



LOW GESTATIONAL MID UPPER ARM CIRCUMFERENCE IN PREGNANT WOMEN AND ITS RELATION TO POOR PREGNANCY OUTCOME AT SPHMMC, A THESIS SUBMITTED TO SAINT PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR POSTGRADUATE STUDY IN OB-GYN

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Contents

Abstracts	IV
List of abbreviation.....	V
1. Introduction	1
2. Literature review.....	3
3. Objectives.....	6
3.1 General objective.....	6
3.2 specific objectives.....	6
4. Methodology	7
4.1 Study Area	7
4.3 Study Design	7
4.4 Population.....	7
4.4.1 Source Population	7
4.4.2 Study Population	7
4.4.3 Inclusion criteria	8
4.4.4 Exclusion criteria	8
4.5 Sample Size and Sampling Procedure	8
4.6 Study Variables	8
4.6.1 Independent variables	8
4.6.2 Dependent Variables	9
4.7 Data Collection	9
4.8 Data Quality Assurances.....	9
4.9 Data processing and Analysis.....	10
4.10 Ethical Consideration	10
4.11 Operational definitions.....	10
5. Results	12
6. Discussion.....	15

7. Strength and limitation of the study.....	17
8. Conclusion and Recommendations.....	18
Annex I: Consent Form.....	19
Annex II: Amharic version of consent form	21
Annex III: Data collecting format	24
Annex IV: References	27

Abstracts

Background: Mid Upper Arm Circumference is the most useful measurement for identifying pregnant women with increased risk of Low Birth Weight, Intra Uterine Growth Restriction or fetal/ infant mortality compared to all other anthropometric indicators investigated.

Objective: The objective of the study is to determine the magnitude and associated factors with low gestational MUAC for mothers having labor and delivery at SPHMMC.

Methodology: A cross-sectional prospective study was conducted on mothers who came for labor and deliver. During the study period 876 deliveries were registered and 385 of them were selected by Systematic random sampling method and analyzed. Logistic regression was used to analyze the data, odds ratio (OR) and confidence intervals (CI) are reported.

Results: The incidence of IUGR was 28.6% and it was significantly associated with low gestational MUAC with OR=2.4(95% CI=1.48-3.93) and Anemia was found in 8.3% of mothers and it was significantly associated with low gestational MUAC with OR=2.4(95% CI=1.12-5.2). The rate of PTB in this study was 13.5% and no significant association was found with low gestational MUAC. LBW was 30.4% with no significant association with low gestational MUAC.

Conclusion and recommendations: Low gestational MUAC is found in significant proportion of mothers having labor and delivery at SPHMMC and it is significantly associated with anemia and IUGR. MUAC should be measured routinely at ANC follow up to identify those at risk of anemia and IUGR.

Keywords: MUAC, IUGR, PTB, LBW and Anemia

List of abbreviation

MUAC	mid Upper Arm Circumference
LBW	Low birth weight
PTB	Preterm Birth
IUGR	Intrauterine growth restriction
BMI	Body mass Index
HCT	Hematocrit
SPHMMC	St. Paul's hospital millennium medical college
AAU	Addis Ababa University
WHO	world health organization
POCT	Point-of –care test
DHS	Demographic and Health Survey
SFPs	Supplemental and Feeding Program
EGOPD	Emergency Gynecology and Obstetrics OPD

1. Introduction

Mid Upper Arm Circumference (MUAC) is the most useful measurement for identifying pregnant women with increased risk of Low Birth Weight (LBW), Intra Uterine Growth Retardation (IUGR) or fetal/ infant mortality compared to all other anthropometric indicators investigated (weight-for-gestational-age, weight gain, absolute weight, pre- or early pregnancy weight, BMI, pre- or early pregnancy BMI). (1)

Maternal malnutrition is an important risk factor for adverse infant outcomes, including low birth weight (LBW). Birth weight represents a key barometer of fetal health, and LBW infants are at increased risk of morbidity and mortality. While maternal nutritional status is a useful predictor of pregnancy and birth outcomes, evaluating maternal nutritional status in resource-restricted regions remains challenging. Maternal height and weight are frequently unavailable, and if recorded, often inaccurate since adult weigh scales are costly to obtain and maintain calibrated. Clinical observation may be unreliable as maternal malnutrition can be masked by pregnancy-associated weight gain and fluid shifts. (2)

