ANNEXURE-I

STUDY INFORMATION SHEET

Title of the Study: Dual Nutrition Burden in Urban Women from Low Middle Income Families

Principal Investigator: Anshi Goel

What is the purpose of the study?

Data from large scale surveys have shown that undernutrition and infections persist and continue to be major problems in women, there has been a progressive increase in over-nutrition as well as hypertension in women from all segments of population including those from low income group. With increase in age there is a progressive increase in over-nutrition in women.

What does this study involve?

The study team will visit your home and inform you about the details of the study .If you agree to participate in the study the research team will measure

- *measure* height, weight and compute BMI,
- *measure* waist and hip circumference and compute waist hip ratio and

Women who were under or overnourished will be given personalized counseling to improve their nutritional status . Those with *hypertension* will be referred to the nearest hospital for assessment and management of hypertension. All these women will be followed up once in three months over the next two years and response to counseling and care in terms of changes in nutritional status and Control of hypertension will be documented . There is no invasive procedure or risk associated with the study .

Possible benefits:

Participants will benefit from early detection of under and over-nutrition and counseling how to improve the nutritional status.

Possible risks

None.

Cost to the participants:

There is no cost to the participants. The research team will visit the homes and undertake all the measurements

Compensation:

No compensation will be given.

Confidentiality of the information:

Confidentiality regarding the privacy of the information will be maintained. Individual identity will not be disclosed.

How will your decision 'Not to participate' in the study affect the care that you receive?

Your decision not to participate in this research study will not affect your relationship with the health and nutrition services provided . You will continue to have access to all the services provided .

ANNEXURE-II

अध्ययन सूचना पत्र

अध्ययन का शाषक- शहर का कम आय वाल पारवारा ाक माहलाआ पर दाहरा पाषण भार ।

□ाि□□□ि □ाि □ाि□: अंशी गोयल

अध्ययन का उद्देश्य

सव क डेटा से यह पता चला है ाक माहलाआ म कुपाषण आर सक्रमण एक बहुत हा गम्भार समस्या ह। यह दखा गया ह ाक हर समुदाय का माहलाआ म उच्च रक्तचाप आर माटाप का समस्या बढ़ता जा रहा ह । बहुत से शाध काया स यह पता लगता ह ाक माहलाआ म माटाप उम्र क साथ बढ़ता जा रहा ह **अध्ययन म क्या शामिल है?**

अध्ययनकता आपक घर आयग व इस अध्ययन से संबंधित सारा जानकारा आपका दग । याद आप सहमत ह ता आप इस अध्ययन म साम्मालत हा सकत ह ।

ावशषज्ञ आपका माप लग-

ऊचाइ, वजन, कमर का माप व शरार के निचले भाग का माप,

कुपाषण व माटाप स ग्रासत माहलाआ का स्वास्थ्य सुधार सबाधत जानकारा दग । अध्ययनकता इन माहलाआ क माप हर तान महाना म लग तथा यह क्रया पूर दा साल तक चलगा ।

संभव लाभ

उम्माद ाक जाता ह ाक कुपाषण व माटाप क बार म पता लगन क बाद माहलाए इस जानकारा का लाभ उठा पायेगीं आर उनक स्वास्थ्य म सुधार आ पायगा ।

संभव नुकसान

काइ नहा ।

भाग लन क लए लागत (खच)

इस अध्ययन के लए माहलाआ का काइ भा पस न ता दय जायग आर न हा लय जायग । अध्ययन कता स्वय घर जायग आर सार माप लग ।

मुआवजा

काइ भा मुआवजा नहा दया जाएगा ।

गोपनीयता

आपक पारवार स ला गइ व्याक्तग जानकारा गुप्त रखा जायगा व उनका पहचान क बार म ाकसा का भा ाकसा तरह का जानकारा नहा दा जायगा ।

अध्ययन म शाामल न हान का आपक पारवार पर प्रभाव

अगर आप इस अध्ययन म शाामल नहा होना चाहत ता इसस आपक पारवार क इलाज़ आर स्वास्थ्य सवाआ म काइ कमा नहा आयगा । आपका पारवार क सारा सवाए जा आप पहल स ल रह ह, ाजनक आप हक़दार ह लना जारा रखग । आप अध्ययन म शाामल हान क बाद ानकलन का ानणय कभा भा ल सकत ह । इस अध्ययन म भाग लेना पूरा तरह स आपका मज़ा ह आर आपका हक ह ाक ाकसा भा समय ाबना कारण बताए इस अध्ययन स आप स्वय को निकाल सकते है । मगर हमारा सलाह ह ाक आप ानकलन स पहल अध्ययन के जाचकताओ से बात कर ल आर कारण बता द ।

ANNEXURE-III

Consent Form

Title of the Study: : Dual Nutrition Burden in Urban Women from Low Middle Income families

Investigator: Anshi Goel

I……., wife of…….a resident of……
……
……have been provided the study information sheet and have read the information in it/ have had the study information sheet read out to me. I am over 18 years of age, and exercising my free power of choice, hereby willing to give my consent to be included in the study and further certify that:

(1) I have fully understood the information provided about the study.
(2) I have been informed that there are no known risks associated with this study
(3) I am aware of the fact that I can opt out of the study and this will not affect my access to services in the hospital.
(4) I have been provided information about individuals whom I can contact to seek clarification.
(5) I have been told that my identity will be kept confidential if the data are presented or published.

Name and Signature/ Thumb Impression

…….(Name)…….(Signature)

Date:…… Time:…….

Witness (in case the woman is illiterate and thumb impression is taken in consent form)

I certify that the nature, purpose and potential benefits of the above study have been read out and explained to participant……..(vernacular) and all her queries have been satisfactorily answered.

Name and Signature of witness:

…….(Name)…….(Signature)

Date:…… Time:…….

Address of the witness :
……
……

ANNEXURE-IV

मजूरा फाम

अध्ययन का शाषक- शहर का कम आय वाल पारवारा ाक माहलाआ पर दाहरा पाषण भार ।

□ाि□□□ाि □ाि □ाि□: अंशी गोयल

म_____ निवासी _____ अध्ययन सूचना पत्र का पड़ ालया ह अथवा मुझ य सुचना पत्र पड़कर सुना ादया गया ह। मरा उम १८ वष स ज्यादा ह आर म ाबना ाकसा प्रकार क दवाब म अपना मजा स इस अध्ययन म भाग लन का अनुमात दता/ दता हू आर प्रमााणत करता/ करता हू।

1. मुझे इस अध्ययन क बार म उपलब्ध कराइ गया जाचकारा पूरा तरह समझ म आ गया ह।
2. मुझ मर आधकारा आर ाजम्मदाारया का जाचकता द्वारा समझा ादया गया ह।
3. मुझे बता ादया गया ह ाक अध्ययन स क्या हाान आर सभाावत लाभ ह।
4. म जाचकता क साथ सहयाग क ालय सहमत हू।
5. म जानता हू ाक ाकसा भा समय ाबना कारण ादय म अपन का इस अध्ययन स ानकाल सकता हू आर इसस मर स्वास्थ्य सवाआ म काइ कमा नहा आयगा।
6. म जाचकता का अनुमात दता हू ाक वा मर इस अध्ययन म शाामल हान स ामला जानकारा का स्पासर अथवा गवमट एज़सा का द सकत ह।
7. इस अध्ययन द्वारा ामला सूचना का कहा पश ाकया जाएगा ता मरा पहचान गुस रखा जाएगा ।
8. मुझ बता ादया गया ह ाक अध्ययन क ावषय म काइ सवाल हान पर ाकसस सपक करना ह । मुझे इस अध्ययन क सूचना पत्र आर मजूरा फाम का कापा भा द दा गया ह।

नाम _____ हस्ताक्षर _____

घर का पता:

तिथि: समय

HOUSEHOLD PROFORMA

AREA Anganwadi No House No Household No

Profile of the members of the household											
S. No.	**Name**	**Relation to HOH**	**Sex**	**Age (yrs.)**	**Marital Status**	**Physiological status**	**Age at Marriage (Yrs.)**	**Education (Code)**	**Working status (Code)**	**Morbidity**	
										C.M	**P.M**

Coding instructions
Marital status
1. Currently married 2. Widow/widower 3. Unmarried 4. Divorced 5. Others
Education
1. Illiterate 2. Can read 3.Primary school 4. -secondary school 5. College
Work status
1. Not working 2. Unskilled 3. Semi-skilled 4. Clerk/ Teacher/ Office 5. Business 6. Home maker 7. Others
Morbidity
1. No morbidity 2. Diarrhoea & Dysentery 3. Fever4. Resp infection 5. Others
CM morbidity in last 15 days PM Morbidity in last month

