and addressing modifiable risk factors to support optimal growth and development during the preschool years.

1. **Head circumference:**

Head circumference is the measurement around the largest part of a child’s head, just above the eyebrows and ears. It is used to monitor brain growth and development in children, as abnormal measurements may suggest neurological conditions or malnutrition.

Table 19: Distribution of head circumference of respondent

|  |
| --- |
| **Head Circumference in Centimetres** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 41 | 4 | 1.0 | 1.0 | 1.0 |
| 42 | 59 | 15.3 | 15.3 | 16.4 |
| 43 | 158 | 41.0 | 41.0 | 57.4 |
| 44 | 76 | 19.7 | 19.7 | 77.1 |
| 45 | 16 | 4.2 | 4.2 | 81.3 |
| 46 | 16 | 4.2 | 4.2 | 85.5 |
| 47 | 24 | 6.2 | 6.2 | 91.7 |
| 48 | 20 | 5.2 | 5.2 | 96.9 |
| 49 | 8 | 2.1 | 2.1 | 99.0 |
| 50 | 4 | 1.0 | 1.0 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished data in table (19) contributes that the 1.0 % respondent belongs to the category of 41 cm of head circumference, 15.3 % respondent belongs to the category of 42 cm of head circumference, 41 % respondent belongs to the category of 43 cm of head circumference, 19.7 % respondent belongs to the category of 44 cm of head circumference, 4.2 % respondent belongs to the category of 45 cm of head circumference, 4.2 % respondent belongs to the category of 46 cm of head circumference, 6.2 % respondent belongs to the category of 47 cm of head circumference, 5.2 % respondent belongs to the category of 48 cm of head circumference, 2.1 % respondent belongs to the category of 49 cm of head circumference and 1.0 % respondent belongs to the category of 50 cm of head circumference. Possible explanations for variations in head circumference measurements observed in existing literature on head circumference and child development. Consider potential interventions or preventive strategies aimed at promoting optimal head growth and neurodevelopment in children.

1. **Mid Upper Arm Circumference:**

MUAC is the circumference of the upper arm, measured at the midpoint between the shoulder and the elbow. It is a quick and effective screening tool to assess nutritional status, particularly for detecting undernutrition. A low MUAC is often used to identify children at risk of malnutrition.

Table 20: Distribution of MUAC of respondent

|  |
| --- |
| **Mid Upper Arm Circumference** |
| **cm** | **Frequency (N)** | **Percentage (%)** |
| 13 | 4 | 1 |
| 14 | 67 | 17.4 |
| 15 | 61 | 15.8 |
| 16 | 110 | 28.6 |
| 17 | 105 | 27.3 |
| 18 | 38 | 9.9 |

The furnished data in table (20) contributes that the 1 % respondent belongs to the category of 13 cm of MUAC, 17.4 % respondent belongs to the category of 14 cm of MUAC, 15.8 % respondent belongs to the category of 15 cm of MUAC, 28.6 % respondent belongs to the category of 16 cm of MUAC, 27.3 % respondent belongs to the category of 17 cm of MUAC and 9.9 % respondent belongs to the category of 18 cm of MUAC. Implications of the MUAC measurements in the context of nutritional assessment. Highlight the significance of MUAC as a simple, non-invasive indicator of acute malnutrition in preschool children and also, further investigation, such as longitudinal studies to assess the predictive value of MUAC for long-term health outcomes in preschool children.

1. **Waist Circumference:**

Waist circumference is the measurement around the waist at the level of the navel (belly button). This measurement can help assess the risk of overweight or obesity in children. It is often used alongside other measurements like BMI to understand body fat distribution.