In Harare teaching hospital, Zimbabwe, per 1000 live births the annual incidence of LBW was 199. In Ethiopia, studies conducted in the year 2000 and 2004 in Addis Ababa and around Jimma rural communities showed that the prevalence of LBW was 8.8% and 10%, respectively. According to the Ethiopian Demographic and Health Survey (DHS) report, 23% of babies born in the rural setting were LBW. The same report showed the prevalence of LBW for rural Oromia region was 20.5%. (7)

There is no any evaluation and intervention method in our ANC, labor and delivery in SPHMMC regarding malnutrition during pregnancy. The evaluation of malnutrition during ANC will be evaluated only for HIV positive mothers in some hospitals and health centers using MUAC.

AS we are part of the developing world those complications of malnutrition like IUGR, LBW, preterm delivery and anemia are expected to be common and evaluation and timely intervention likely avert the long term sequel of maternal malnutrition during pregnancy.

The main purposes of this paper are to examine factors associated with maternal malnutrition measured using MUAC and assess the associated complications. As a matter of fact, no published research study was found on the subject matter in the institution. Therefore, the study on this topic is relevant and timely.

The finding of this study will have several implications for ANC follow up and programs. At the same time it will fill in the gap at maternal evaluation for nutritional status during pregnancy. It can help as a base to initiate other studies that will be conducted in the institute.

2. Literature review

Maternal mid upper arm circumference is a potential indicator of maternal nutritional status. It could be used in association with other anthropometric measurements, instead of pre-pregnancy weight, as an alternative indicator to assess women at risk of poor pregnancy outcome. (1)

Maternal MUAC measured during gestation has been shown to be associated with LBW in a number of African and Asian studies, although no reference ranges have been established. (2)

Vitamin A and iron deficiencies are among the most common nutritional deficiencies in most developing countries probably second to Protein- Energy- Malnutrition. It is estimated that 80% of pregnant women in developing countries do not meet their Recommended Dietary Allowance (RDA) for iron and 25% of these women have extremely low vitamin A intakes therefore resulting in clinical and sub clinical signs of iron and vitamin A deficiencies. These deficiencies have implications on maternal nutritional status and health that may ultimately affect birth outcomes. There is significant relationship between vitamin A consumption levels, iron consumption levels and nutritional status of the pregnant women. The inadequate dietary intake of iron put them at risk of pregnancy complications such as anemia and maternal morbidity. (4)

Preterm birth is a major determinant of neonatal mortality and childhood morbidity. There seems to be an upward trend, which contributes to almost 3.6 million preterm births accounting for 23.6% of the global preterm births reported each year. Preterm birth has been consistently associated with maternal underweight and nutrient deficiencies during pregnancy. Therefore, nutritional assessment needs to be an integral part of antenatal care and should be continued during pregnancy in order to reduce the risk of maternal, fetal and neonatal complications, as well as the short- and long-term adverse outcomes.(5)

Though its extent varies from place to place, LBW is a common phenomenon in many parts of the world. For example, in North America, its prevalence is less than 6%, studies in Thailand, Pakistan and Iran showed its prevalence ranges from 8–15% of the annual births. Low Birth Weight (LBW) is one of the risk factors for child morbidity and mortality. A child's birth weight is an important indicator of the child's vulnerability to the risk of childhood illnesses and the chances of survival. Children whose birth weight is less than 2.5 kilograms, are considered to have a higher than average risk of early childhood death. (7)

Mid upper arm circumference (MUAC) is a clinical indicator of nutritional status frequently used in famine relief because of its correlation with body mass index (BMI) and because it is not affected by edema. MUAC reflects both past and present nutritional status and is less responsive than body weight to short-term changes in health and nutritional status. Because it is relatively stable throughout pregnancy, even when measured late in gestation, MUAC may be more reflective of nutritional status than body weight. (10)

There are differences between developed and developing countries in determining the most appropriate cut-off points for anthropometric measurements. Screenings with measurements that require only one contact with a woman are useful due to limitations in available prenatal care in developing countries. To answer these questions some authors have studied the relationship between maternal mid-upper arm circumference (MUAC) and pregnancy outcome. They have shown that MUAC is a good indicator of pregnancy outcome. (13)