PROFILE OF THE HOUSEHOLD	**Code**
Household Type **1. Joint 2. Nuclear**	
Household Size	
Caste **1.SC 2. ST 3. OBC 4. Others**	
Socio-economic status **1.High 2. Middle 3. Low**	
Dietary habits **1. Vegetarian 2. Non-Vegetarian**	
Monthly Family Income **1. <Rs. 5,000 2. Rs 5,000-10,000 3. >Rs 10,000**	
Type of house **1. Kuttcha 2. Semi Pucca 3. Pucca**	
Ownership of House **1. Own 2. Rented**	
No. of rooms in the house **1. One 2. Two 3. Three 4. >Three**	
Toilet facility in household **1. No facility 2. Sulabh 3. Shared Toilet (flush) 4. Own flush**	
Means of transport **1. Public Transport 2. Bicycle 3. Scooter/Moped 4. Any other**	
Cooking fuel used at home **1. Kerosene/ charcoal/wood 2. Gas/Electricity 3. Other**	
Drinking water source 1**.Public Tap 2. Hand pump 3.Water tanker**	
Means of entertainment **1. Radio 2. T.V (B/W) 3. T.V(Colour) 4. None**	
Kitchenware (predominantly) 1**. Aluminium 2. Cast Iron 3. Brass/ Copper 4. Stainless steel**	

ANNEXURE-VI

Pregnant /Lactating woman /non lactating women CARD

AREA AWW LOCALITY NO FAMILY NO MUID CHILD UID

NAME OF WOMAN NAME OF HUSBAND Age

MORBIDITY PROFILE- (last 15 days)

Date of visit	Morbidity Yes / No	Type of episode (A)	No. of episodes	Duration (days)	Seve rity B	Treatment		Current status E
						What C	By whom D	

Key: A1. Diarrhea 2. Dysentery 3. Fever 4. Respiratory infection 5. Eruptive fever 6. Skin diseasea 7. Any other;
B1. Mild 2. Moderate 3. Severe; C 1. Home remedies 2. Home fluids 3. ORS 4. Antibiotics 5. Antipyretics 6.Unknown Medicines by quacks 7. Cough syrup 8.Others;
D 1. None 2. AWW 3. ANM 4. Quacks 5. Govt. doctor 6. Private doctor 7. Any other
E1. Improved,2. Deteriorated, 3. No change

If pregnant list problems during pregnancy

ANTHOPOMETRY

MOTHER'S HT (cm)_____

Date of visit	P/L/ NPNL	Duration of P/L(months)	Wt.	MUAC	Triceps	Biceps	BP	WC	HC

NOTE: 0-59 MTH WEIGHT TO RECOREDED MONTHLY: MOTHER 3MONTHLY: L/HT 0-11 MTH MONTHLY AND 12-59 3 MONTHLY,MUAC AND FFT 3 MONTHLY: CHILD ILL TAKE WEIGHT AT ILLNESS &AFTER 15 DAYS

ANTE NATAL CARE

Date of visit	Duration of pregnancy (weeks)	ANC where (A)	ANC By (B)	Examination (C)	Problems (D)	Treatment (E)

(A) 1. Sub centre /UHC, 2. PHC/CHC, 3. Govt. Hosp., 4. Private clinic, 5. Private hosp. & 6. Others
(B) 1. ANM, 2. GNM. 3. Doctors, $. Others
(C) 1. Wt. 2. BP. 3. Urine, 4. Hb 5. Abdominal Exam, 6. Ultra Sound 7. Others.
(D) 1. Under-nutrition, 2. Over Nutrition 3. Anemia, 4. PIH, 5. IUGR, 6. Others
(E) 1. IFA (100), 2. TT, 3. Hospitalization, 4. Others

Delivery details

Date of Birth	Place of Birth (F)	Conducted By (G)	Outcome of Pregnancy (H)	Type of delivery (I)	Birth Wt. (In gms)

(F) 1. Sub centre /UHC, 2. PHC/CHC, 3. Govt. Hosp., 4. Private clinic, 5. Private hosp. & 6. Others
(G) 1. ANM, 2. GNM. 3. Doctors, $. Others
(H) 1. Spontaneous Abortion 2. Induced Abortion. 3. Still birth ,4.Live Birth
(I) 1. Normal, 2. Forceps 3. Caesarian, 4. Others

मौलाना आजाद मैडिकल कॉलेज
तथा संघित लोकनायक
गोविन्द बल्लभ पन्त चिकित्सालय एवं
गुरू नानक नेत्र केन्द्र, नई दिल्ली-110 002
MAULANA AZAD MEDICAL COLLEGE
and Associated Lok Nayak
Govind Ballabh Pant Hospitals and
Guru Nanak Eye Centre, New Delhi-110 002

23rd September 2015

Dr. Prema ramachandran
Director
Nutrition Foundation of India
New Delhi

Research Proposal: **Dual nutrition and health burden in women from urban low income group Families**

Dear Dr. Ramachandran,

The Institutional Ethics Committee of Nutrition Foundation of India carefully considered the above mentioned research proposal in its meeting held on 30 .5.2015 . On behalf of the committee I wish to inform you that approval of the institutional Ethics Committee has been accorded to the above study subject to the following observations:

1. To incorporate the suggestions for study design/methods as recorded in the Minutes of Meeting of IEC on 30.5.2015
2. Modification of Hindi consent form as suggested

The IEC members present at the meeting were:

Dr. S Ramji
Dr. Reva Tripathy
Dr. D Dewan
Dr. Sushma Sharma
Mr. J S Sharma
Dr. Sarath Gopalan
Dr. Prema Ramachandran

Yours sincerely

Siddarth Ramji

Chairperson, NFI Institutional Ethics Committee
Director-Professor, Deptt. of Paediatrics and Neonatology
Maulana Azad Medical College, New Delhi

INSTITUTIONAL HUMAN ETHICS COMMITTEE

Avinashilingam
Institute for Home Science and Higher Education for Women
University
(Estd. u/s 3 of UGC Act 1956)

19th March 2018

To
Ms. Anshi Goel
Department of Food Science and Nutrition
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore – 641 043

Dear Anshi Goel,

Ref: Your proposal No. IHEC/17-18/FSN/49 "Dual Nutrition and Health Burden among Women in Urban Low Income Group" submitted for approval of the IHEC on 14th December.

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC/17-18/FSN/49 "Dual Nutrition and Health Burden among Women in Urban Low Income Group" submitted by you. The Approval number for the same is AUW/ IHEC/ FSN -17-18/XPD/49.

We wish you all the best in your research endeavours.

Regards.

S. Uma Mageshwari
Dr.S.Uma Mageshwari
Member Secretary

Institute for Home Science and Higher Education for Women, Coimbatore
Institutional Human Ethics Committee

Thesis - Anshi 9.1.2021

ORIGINALITY REPORT

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Coimbatore, Tamil Nadu, India
(Deemed University under Category 'A' by MHRD)
Re-accredited with 'A' Grade by NAAC

Certificate of Participation

This is to certify that ~~Dr. / Mrs.~~ / *Ms.* Anshi Goel KM, Ph.D Scholar (Part-Time)
of Department of Food Science and Nutrition
was a participant of the **Research Convention entitled "Research Ethics, Methods and Post Research Methods"** *held at* **Avinashilingam Institute for Home Science and Higher Education** *for Women, Coimbatore during* 18-20 February 2016.

Parvathi

Dr. A. Parvathi
Dean, Faculty of Science

Venmathi

Dr. A. Venmathi
Registrar (i/c)

Avinashilingam Institute for Home Science and Higher Education for Women

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Re-accredited with 'A+' Grade by NAAC. Recognised by UGC under Section 12B
Coimbatore - 641 043, Tamil Nadu, India

DST-CURIE Sponsored

Research Convention

Certificate

This is to certify that Ms. ***Anshi Goel , Ph.D Scholar*** *of* ***Department of Food Science and Nutrition****, was a participant of* ***"Research Convention – Fundamentals for Scholar Friendly Quality Research"*** *held at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore on* ***15th & 16th November, 2019****.*

Dr. K. Udaya Chandrika
Dean, School of Physical Sciences & Computational Sciences

Dr. S. Kowsalya
Registrar

Avinashilingam
Institute for Home Science and Higher Education for Women
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ICMR & NSI Sponsored International Conference on

Advances in Nutrition and Health Communication

3rd & 4th August, 2017

Organized by

Department of Food Science and Nutrition and Department of Visual Communication

Certificate

This is to certify that ~~Dr.~~/Ms./~~Mrs.~~/~~Mr.~~ ANSHI GOEL, PH.D SCHOLAR
of AVINASHILINGAM UNIVERSITY FOR WOMEN, COIMBATORE *has participated in the International Conference as Delegate / ~~Chair Person~~ / ~~Rapporteur~~ / Presenter (~~Oral~~ / Poster) entitled* Combating Overnutrition in Women through Nutrition Education [1st Prize] *held on 3rd & 4th August, 2017.*