Table 21: Distribution of waist circumference of respondent

|  |
| --- |
| **Waist Circumference in Centimetres** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 41 | 4 | 1.0 | 1.0 | 1.0 |
| 42 | 4 | 1.0 | 1.0 | 2.1 |
| 43 | 54 | 14.0 | 14.0 | 16.1 |
| 44 | 136 | 35.3 | 35.3 | 51.4 |
| 45 | 153 | 39.7 | 39.7 | 91.2 |
| 46 | 30 | 7.8 | 7.8 | 99.0 |
| 47 | 4 | 1.0 | 1.0 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The analysis of data in table (21) contributes that the 1 % respondent belongs to the category 41 cm of waist circumference, 1 % respondent belongs to the category 42 cm of waist circumference, 14 % respondent belongs to the category 43 cm of waist circumference, 35.3 % respondent belongs to the category 44 cm of waist circumference, 39.7 % respondent belongs to the category 45 cm of waist circumference, 7.8 % respondent belongs to the category 46 cm of waist circumference and 1 % respondent belongs to the category 47 cm of waist circumference. Implications of the observed waist circumference measurements for the health and well-being of preschool children. Consider how waist circumference relates to body composition, abdominal adiposity, and risk factors for chronic diseases. And, the observed waist circumference measurements align with established reference values or growth standards for preschool children.

1. **Body Mass Index (BMI):**

BMI is calculated using the formula:

**BMI = Weight (kg) / Height (m)2**

BMI is used to assess whether a child has a healthy weight for their height. It can be used to identify underweight, normal weight, overweight, or obesity in children, though growth charts specific to children’s age and sex are essential for interpreting BMI in this age group.

Table 22: Distribution of BMI of respondent

|  |
| --- |
| **BMI** |
|  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Under weight | 294 | 76.4 | 76.4 | 76.4 |
| Normal | 72 | 18.7 | 18.7 | 95.1 |
| overweight | 12 | 3.1 | 3.1 | 98.2 |
| Obese | 7 | 1.8 | 1.8 | 100.0 |
| Total | 385 | 100.0 | 100.0 |  |

The furnished data in table (22) contributes that the 76.4 % of respondent among the category of underweight, 18.7 % of respondent among the category of normal, 3.1 % of respondent among the category of overweight and 1.8 % of respondent among the category of obese. Potential factors that may influence BMI among preschool children, such as diet quality, physical activity levels, parental feeding practices, socioeconomic status, and environmental factors and also, promoting healthy weight management and preventing obesity among preschool children. This may include strategies targeting diet, physical activity, screen time, and the food environment.

**Association between sociodemographic and anthropometric measurements of preschool children:**

1. **Parental Education and Children's Growth:**

According to the table (23) the parents of the children with a higher literacy rate which is 98.2 % tend to have better nutritional outcomes and healthier anthropometric measurements. This is because educated parents are more likely to understand the importance of good nutrition, regular health check-ups, and early childhood care [7].

Table 23: Parental Education and Children's Growth parameters of according to NIN and WHO:

|  |  |
| --- | --- |
| Percentage (%) (N=385) | Average anthropometric parameter of child (Normal Category) |
| Height  | weight  | MUAC | Head circumference | Waist circumference |
| 94.9-109.9 cm | 15.3-18.5 cm | 15.2-16.5 cm | 47.3-50.7 cm | 44.5-51.0 cm |
| Literacy of parent | Literate | 98.20% | % | 275 = 71.4% | 300 = 77.9 % | 276 = 71.6 % | 56 = 14.5 % | 323 = 83.8 % |
| Illiterate | 1.80% |
| \*Note: 275, 300, 276, 56, and 323 are the number of children fit under the criteria of healthy growth standard |
|  |

1. **Income and Access to Nutrition:**

According to the survey in table (15) mentioned above that the family income of preschool children are mostly belongs to the category of income 5,000-10,000 rupee with a frequency of 228 out of 385 which is strongly influence the dietary choices which happens to be seasonal vegetables, fruits, and cereals and also milk and milk products. Individuals of lower socioeconomic status often facing challenges in accessing and consuming healthy foods but only 3.4 % of the family members were belong to the category of unemployed according to table (14) which helps individuals to work in multiple fields and also 82.9 % of the family members were belong to the nuclear family as well as 30.4 % and 45.5 % of the family were belong to the category of 2 members and 3 members. See table (11 and 12), therefore the access of nutritional food is easily affordable for every individual.