MUAC is a good indicator of the protein reserves of a body, and a thinner arm reflects wasted lean mass, i.e. malnutrition. The WHO Collaborative Study 1995 showed MUAC cut-off values of <21 to 23 cm as having significant risk for LBW (OR 1.9, 95%CI: 95% 1.7-2.1) when highest

and lowest quartiles of the maternal height distribution were compared. As LBW has detrimental effects on a child's survival it seems that a more inclusive approach with a MUAC cut-off of <22 or <23 cm should be used to indicate risk of LBW and to use as entry criterion for nutritional programs. MUAC is rather insensitive to changes over the total period of pregnancy for adult women, is easy to measure, and requires only one measurement. Current data suggest that <23 cm appears adequate for African continent. It is also the most conservative cut-off value ensuring the most pregnant women at risk for LBW are included. It is likely that the relevance of the use of MUAC is similar in different humanitarian emergencies, being it conflict, natural disaster, sudden or slow onset. (14)

Increasingly, MUAC is also being used to assess nutritional status and determine eligibility for nutrition support among adolescents and adults in low-resource settings, especially among pregnant women and people living with HIV (PLHIV) who are eligible for antiretroviral therapy (ART). As with children, the use of MUAC among adolescents and adults offers the advantages of being a simple and relatively inexpensive measure that can be carried out at both community- and facility-based settings. Measurement of MUAC requires minimal equipment and calculations as compared to weight and height measurements for calculation of body mass index (BMI) or other anthropometric measurements, such as skinfold thickness. (15)

Low birth weight (LBW) is the most important risk factor for infant mortality and a significant determinant of childhood morbidity. In developed countries LBW predominantly results from preterm delivery, whereas in developing countries, where LBW incidence is often greater than 10%, it is almost exclusively due to intra-uterine growth retardation (IUGR).(16)

3. Objectives

3.1 General objective

- To determine the magnitude and associated factors with low gestational MUAC for mothers having labor and delivery at SPHMMC

3.2 specific objectives

- To determine the magnitude of low MUAC
- To assess associated factors with low MUAC

4. Methodology

4.1 Study Area

This is a hospital based study conducted in SPHMMC in Addis Ababa, capital of Ethiopia. SPHMMC is one of the tertiary hospitals under the Federal Ministry of Health. It is also a teaching hospital for its students and AAU. The hospital gives service to more than 200,000 patents annually that are referred from all corners of the country. It has almost 900 deliveries every month.

In Ethiopian calendar year of 2003 (September 11, 2010 – September 10 2011), there were 200,714 outpatients, 20,509 emergencies, 12,259 admissions, 4031 deliveries and performed 3432 major surgeries.

The department of Obstetrics and gynecology has 18 consultants and 60 residents with 9000 deliveries in the last Ethiopian year 2008.

4.3 Study Design

A cross-sectional prospective study was conducted on mothers who came for labor and deliver to SPHMMC form January 1 up to 31, 2017.

4.4 Population

4.4.1 Source Population

The source population was mothers having labor and delivery.

4.4.2 Study Population

The study population was mothers having labor and delivery in SPHMMC form January 1 up to 31.

4.4.3 Inclusion criteria

All mothers who have labor and delivery at SPHMMC was included.

4.4.4 Exclusion criteria

Mother died before giving birth or critically ill to give consent were excluded from the study.

4.5 Sample Size and Sampling Procedure

Sample size was calculated using the formula $n = Z^2 p (1-p)/w^2$ where P considered to be 50% as there was no study showing the proportion and it was 385 mothers.

Systematic random sampling was used. The sampling fraction was $900 / 385 = 2$ as the monthly deliveries were 900. Therefore the sampling interval was 2. The first individual was selected with lottery method and the other was selected at a regular interval of two and those selected was interview by data collectors.