Dr. A. Venmathi
Convener

Dr. N. Vasugi Raaja
Convener

Dr. S. Kowsalya
Registrar

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Dual Nutrition Burden in Urban Women from Low Middle Income Families

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(1. Nutrition Foundation of India, New Delhi - 110 016, India

2. Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 641 043)

e-mail: anshi.anshi.goel13@gmail.com

(Received 23rd August, 2019)

Abstract

Currently India is experiencing dual nutrition burden. Prevalence of both under and over nutrition is reported to be higher in women as compared to men. Over nutrition rates in Delhi are among the highest in India. A mixed longitudinal study was undertaken to assess nutritional status of urban women from low middle income families. Between January 2015 and December 2017, 4155 non-pregnant non-lactating women were enrolled for this observational study. These women belonged to food secure low middle income families. They were living in highly congested urban localities in one or two room tenements and had no access to public spaces where they could go for walk or discretionary physical activities. In all women, height was measured at enrolment. Efforts were made to measure weight, mid upper arm, waist and hip circumferences once in three months. Prevalence of under nutrition (BMI < 18.5) in the 18-29 years age group was 12.1%, but 33.9% had BMI of ≥25. There was a progressive increase in over-nutrition, high waist and hip circumferences with increasing age; 68.4% of women aged 50 years and above were over-nourished. None of the undernourished women had waist circumference ≥ 80 cm; among the normally nourished 8.5% and in the over-nourished women 3/4th had waist circumference above 80cm. Hip circumference showed a similar trend but prevalence of ≥ 102 cm was lower. Prevalence of over nutrition, truncal and abdominal adiposity was high in women from Delhi low middle income families.

Keywords: *Dual nutrition burden, over nutrition, non-pregnant women, BMI, anthropometric measurement*

Introduction

Developing countries like India are currently undergoing economic, social, demographic, health and nutrition transitions. India has been facing dual nutrition burden[1,2] and consequent health problems[3,4] in the last two decades. Surveys carried out by NNMB[5,6], NFHS[7-10], DLHS[11,12] and AHS CAB[13] have defined the magnitude of dual nutrition burden in different states and different segments of population. Data from all the surveys indicate that prevalence of both under and over-nutrition is higher in women as compared to men. Over years severe under-nutrition with life-threatening complications have become rare but prevalence of moderate under-nutrition continues to be high in younger women and especially among the marginalised segments of population. Maternal under-nutrition has adverse health consequences for the mother-child dyad.

In the last two decades there has been a steady and progressive increase in over-nutrition[5,6,9,10] and associated non-communicable diseases[3,4]. Initially prevalence of over-nutrition was seen mainly in urban affluent families; however recent national surveys[10,13] indicate that prevalence of over-nutrition is high even among poor especially in urban areas. Data from NFHS4[10] showed that in Delhi a predominantly urban state prevalence of over-nutrition is high especially in women. A study was taken up to assess prevalence of under and over-nutrition in non- pregnant non-lactating women belonging to low middle income families in South Delhi.

Materials and Methods

Between January 2015 and December 2017, a mixed longitudinal study was taken up to assess nutritional status of non-pregnant non-lactating women from urban low income families residing in selected blocks in South Delhi. Study design is given in Figure 1. Approval to undertake the study was obtained from the Institutional Ethics Committee of Nutrition Foundation of India. Permission to conduct the study was obtained from Department of Women and Child Development, National Capital Territory, Delhi.

A census of all the households in Neb Sarai, Ladosarai and Andheria Mod blocks in South Delhi was done in January 2015 and subsequently updated in January 2016 and 2017. From the census data, households with non-pregnant and non-lactating women were identified. These women and their families were contacted; the rationale and the detailed information about the study were discussed with them. Informed consent was obtained from women 18 years or above who were willing to participate in the study, did not have any health problems and whose families were likely to stay in the locality for the next year. These women were enrolled for the mixed longitudinal study. At enrolment socio-demographic data were collected using a pre-tested pre-coded questionnaire. Height was measured using the wall mounted

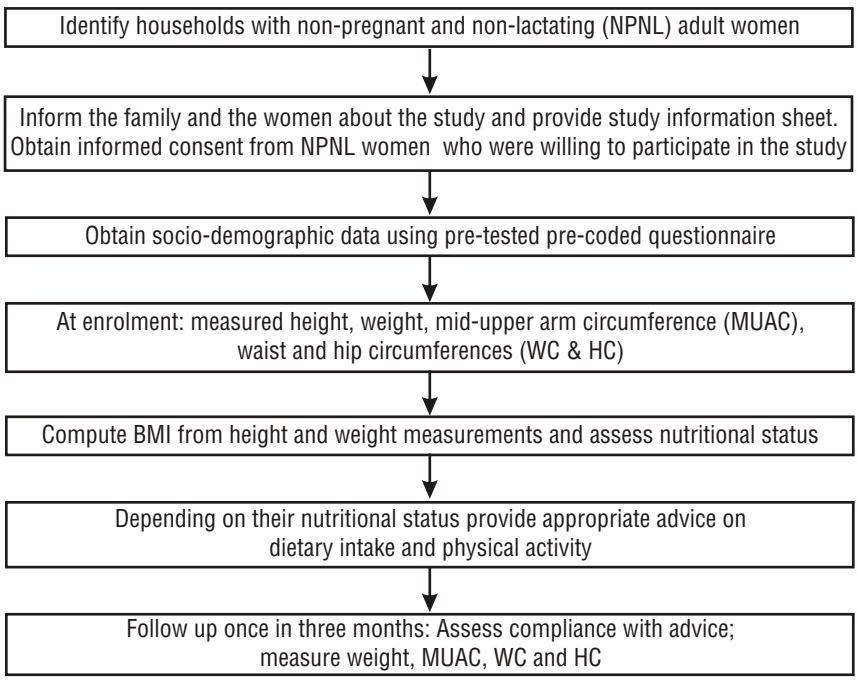


Figure 1
Study design

staturemeter. Weight was recorded using a digital balance with 100 g accuracy. Accuracy of balances was checked every day. Mid Upper Arm Circumference (MUAC), Waist Circumference (WC) and Hip Circumference (HC) were measured using the non-stretch tape with a vernier scale. All personnel were trained, assessed for accuracy in taking anthropometric measurements; only those found to be accurate were sent for data collection. Inter-day and inter-individual variations in measurements were minimised by periodic quality assurance checks.

From height and weight measurements, BMI was computed and nutritional status of women assessed using BMI and nutrition advice was provided taking into account the nutritional status as assessed by BMI. Based on circumferential measurements, adiposity and its location were assessed. Attempts were made to follow up these women once in three months to collect information on compliance with nutrition advice and carry out anthropometric measurements.

The number of women enrolled for the study and the number of times the measurements were carried out in these women during the period of study are indicated in Table I. Height was measured only at enrolment in these women. The

TABLE I

Women Enrolled and Anthropometric Measurements

Year	Number of women	Number of times anthropometric measurements carried out				
		Height	Weight	MUAC	WC	HC
2015	841	841	2689	1689	2317	2317
2016	784	784	2419	1434	1983	1983
2017	2530	2530	6107	3617	3606	3606
Total	4155	4155	11215	6740	7906	7906

study envisaged that other anthropometric measurements will be carried out once in three months. Weight was measured in 11215 visits (2.7 measurements/year) circumferences could not be measured in winter easily and hence the number of times circumferential measurement was taken was lower; mid-upper arm circumference was measured 1.6 times in a year. Information on age, weight and BMI was available in 11107; number of measurements available in the three age groups (18-29, 30-49 and ≥ 50 years) and three BMI groups (<18.5, 18.5 to 24.9 and ≥ 25) is given in Table II.

TABLE II

Number of Weight Measurement in Age/ BMI Groups

Age / BMI	< 18.5	18.5 - 24.9	≥ 25	Total
18 - 29yrs	663	2959	1858	5480
30 - 49 yrs	156	1517	2332	4005
> 50 yrs	56	457	1109	1622
Total	875	4933	5299	11107

Data were analysed using Excel and SPSS 25 (Property of IBM Corp. Copy right IBM corporation and its licensors 1989-2017). Nutritional status of women was computed using BMI in the three age groups. Mean and SD of all anthropometric parameters were calculated in three age groups (18-29, 30-49 and ≥ 50 years) and BMI groups (<18.5, 18.5 to 24.9 and ≥ 25). Statistical significance of the differences in means in different groups was assessed using student t test. Prevalence of high waist circumference (≥ 80cm)[14] and hip circumference (≥ 102 cm)[14] in the three age and BMI groups were computed and statistical significance of the differences were assessed using chi square test.