1. **Cultural Beliefs and Practices:**

In table (24) 75.3 % of children were Hindu’s and 24.7 % of were Muslim’s. In cultural contexts, the introduction of complementary foods or feeding practices are vary, affecting children’s growth patterns. And cultural practices result in overfeeding or underfeeding but according to survey height, weight, MUAC, head circumference, and waist circumference of children are affected by some minor and major aspects by their cultural practices and dietary intake according to be their beliefs [5]. For total 385 children the height of total frequency of under height and over height category are 8 (2.07 %) and 102 (26.49 %), weight category comes by underweight and overweight with frequency of 77 (20 %) and 8 (2.07 %), MUAC category comes by under and over with frequency of 71 (18.44 %) and 143 (37.14 %), head circumference category comes by under and over with frequency of 329 (85.45 %) and 0, and waist circumference category comes by under and over with frequency of 62 (16.10 %) and 0.

Table 24: Cultural beliefs and anthropometric parameters of preschool children.

|  |  |
| --- | --- |
| Percentage (%) (N=385) | Average anthropometric parameter of child (Under-Over Category) |
| Height  | weight  | MUAC | Head circumference | Waist circumference |
| 88-93 cm | 111-117 cm | 12-14 cm | 19-20 cm | 13-14 cm | 17-18 cm | 41-46 cm | 50-56 cm | 41-43 cm | 52-54 cm |
| Religion of child |   | Frequency | % | **Under**  | **Over** | **Under** | **Over** | **Under** | **Over** | **Under** | **Over** | **Under** | **Over** |
| Hindu | 290 | 75.3 | 8 = 2.07 % | 102 = 26.49 % | 77 = 20 % | 8 = 2.07 % | 71 = 18.44 % | 143 = 37.14 % | 329 = 85.45 % | 0 | 62 = 16.10 % | 0 |
| Muslim | 95 | 24.7 |

**Conclusion:**

**Association between sociodemographic and anthropometric measurements of preschool children:**

The growth and development of children, especially during the critical preschool years, are deeply influenced by a combination of parental education, family income, access to nutrition, and cultural beliefs and practices. These factors interplay in shaping the overall health and well-being of children.

**1. Parental Education and Children’s Growth:**

Parental education, particularly maternal education, plays a crucial role in a child's growth. Educated parents are more likely to be knowledgeable about proper child nutrition, health practices, and early developmental milestones. They are better equipped to make informed decisions regarding nutritional needs, promoting healthy eating habits, recognizing early signs of growth issues or malnutrition, ensuring timely healthcare and vaccinations, providing a supportive learning environment that aids cognitive and physical development.

**2. Income and Access to Nutrition:**

Family income is a key determinant of a child's nutritional status. Lower-income families often face constraints in accessing a balanced, nutritious diet, healthcare, and other resources that are essential for healthy growth [13]. Poor nutritional intake, characterized by insufficient calories, protein, vitamins, and minerals, can lead to undernutrition, stunting, and developmental delays in children. Higher income levels typically allow families to afford a wider range of healthy foods, regular medical care, and educational support, leading to better growth and development.

**3. Cultural Beliefs and Practices:**

Cultural beliefs and practices have a significant impact on child-rearing and nutrition. These beliefs may shape the types of food considered appropriate for children, feeding practices and schedules, such as the timing of weaning or restrictions on certain foods, and attitudes toward healthcare and seeking medical help. While some cultural practices promote healthy child development (e.g., the emphasis on breastfeeding or the use of nutritious local foods), others may contribute to suboptimal health outcomes. For example, certain cultural practices might restrict access to essential foods or create dietary imbalances. In some regions, cultural taboos or preferences may limit children's access to key nutrients, which can negatively affect growth [12]. Additionally, certain beliefs may discourage the use of modern healthcare services, which can delay the identification and treatment of malnutrition or illness.

Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

1.

2.

3.

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