4.6 Study Variables

4.6.1 Independent variables

I. Demographic characteristics

- Age
- Place of residence
- Level of education
- Occupation
- Religion
- Marital status

II. Reproductive Characteristics

- Gravidity
- Parity
- Gestational age
- Planned Vs. Unplanned pregnancy

III. Antenatal care follow-up

- Number of ANC
- Iron supplementation

IV. Mid upper arm circumference

4.6.2 Dependent Variables

- Birth weight
- Maternal hematocrit or hemoglobin
- Gestational Age
- IUGR

4.7 Data Collection

Midwives and nurses who followed the labor and attend the delivery collected the primary data from the mother at the time of labor and delivery by interview with structured questionnaire and measure MUAC using the standard adult MUAC measuring tape and secondary data from the patient chart. They were given an orientation before the data collection.

4.8 Data Quality Assurances

Each questionnaire was checked for completeness and was coded every day. Those with any incomplete data were completed by contacting the data collectors or chart review.

4.9 Data processing and Analysis

All questionnaires were checked for completeness and consistency of responses manually. After cleaning, data was entered to SPSS version 20 for analysis. Descriptive statistics (frequencies and percentages) was used to explain the study participant in relation to study variables. Bivariate and multivariate analysis was used to determine the presences of statistically significant associations. The strength of the association was presented by odds ratio and 95% confidence interval. A p value of < 0.05 on multivariate analyses was considered as statistically significant.

4.10 Ethical Consideration

A formal letter of approval was obtained from the SPHMMC IRB. Informed consent was taken from each women and she was informed of her right to exit from the interview any time she wanted. The patients were selected on voluntary bases. Confidentiality was respected throughout the Data collection, analysis and interpretation. The privacy of the patient was respected and she had the right to jump any question. There was no direct risk or benefits for mothers for being a part of this study. The information gained during the study was used only for this study.

4.11 Operational definitions

- Low MUAC is MUAC <23cm
- LBW is birth weight <2500gm
- IUGR is birth weight for gestational age <10percentile with features of IUGR
- Preterm is delivery before 37weeks of gestational age
- Anemia is hematocrit <33% or hemoglobin <11 gm/dl

- Poor pregnancy outcome are those pregnancy complicated with IUGR, Anemia, Preterm birth and Low birth weight.

5. Results

A total of 876 deliveries were attended in the month of January, 2017 at SPHMMC at the labor ward and EGOPD from which 385 of them were selected by systematic random sampling and analyzed. The basic characteristic is shown in Table 1 .Table 2 showed the percentage of poor pregnancy outcome.

29.4% Of mothers having labor and delivery at SPHMMC have low MUAC which has a strong association with anemia (P-value=0.025) and IUGR (P-value=0.000). Anemia is found in 8.3% of mothers who are 2.4 times more likely to have low MUAC (OR=2.4 with 95% CI=1.12-5.2) vs. with mothers having MUAC>23cm. IUGR is found in 29.6% of mothers who are 2.4 times more likely to have low MUAC (OR=2.4 with 95% CI =1.48-3.93)vs. with mothers having MUAC>23cm

Low birth weight and preterm delivery is found in 30.4% and 13.5 % of mothers respectively but no significant association found during bivariate analysis with low MUAC.

Table 2 the basic characteristic of study subjects with LBW, Anemia, IUGR and Low MUAC

Characteristics		Total n=385,n%	Birth Weight<2500gm	Hct<33%	GA<37weeks	IUGR	MUAC<23cm
Age	<19	23(6%)	8	1	6	9	15
	20-35	341(88.6%)	102	29	43	94	93
	>35	21(5.5%)	7	2	3	7	5
Residence	rural	35(9.1%)	16	5	6	14	14
	Urban	350(91.9%)	101	27	46	96	99
Level of education	None	68(17.7%)	22	10	7	21	24
	Primary	151(39.2%)	50	12	22	43	50
	High	106(27.5%)	32	8	16	35	30
	College	60(15.6%)	13	2	7	11	9
Occupation	employed	130(33.8%)	38	7	20	33	28
	unemployed	255(66.2%)	79	25	32	77	85
Marital status	Married	373(96.9%)	113	32	50	106	109
	single	5(1.3%)	1	0	1	2	2
	Divorce	7(1.8%)	3	0	1	2	2
Planned pregnancy	Yes	363(94.3%)	107	28	50	101	99
	No	22(5.7%)	10	4	2	9	14
ANC	Yes	376(97.7%)	114	32	51	107	108
	No	9(2.3%)	3	0	1	3	5
Iron supplementation	Yes	330(85.7%)	103	32	45	95	95
	No	55(14.3%)	14	0	7	15	18

Table 2 the percentage of poor pregnancy outcome and Low MUAC

	Percentage
Low MUAC	29.40%
LBW	30.40%
Anemia	8.30 %
Preterm birth	13.50%
IUGR	28.60%

6. Discussion

In this study 29.4% of mothers have MUAC<23cm but in other study done at kersa by Assefa (7) showed the incidence was 47.3%.