Results and Discussion

Socio demographic profile

Analysis of data on socio demographic profile of the study households showed that majority were nuclear families (75.8%) with five or less members (72.3%). Majority of men (68.5%) and women (50.2 %) had

secondary school education. Majority of the men (70.6%) worked in white collar jobs; while 22% were semi-skilled workers. Over 90% of women were home makers. Over 95% of households lived in brick and mortar buildings; 29.5% owned their houses; the rest, mostly migrants, lived as tenants. Over 95% had access to piped water supply at home or in the vicinity and access to flush toilets either in their own home or shared with other households. For cooking almost all households used Liquefied Petroleum Gas (LPG) and stainless steel utensils. Over 98% owned colour TV, which was their main source of entertainment. If the household possessions are considered, these households belong to low middle income group. Because of urban housing constraints, these families lived in one or two room tenements in over-crowded unhygienic localities. These families stated that they were food secure; if needed they accessed subsidised food grains from Public Distribution System and availed ICDS supplementary feeding programmes. Most women were home makers; after completing household chores within the small room, they sat down and watched TV or chatted with friends using mobile phones. When overweight women were counselled about increasing physical activity, many stated that they had no public places where they could walk or carry out discretionary physical activity.

TABLE III

Anthropometric Profile of Women

Parameter	Mean±SD
Height* (cm)	151.7 ± 5.88 (4155)*
Weight (kg)	57.5 ± 12.71 (11141)
BMI	25.1 ± 5.20 (11133)
MUAC (cm)	26.5 ± 4.06 (6718)
WC (cm)	78.1 ± 11.85 (7835)
HC (cm)	96.1 ± 10.13 (7835)

* Height does not change in adult women; hence taken only at the time of enrolment

Nutritional profile of women

The mean and SD of the anthropometric parameters in the study population is given in Table III.

These women were relatively short (mean height was only 151.7 cm); mean weight was 57.5 kg. These women had relatively high mean BMI, MUAC, WC and HC. Prevalence of under-nutrition was relatively low (7.9%); 44.7% were normally nourished (Figure 2). Nearly half of these women (47.7%) were over-nourished; about 40% had high WC and 25% had high HC (Figure 2).

Changes in anthropometric measurement in relation to age

Mean height, weight, BMI, MUAC, WC and HC in three age groups (18-29, 30-49 and ≥ 50 years) is shown in Figures 3 and 4. The differences in the mean height between

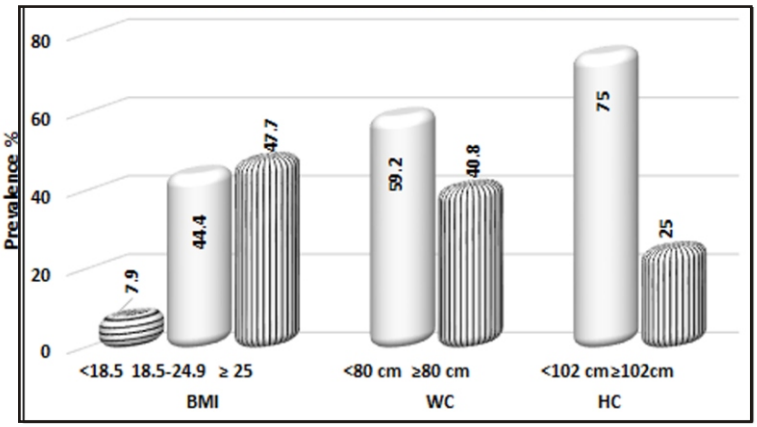
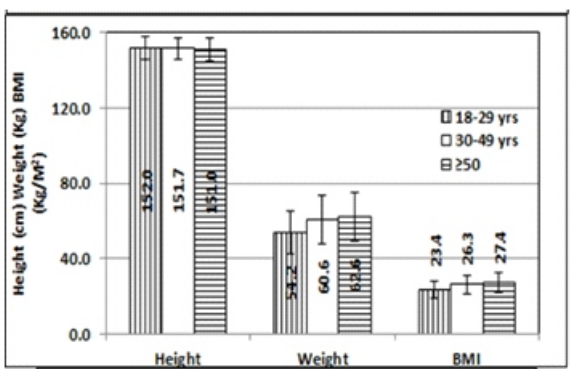


Figure 2
Nutritional status and adiposity in women

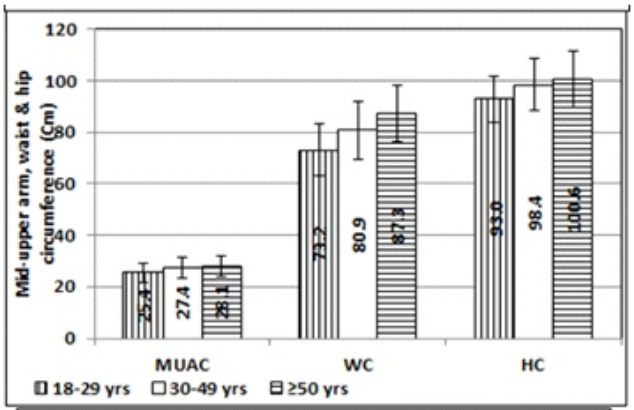
the three groups were very small (152 cm, 151.7 and 151cm).

With increasing age there was a progressive increase in body weight (54.2, 60.6 and 62.6 kg), BMI (23.4, 26.3 and 27.4), MUAC, WC and HC. Even in the 18-29 years age group prevalence of under-nutrition was low (12.1%); there was a



T-test of anthropometric parameters agewise			
	18-29 vs 30-49	30-49 vs ≥50	18-29 vs ≥50
Height	0.0137 (ss)	<0.0001	<0.0001
Weight	<0.0001	<0.0001	<0.0001
BMI	<0.0001	<0.0001	<0.0001

Figure 3
Anthropometric measurements in relation to age

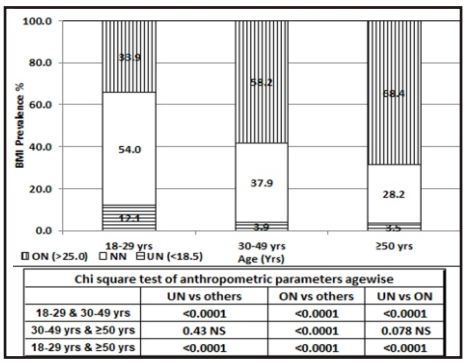


T-test of circumferential measurements agewise			
	18-29 yrs vs 30-49 yrs	30-49 vs ≥50	18-29 vs ≥50
MUAC	<0.0001	<0.0001	<0.0001
WC	<0.0001	<0.0001	<0.0001
HC	<0.0001	<0.0001	<0.0001

Figure 4
Circumferential measurements in relation to age

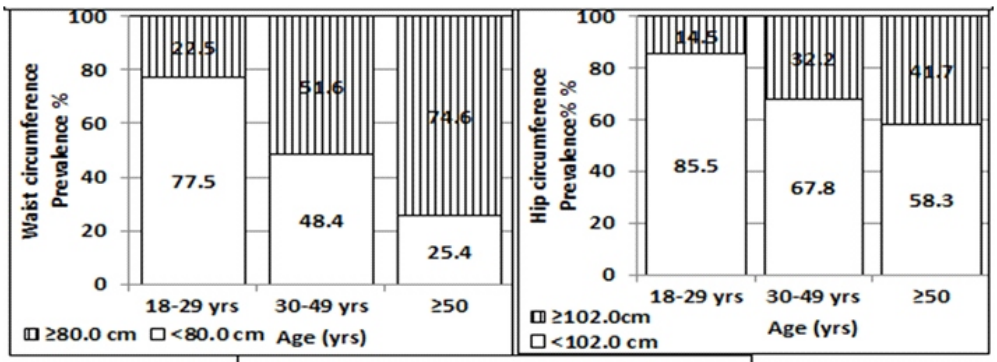
further fall in under-nutrition rate with increase in age. Prevalence of over-nutrition even in the under-30 year age group was high (33.9 %); there was a steep increase in prevalence of over-nutrition with increase in age; in the ≥ 50 years age group 68.4% of women were over-nourished (Figure 5).

There was a progressive increase in mean WC with age; there was also an increase in MUAC and HC with age but these were of a lower magnitude as



Chi square test of anthropometric parameters agewise			
	UN vs others	ON vs others	UN vs ON
18-29 & 30-49 yrs	<0.0001	<0.0001	<0.0001
30-49 yrs & ≥50 yrs	0.43 NS	<0.0001	0.078 NS
18-29 yrs & ≥50 yrs	<0.0001	<0.0001	<0.0001

Figure 5
Nutritional status women in relation to age



Chi square test of circumferential measurements agewise

	WC N vs ON	HC N vs ON
18-29 & 30-49 yrs	<0.0001	<0.0001
30-49 yrs & ≥50 yrs	<0.0001	<0.0001
18-29 yrs & ≥50 yrs	<0.0001	<0.0001

Figure 6
Prevalence of adiposity in relation to age

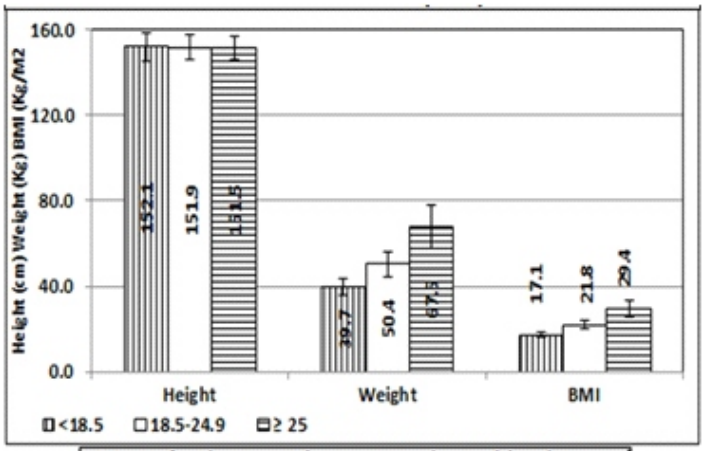
compared to WC. Prevalence of adiposity as assessed by high WC and HC were seen right from 18-29 years age group and increased with increasing age. In each age group prevalence of high WC was higher as compared to high HC. Three fourth of women aged 50 years and above, had high WC and 41.7% of them had high HC (Figure 6).

Changes in anthropometric measurement in relation to nutritional status

Mean height, weight, BMI, MUAC, WC and HC in under-nourished, normally nourished and over-nourished women is shown in Figures 7 and 8. The differences in the mean height in under-nourished, normally nourished and over-nourished women were small and were not of any physiological significance. There was a progressive increase in the mean weight, BMI, MUAC, WC and HC with increasing BMI (Figures 7 and 8). All these differences were substantial and were statistically significant.

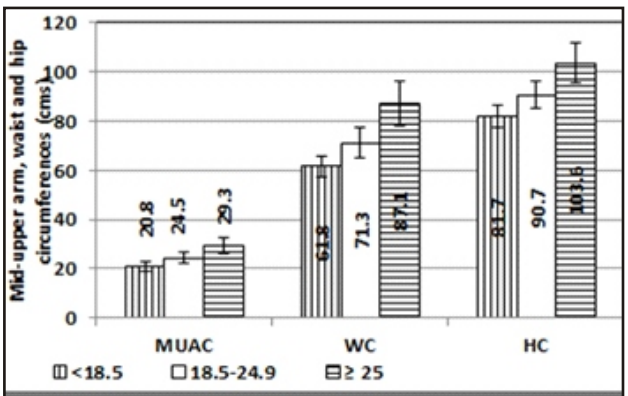
None of the under-nourished women had waist or hip circumference above the cut off levels; among normally nourished women only 8% had high WC and 1.4% had high HC. Among the over-nourished women (78%) had high WC and 51.3% had high HC (Figure 9).

Mean MUAC, WC and HC in relation to age and BMI are shown in Figures 10 and 11. Mean MUAC and HC increase with



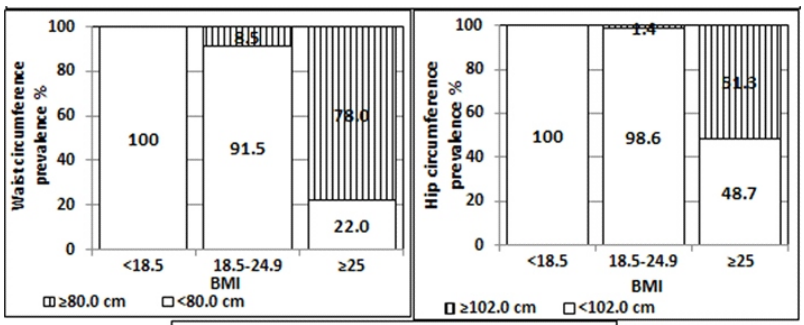
T-test of anthropometric parameters by nutritional status (BMI)			
	<18.5 vs 18.5-24.9	18.5-24.9 vs ≥ 25	<18.5 vs ≥ 25
Height	0.3665 (ns)	0.0005	0.0042
Weight	<0.0001	<0.0001	<0.0001
BMI	<0.0001	<0.0001	<0.0001

Figure 7
Anthropometric measurements in relation to nutritional status (BMI)



T-test of circumferential measurements by nutritional status (BMI)			
	<18.5 vs 18.5-24.9	18.5-24.9 vs ≥ 25	<18.5 vs ≥ 25
MUAC	<0.0001	<0.0001	<0.0001
WC	<0.0001	<0.0001	<0.0001
HC	<0.0001	<0.0001	<0.0001

Figure 8
Circumferential measurements in relation to nutritional status (BMI)



Chisquare test of circumferential measurements by BMI		
	WC N vs ON	HC N vs ON
<18.5 vs others	<0.0001	<0.0001
≥ 25 vs others	<0.0001	<0.0001
<18.5 vs ≥ 25	<0.0001	<0.0001

Figure 9
Prevalence of adiposity in relation to nutritional status (BMI)

increase in BMI, but are similar across all age groups. In contrast mean WC increases both with increasing age and with increasing BMI. These data indicate older women are prone for abdominal adiposity (as assessed by WC) not only when they are over-nourished but also when they are normally nourished (Figures 10 and 11).

Prevalence of high WC and HC in relation to age and BMI is given in Figure 12. For any given age and BMI, prevalence of high WC was higher as compared to high HC. High HC was seen in women with high BMI across all age groups. High WC was seen even normally nourished women in 30-49 year age; with increase in age and BMI

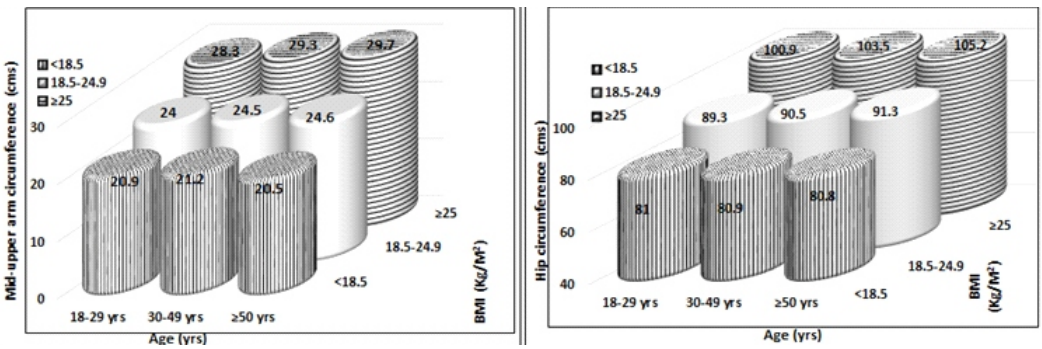


Figure 10
Mean mid-upper arm and hip circumference in relation to age and nutritional status (BMI)

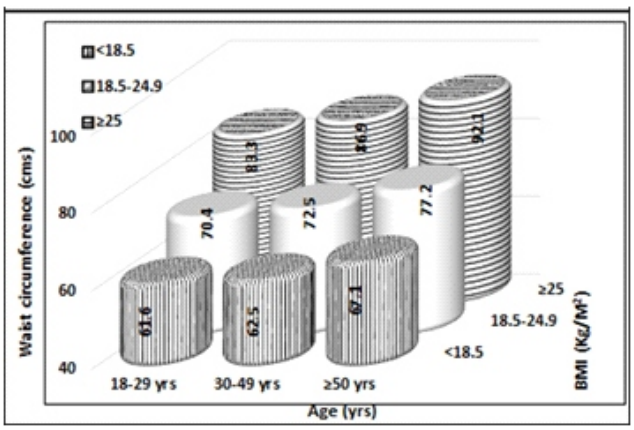


Figure 11
Mean waist circumference in relation to age and nutritional status

prevalence of high WC increased; all women aged 50 years and above who were over-nourished had high WC (Figure 12).