In this study the incidence of IUGR was 28.6% and it was significantly associated with low gestational MUAC with OR=2.4 (95%CI=1.48-3.93) that is mothers with IUGR is 2.4 times more likely to have low MUAC Vs. with mothers without IUGR. This was also showed in other studies done in Malawi by Kalanda (19), 2006 with OR=2.1 (95% CI: 1.1-3.4) that is Women with MUAC <23 were 2.1 times more likely to have disproportionate growth vs. women with MUAC $\geq$ 23 and Verhoeff (16), 2001 with OR=1.5 (95% CI=1.1-1.9) that is women with MUAC <23 were 1.5 times more likely to have IUGR vs. women with MUAC $\geq$ 23.

Anemia was found in 8.3% of mothers which is the lowest when compared with other studies. This study found that there was significant association between low gestational MUAC and anemia with P value of 0.025 and OR=2.4(95% CI=1.12-5.2) that is mothers with anemia is 2.4 times more likely to have low MUAC vs. mothers without anemia. Similar study done by Charles (17), 2010 in Jamaica found out that Women with MUAC <25 were 3.1 times more likely to have anemia vs. women with MUAC $\geq$ 25 with OR=3.1 (95% CI=1.26-7.71) and Verhoeff (21), 1999 Malawi MUAC <23 is significantly associated with anemia for those that are Primigravida and secundigravida but not multigravida.

In our study the incidence of Low birth weight was 30.4%, in other study done at kersa by Assefa showed nearly similar result where the incidence of LBW was 28. 3%. It was found that poor economy, MUAC less than 23 cm, not attending ANC, experience of physical violence and time to walk to health facility 40–79 minutes were strong predictors of LBW. MUAC<23cm is associated with LBW with P value of 0.004 and OR=1.5(95%CI=1.14-2.01). Similar study done by Karim (20), 1997 in Bangladesh reveled LBW with MUAC <23: OR=5.0 (95% CI=1.4-17.9).

But in our study we could not find significant association between low birth weight and low gestational MUAC. Similar studies done by Dhar (23), 2008 in Bangladesh and Elshibly (24), 2008 in Sudan showed that low MUAC did not associate with Low birth weight.

The rate of Preterm birth in this study was 13.5% and no significant association was found with low gestational MUAC. In one Indian study done by Begum (18), 2003 OR= 7.78 (95% CI=3.91-15.62) (Women with preterm labor were 7.8 times more likely to have MUAC <20 vs. women with at-term labor). In another two studies done in Malawi by Verhoeff (16), 2001 and Kalanda (19), 2006 OR=1.8 (95%CI=1.3-2.3) (Women with MUAC <23 were 1.8 times more likely to have a preterm birth vs. women with MUAC $\geq$ 23) and OR=2.0 (95% CI: 1.4-2.9) (Women with MUAC <23 were 2 times more likely to have a preterm birth vs. women with MUAC $\geq$ 23 were found respectively). In another study done in Indonesia by Sebayang (21), 2012 OR=1.13 (95%CI=1.03-1.24) (Women with MUAC <23.5 were 1.1 times more likely to have a preterm birth vs. women with MUAC $\geq$ 23.5).

7. Strength and limitation of the study

The major strength of this study is that it tried to see the association of low gestational MUAC with its poor pregnancy outcomes together unlike other researches where the associations were studied in a separate one. Also the presence IUGR was confirmed with physical signs of IURG not only birth weight <10 percentile.

The major limitation of the study was that for mothers who do not know their GA it used their month of estimation to consider as preterm or term which is not reliable to classify neonates as term or preterm.

8. Conclusion and Recommendations

Low gestational MUAC is found in significant proportion of mothers having labor and delivery at SPHMMC and it is significantly associated with anemia and IUGR. No significant association was found with poor pregnancy outcomes like preterm delivery and low birth weight.