Discussion

Since 1970s, India had invested in nutrition surveys to assess the reduction in under-nutrition especially among vulnerable segments of the population. Data from NNMB surveys[5,6] indicated that between 1970s and 2000, there had been a slow but steady decline in under-nutrition both in children and women. During the 1990s, NFHS 1 and 2, showed that while the decline in under-nutrition continued, there was a concurrent increase in prevalence of over-nutrition[7,8,11]. The term dual nutrition burden was coined in the 1990s to denote the phase of ongoing nutrition transition in

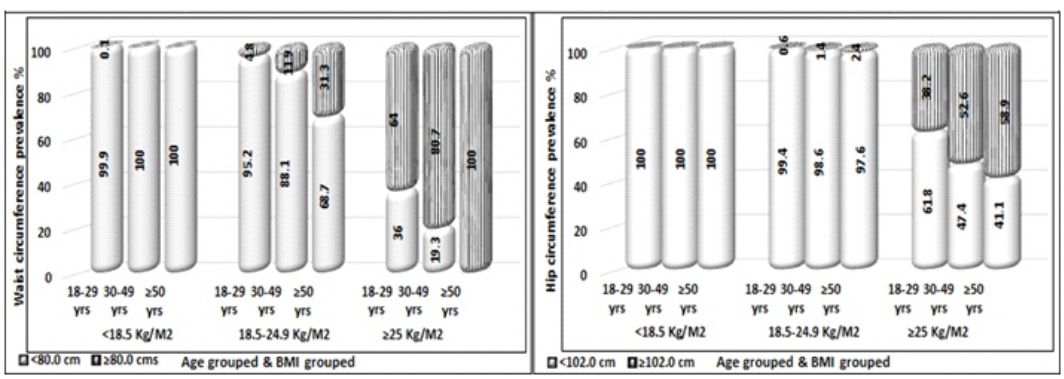


Figure 12
Prevalence of adiposity in relation to age and nutritional status (BMI)

low and middle income countries, characterized by persistent under-nutrition mainly among poorer segments of population and emerging problem of over-nutrition seen mostly among the urban affluent segments. Data from national surveys undertaken since 2000, showed that over-nutrition was prevalent not only in urban but also in rural areas and in all income groups[8,11]. The surveys which were initiated decades earlier for assessing reduction in under-nutrition, provided the early warning about the rising prevalence of over-nutrition in the country.

Globally and nationally in India, the period between 1990 and 2015 witnessed the steepest fall in the prevalence of under-nutrition, morbidity due to communicable diseases and steep improvement in maternal and child health. But during this period there was concurrent, substantial increase in the prevalence of over-nutrition and non-communicable diseases in India[9-13]. Over-nutrition rates in men and women have doubled in the last decade[10]. Prevalence of over-nutrition in women in Delhi which is a predominantly urban state was very high[10]. Data from research studies in Delhi have shown that under-nutrition in childhood can be a very important risk factor for over-nutrition in adult life[15].

Data from the present study showed that prevalence of under-nutrition was quite low in these urban women from small, predominantly nuclear, low middle income food secure families. Majority of them lived in small one or two room tenements; so sweeping, mopping and cleaning the house were neither very time consuming nor involving intensive physical activity. They had ready access to water and used LPG for cooking. As a result their physical activity in the household work domain was sedentary. They had relatively ready access to health care for infection. These favourable factors account for the low prevalence of under-nutrition in these women. This situation provides an opportunity for effective interventions by identifying the small number of under-nourished women, finding out factors responsible for under-nutrition and correcting it. As a part of the study these under-nourished women and their families were informed that correction of under-nutrition prior to pregnancy will improve nutritional status of the mother and her offspring when she becomes pregnant; families were counselled to increase dietary intake and reduce physical activity in under-nourished women. The number of under-nourished women was too small to assess whether they followed the advice and whether their nutritional status improved prior to and during pregnancy.

About 50% of women were normally nourished. All these women were informed that they were normally nourished; they were encouraged to continue their current dietary habits and life style. They were also requested to keep watch on their weight recorded once in three months. If there was any persistent weight gain, factors

responsible for it such as alteration in dietary intake or physical activity were identified. Nutrition counselling was provided to prevent further weight gain. During nutrition education and counselling, it was emphasised that prevention of over-nutrition is critical as weight reduction in over-nourished women is very difficult.

Prevalence of over-nutrition in these women was high. Even among the 18 to 29 year old women (majority of whom had borne and cared for two or more children) one third were over-nourished. There was a progressive increase in over-nutrition with increasing age; nearly 70% of women beyond 50 years of age were over-nourished. The same factors household food security and low physical activity levels which were responsible for the low prevalence of under-nutrition, contributed to the high prevalence of over-nutrition. With children growing up, women in their thirties spend less time and energy in caring for them. Those in their fifties spend very little time and energy on household chores, because the daughters/daughters-in-law had taken over most of the household chores. They spent most of the day sitting down, talking to neighbours and watching TV. Many also slept for an hour or two during the afternoon. All these resulted in their having very low physical activity. There was not much change in dietary intake with increasing age but because of the steep reduction in physical activity, these women appeared to have a positive energy balance and consequent slow progressive increase in body weight. Majority of these women believed that weight gain with increasing age was "normal" and after menopause further increase in weight was inevitable. There is an urgent need to correct these wrong beliefs and ensure that they increase their discretionary physical activity. None of these over-nourished women sought any nutrition or health care when they did not have any symptoms suggestive of health problems; only those women who had developed symptoms due to complications associated with non-communicable diseases sought health care. It is important to create awareness that undue weight gain is harmful to health and they should seek health and nutrition care as soon as they recognise that they were gaining weight. There is also a need to build up the awareness that unlike communicable diseases associated with under-nutrition, Non-Communicable Diseases (NCD) associated with over-nutrition are asymptomatic in the initial phases; symptoms arise only after complications set in. Screening of all women above 30 years of age and/or over-nourished women is essential for early detection of non-communicable diseases[16]. Early detection in the asymptomatic phase of the NCD and effective care consisting of life-style modifications and consistent medication will prevent complications due to NCD[16].

Data from the present study showed that abdominal adiposity (waist circumference ≥ 80 cm) increased with increasing age and increase in BMI. Abdominal adiposity was seen in one-fourth of the 18-29 year women; half of the

30-49 year and 3/4th of the women beyond 50 years of age. Three fourth of the over-nourished women had abdominal adiposity. The association between abdominal adiposity and increased risk of non-communicable diseases has been well documented[2-4]. It is essential to improve awareness of the women and their family about adverse health consequences associated with abdominal adiposity and advice women with over-nutrition and/or abdominal adiposity to seek health care institutions and undergo screening for non-communicable diseases.

Assessment of nutritional status and early detection of under- and over-nutrition is an important component of public health. Ideally nutritional and health assessment should be carried out periodically in all individuals and more often in vulnerable segments of population. Currently neither nutrition and health services nor our population are geared for such routine periodic assessment and appropriate counselling for prevention, early detection and effective management of under or over nutrition before clinical problems arise. There are efforts to upgrade facilities in primary health centres, so that they function as health and wellness centres providing screening for early detection of problems and providing appropriate care. In places where these centres are not yet functional, every effort should be made to assess nutrition and health status of every person as and when they seek health or nutrition care.

Conclusion

Data from the present study indicate that among the urban women from low middle income families, prevalence of under-nutrition was low. Efforts for early detection and effective correction of under-nutrition in pre-pregnancy period are therefore possible and will benefit mother-child dyad. Over 40% of these women were normally nourished. Efforts should be directed to ensure that these women continue their current dietary intake and lifestyle remain normally nourished and healthy. Nearly half the women were over-nourished and over 40% have abdominal adiposity. In these women rise in over-nutrition was not due to increase in energy intake but mainly due to steep reduction in physical activity. Focussed attention on improving physical activity can help them to halt rise in over-nutrition and related increase in NCD rates. It is imperative that over-nourished women are advised to seek nutrition and health care for effective management of over-nutrition and early detection and management of non-communicable diseases. Delhi has functioning nutrition and health systems. These systems can be oriented and geared up for early detection and effective management of both under- and over-nutrition and associated health problems. Promoting synergy between health and nutrition services can enable the state to achieve improvement in health and nutritional status of women.

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Effect of Lactation on Nutritional Status in Urban Women from Low Middle Income Families

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Abstract

In India breast feeding is universal. Studies carried out in the 1980s have shown that in women from low income families, lactation during the first six months was associated with weight loss. Over time there has been substantial reduction in under-nutrition across all groups including lactating women and over-nutrition has emerged as a public health problem. A study was taken up to assess the impact of universal and prolonged lactation on nutritional status and adiposity in 2240 women from urban low middle income group; 83.5% were 18-29 years of age and 16.5% were 30 years or older. As lactating women had to meet the energy cost of milk production, they weighed less and had lower mean BMI, MUAC, HC and WC as compared to non-lactating women. Prevalence of under-nutrition was higher and over-nutrition was lower in lactating women as compared to non-lactating women. In this community, prevalence of under-nutrition was low and lactation was not associated with persistent deterioration in nutritional status in either of the age groups; identifying lactating women who are under-nourished, providing them with nutrition education and take home rations continuously and monitoring their improvement may result in steep reduction in under-nutrition rates. Prevalence of over-nutrition in lactating women especially in ≥30 year age group was high; over-nutrition rates increased with waning lactation. Nutrition and health education on importance of increasing physical activity and interventions to promote discretionary physical activity are urgently required to halt the rise in over-nutrition and risk of non-communicable diseases in these women.

Keywords: *Lactation, breast feeding, low middle income groups, nutritional status, anthropometric measurements, non communicable disease*

Introduction

The importance of breast ttfeeding as the critical factor for survival, growth and well-being of the infant especially among poorer segments of population in developing countries is well recognised. In India successful health and nutrition education interventions had ensured that breast feeding is universal and continues up to two years in majority of women[1]. Studies carried out in the 1980s had shown that prevalence of under-nutrition in women from lower income groups were high and that lactating women lost weight in the first 6 months of lactation; with waning lactation and reduction in amount of breast milk secretion, majority of women regained their weight in the next 2 years[2]. Lactating women secrete about 500 to 700 ml of milk/day and require substantial increase in energy intake[3]. Data from NNMB surveys have shown that the gap between dietary intake and energy requirements widen during lactation[4]. The ICDS programme provides food supplementation to lactating women during the first six months of lactation to bridge this gap and prevent deterioration in maternal nutrition during lactation[5]. However the coverage and consumption levels under this programme have been suboptimal. Unlike the Indian situation, lactation is not common in developed countries and is seldom prolonged. Studies on changes in body weight and body composition in well-nourished and over-nourished women in developed countries had shown that in majority of these women, pregnancy and lactation resulted in gain in weight as compared to pre-pregnancy weight[6-8].

National surveys have shown that India has also entered the dual nutrition burden era[1,9]. Under-nutrition was less than 10% and over-nutrition accounted for one-third in Non-Pregnant Non-Lactating (NPNL) women aged between 18-29 years in low middle income group in Delhi[15]. There had been small scale studies in India exploring the effect of lactation on nutritional status in the dual nutrition burden era[10-14] but so far there had been no large scale community based studies documenting the effect of lactation on maternal nutritional status. A study was therefore taken up to assess the impact of universal and prolonged lactation on nutritional status of women from urban low middle income group. Data from this study may provide valuable leads for mid-course corrections in on-going food supplementation programmes to lactating women and also provide impetus to interventions aimed at halting rise in the over-nutrition rates in young women.

Materials and Methods

A mixed longitudinal study was taken up between January 2015 and December 2017, to assess nutritional status of lactating women from urban low income families, residing in selected ICDS

blocks in South Delhi. The study area was purposively chosen because the institution has been working in this locality during the past decade and we have built up a good rapport with the people and the ICDS personnel in the area. A household census was done in 2015 and census was updated in 2016 and 2017. All families with lactating women who were likely to stay in the area for at least one year were identified. The study design is given in Figure 1.

The details about the study were explained to these families and the Hindi version of study information sheet was provided to them. A week later families were revisited; those who were willing to participate in the study were given the consent form and their consent obtained.

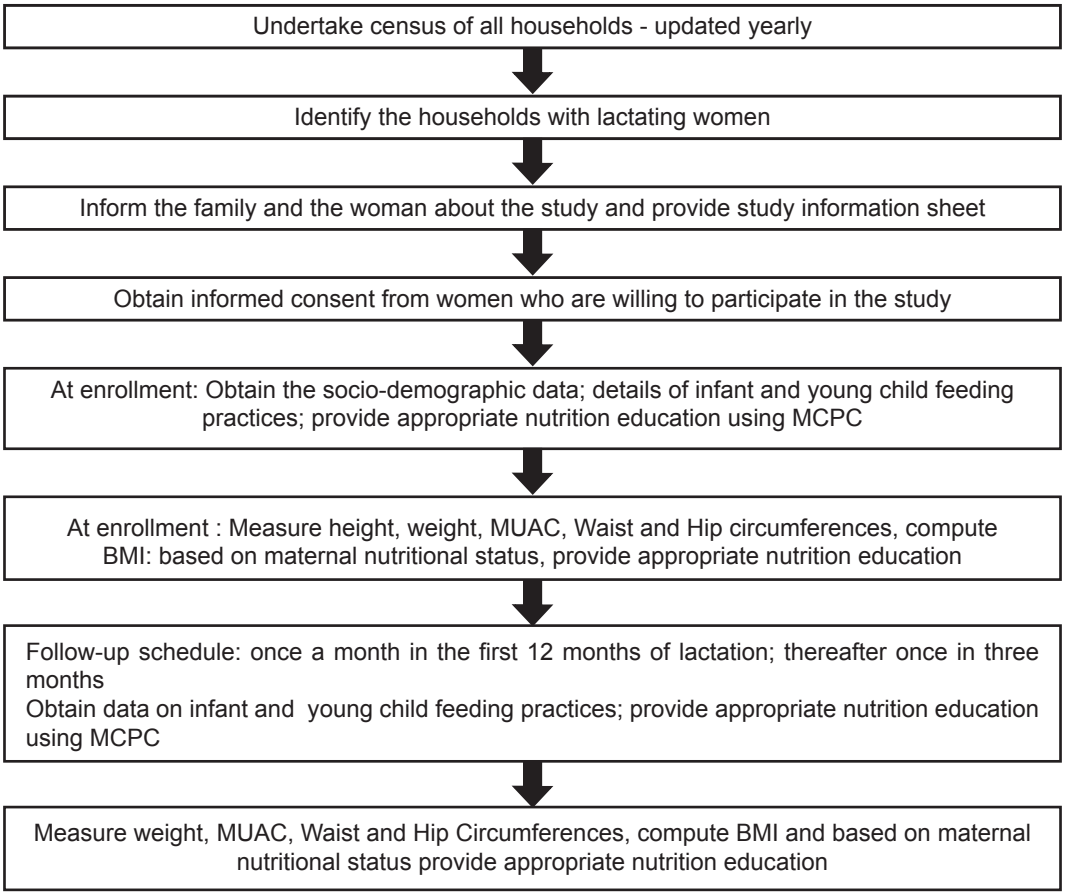


Figure 1
Study design

All lactating women who had consented to participate in the study were enrolled. Socio-demographic details of the families and details of infant feeding practices, documenting duration and intensity of lactation were obtained in a pre-tested and pre-coded proforma.

The following measurements were taken at enrolment: height using wall mounted stature meter with 0.1 cm accuracy, weight using digital balances with 100g accuracy, Mid Upper Arm Circumference (MUAC), Waist Circumference (WC) and Hip Circumference (HC) using non-stretch tape with vernier attachment. Accuracy of balances was checked every day. Measurements were carried out by personnel who had been trained and were proficient in taking these measurements. Inter-day and inter-individual variations in measurements were minimised by quality assurance checks. During the first 12 months of lactation, women were weighed every month; in the 12-35 month period they were weighed once in three months. Circumferential measurements were taken once in three months. In winter months the circumferential measurements especially MUAC could be taken only when it was not very cold. BMI was computed from height and weight measurements and nutritional status of women was assessed using BMI. Based on circumferential measurements adiposity and its location were assessed. Nutrition advice was provided to all women taking into account the nutritional status as assessed by BMI.

This observational study was approved by the Institutional Ethics Committee of NFI and AIHSHEW. Permission to conduct the study was obtained from the Department of Woman and Child Development National Capital Territory of Delhi.

Data cleaning

Data were entered and managed in Microsoft Excel 2013. Data were cleaned; only those visits where accurate information on duration of lactation and maternal weight were available were taken up for data analysis. Nutritional status of women were assessed using the WHO cut-offs for BMI and adiposity by using the WHO cut-offs for WC, HC and Waist Hip Ratio (WHR). A total of 2240 lactating women were enrolled for the study; 83.5% were in the 18-29 year age group (Group A) and 16.5% in the ≥ 30 year age group (Group B) (Table I).

Earlier studies have shown that there were substantial differences in nutritional status in NPNL women in the 18-29 year age group and those who were beyond 30 years of age[15]. Therefore data from lactating women from the two age groups - Group A and Group B - were analysed separately. The number of visits during which different anthropometric measurements was carried out in Group A and Group B is given in Table I; weight was measured in the highest number of visits and MUAC in the least number of visits.