According to the findings of this study, MUAC measurement during pregnancy may aid in the prediction of the poor pregnancy outcomes like anemia and IUGR. So MUAC should be measured routinely during the ANC follow up at SPHMMC and those with low MUAC should have a further work up to detect anemia and IUGR but other similar studies need to be done.

Annex I: Consent Form

Patient's information document

Dear participants!

My name is -----, I am currently a member of data collectors for a research which is conducted by Dr. Fikre Geremew on the study intended to assess the association of low gestational mid upper arm circumference with IUGR, low birth weight maternal anemia and preterm labor at saint Paulo's hospital millennium medical college which is expected to forward recommendations to solve the problem. You are invited to participate on this project. If you are willing to participate on this project, you need to understand and sign the agreement form. After then you will be interviewed by the data collector. You do not need to write your name or to tell your name to the data collector and all your response and the results obtained will be kept confidentially by using coding system.

Procedure:

We invite you to participate in this project. If you are willing to participate in this project, you need to understand and sign the agreement form. Then after, you will be interviewed by data collectors. You do not need to write your name or to tell your name to the data collector and all your responses and the results obtained will be kept confidentially by using coding system whereby no one will have access to your response.

Risk/Discomfort:

By participating in this research project, you may fill that it has some discomfort especially on wasting time about 10 minutes. We hope you will participate in the study for the sake of the benefit of the research result. There is no risk in participating in this research project.

Benefits:

If you participate in this research project, there may not be direct benefit to you but your participation is likely help us to meet the research objective.

Incentives:

You will not be provided any incentives or payment to take part in this project.

Confidentiality

The information collected from this research project will be kept confidential. Information will be stored in a file, without your name, only code number is used. It will not be revealed to anyone except the principal investigator and it will be kept locked with key.

Right to refuse or withdraw:

You have full right to refuse from participating in this research. You can choose not to respond to some or all question if you do not want to give your response. You have also full right to withdraw from this study at any time you wish without losing any of your right.

Person to contact:

This research project was reviewed and approved by the IRB saint Paulo's hospital millennium medical college. If you have any question you can contact any of the following individuals and you may ask any time you want.

Contact address of principal investigator: -

1. Fikre Geremew (MD)-investigator

Tell: 091175661 Email: fikre9090@yahoo.com

2. Malede Birara (MD)-Adviser

Annex II: Amharic version of consent form

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Informed consent: I hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating voluntarily in the research project. I understand that I am at autonomy to withdraw from the project at any time.

Signature of participants_____ date _____

Name and signature of data collector_____ date _____

Annex III: Data collecting format

Part I

Data collectors' information

Interviewer data
1. Interviewer Name_____
2. Interviewer signature_____
3. Date of interview____/____/____ (DD/MM/YYYY)
Supervisor data
1.superviser name_____
2. supervisor signature_____
Results of the interview

1. Complete
2. Incomplete
3. Refused
4. Other(specify)_____

Part II Demographic characteristics

1. Card no_____
2. Age_____
3. Which best describes where you live?
A. Rural B. suburban C. urban
4. What is the highest level of school you attended?
A. None B. primary school C. high school D. College
E. Graduate / professional degree
5. What is your occupation?
6. Religion
A. Orthodox B. Muslim C. Protestant D Catholic E. Other
7. What is your current marital status?
A. married B. single C. divorced D. widow

Part III Reproductive characteristics

1. Gravidity _____
2. Parity _____

3. Gestational age_____
4. Was the pregnancy intended?
A. Yes B. No

Part IV Antenatal care

1. Do you have ANC during pregnancy
A. Yes B. No
2. How many visits
A.1 B.2 C.3 D.4 E.>4
3. Did you supplemented with iron during the ANC

A. Yes B. No

Part V medical or obstetric complications

1. Medical_____
2. Obstetric_____

Part VI Maternal anthropometry and hematocrit or hemoglobin

1. MUAC_____
2. Hct _____or Hgb_____

Part VII Neonatal outcome

1. Birth weight _____
2. Birth weight for gestational age or features of IUGR
A. < 10 percentile B. Between 10 and 90 percentile C. >90 percentile

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