TABLE I

Number of Women and Visits with Anthropometric Measurements

Number of women in 18-29 years (Group A) with duration of lactation <36 months							
Year	Number of households	Number of Women	Height	Weight	MUAC	WC	HC
2015	715	736	736	3400	2226	3196	3196
2016	515	538	538	1790	1034	1550	1550
2017	277	596	596	2509	805	807	807
Total	1807	1870	1870	7699	4065	5553	5553
Number of women in ≥30 years (Group B) with duration of lactation <36 months							
Year	Number of households	Number of Women	Height	Weight	MUAC	WC	HC
2015	141	141	141	685	438	633	633
2016	98	99	99	343	189	290	290
2017	130	130	130	572	181	183	183
Total	369	370	370	1600	808	1106	1106
Grand Total	2176	2240	2240	9299	4873	6659	6659

Statistical analysis

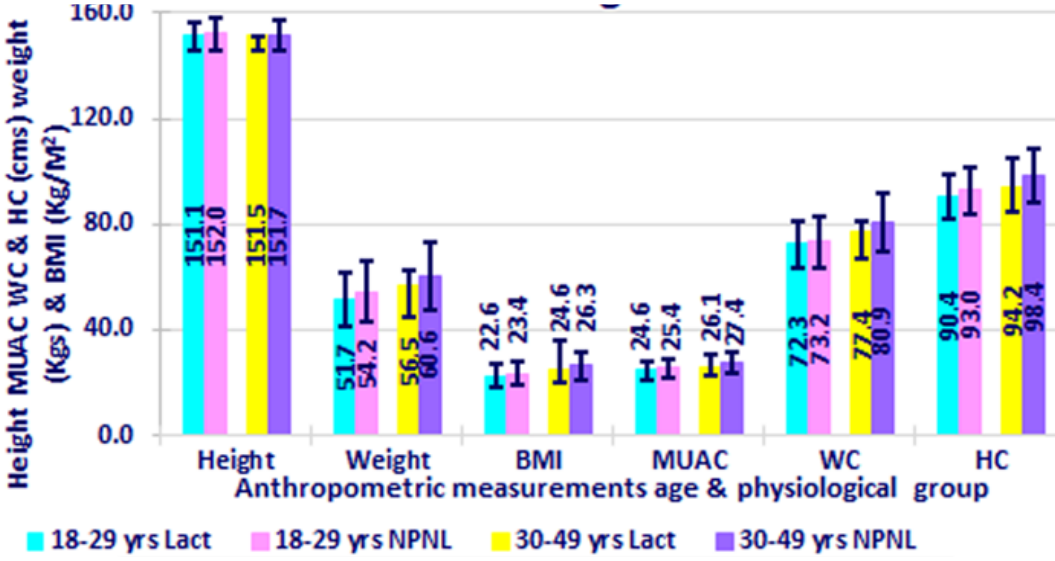
Statistical analysis was carried out using MS Excel and SPSS 26. Means and standard deviations were calculated for continuous variables. Statistical significance of the differences between means in different groups was assessed using two tailed student t test. For categorical variables (eg: under-nourished, normal and over-nourished) percentage prevalence was computed. Statistical significance of the differences in nutritional status and adiposity between Group A and Group B was assessed using chi square test.

Results and Discussion

Socio demographic profile

Analyses of data on socio demographic profile of the study households showed that majority were nuclear families (Group A 70.1%, Group B 63%) with five or less members (Group A 63.6%, Group B 61.4%). Majority of women (Group A 54.7%, Group B 52.2%) had secondary school education. Majority were home makers (Group A 85%, Group B 91.9%). Over 95% of families in both the groups lived in brick and mortar buildings; 40.8% of Group A and 37.3% of Group B women lived in their own houses; the rest were mostly

migrants who lived as tenants. Public tap was the major source of water (Group A 86.7%, Group B 79.7%); tankers supplied drinking water in times of water scarcity. Access to flush toilets either in their own home or shared with other households was available to almost all families (Group A 98.8%, Group B 98.4%). For cooking, almost all households used Liquefied Petroleum Gas (LPG) and stainless steel utensils. Over 90% owned colour TV, which was their main source of entertainment; after completing household chores within the small tenement, women sat down and watched TV or chatted with friends using mobile phones. The families stated that they belonged to low middle income group and this was confirmed when household



Two tailed test comparison between lactating & NPNL					
Anthro	Age group	p value	Anthro	Age group	p value
Height	18-29 yrs	0.00E + 00	MUAC	18-29 yrs	0.00E + 00
	≥ 30 yrs	NS		≥ 30 yrs	2.22E – 16
Weight	18-29 yrs	0.00E + 00	WC	18-29 yrs	6.55E – 06
	≥ 30 yrs	0.00E + 00		≥ 30 yrs	0.00E + 00
BMI	18-29 yrs	0.00E + 00	HC	18-29 yrs	0.00E + 00
	≥ 30 yrs	0.00E + 00		≥ 30 yrs	0.00E + 00

Figure 2

Comparison of anthropometric measurements in lactating and NPNL women

possessions were considered. Majority of families lived in one or two room tenements (Group A 63%, Group B 65.7%), in over-crowded unhygienic localities because of urban housing constraints. These families stated that they were food secure; they accessed subsidised food grains from Public Distribution System and if needed availed ICDS supplementary feeding programmes.

Nutritional profile of lactating women

The mean height, weight, BMI, MUAC, WC and HC were computed in lactating women from Group A and Group B. The institution had conducted a study on nutritional status of Non-Pregnant Non-Lactating (NPNL) women in the same community[15].

The mean values for anthropometric indices in lactating women (Group A and Group B) were compared with corresponding mean values in NPNL women in the 18-29 and ≥30 year age group (Figure 2). The differences in the mean height between lactating women in Group A and Group B and corresponding groups in NPNL women were small and were statistically not significant (except in 18-29 year group), indicating that the groups were homogenous.

In both age groups, lactating women weighed significantly less as compared to non-lactating women. Similar trends were seen in BMI, MUAC, HC and WC suggesting that for any given age, lactating women weighed less and had less adiposity as compared to their NPNL counterparts. All these differences were statistically significant. There were no differences in the distribution of fat as assessed by circumferential measurements between lactating and NPNL women in the same age group.

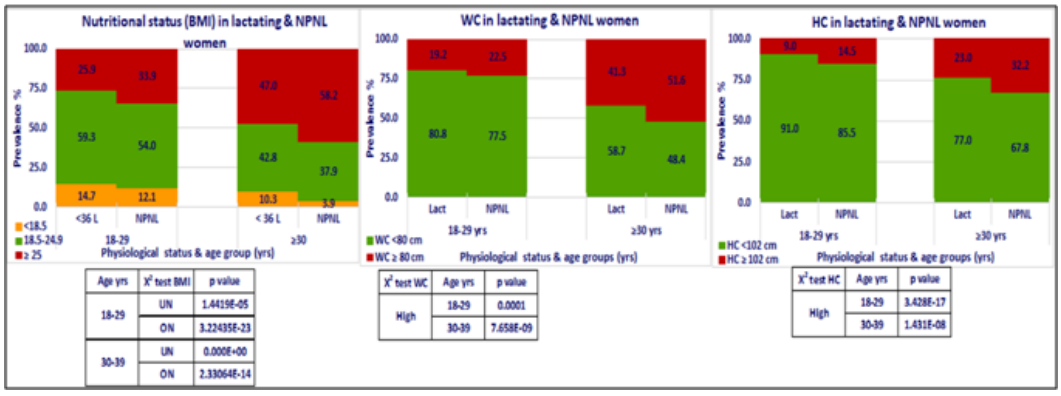


Figure 3

Comparison of nutritional status and adiposity in lactating and NPNL women

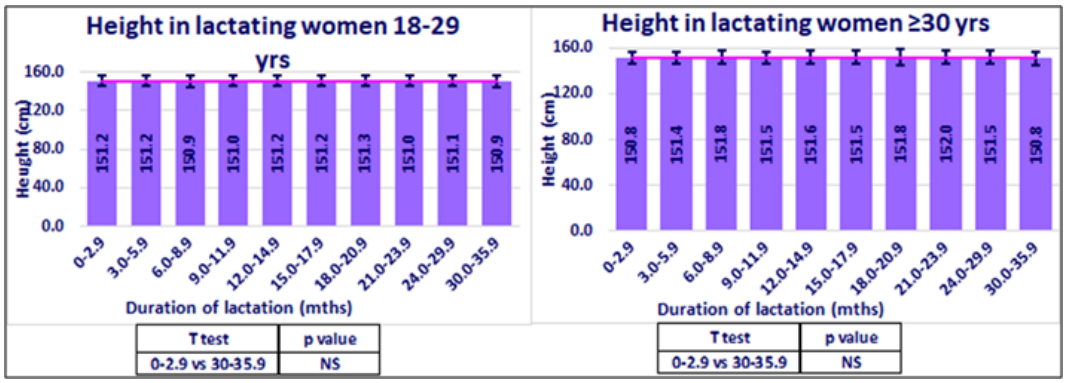


Figure 4
Height in relation to duration of lactation

The nutritional status as assessed by BMI and adiposity as assessed by WC and HC between lactating and NPNL women in the two age groups were compared (Figure 3). In both age groups, lactating women had higher under-nutrition and lower over-nutrition rates as compared to the NPNL counterparts. Similar trend was seen in relation to adiposity as assessed by WC and HC. Abdominal adiposity (waist circumference ≥80cm) rates were far higher as compared to truncal adiposity (hip circumference ≥102 cm) rates in lactating and non-lactating women in both the age groups. All these differences were substantial and were statistically significant.

TABLE II

Anthropometric Measurements done during Different Periods of Lactation

Duration of lactation (months)	Weight (kg)			WC/HC (cm)			MUAC (cm)		
	Age group (yrs)			Age group (yrs)			Age group (yrs)		
	18 - 29	≥ 30	Total	18 - 29	≥ 30	Total	18 - 29	≥ 30	Total
0.01 - 5.9	1890	341	2231	1413	248	1661	986	163	1149
6.0 - 11.9	2118	341	2459	1588	246	1834	1174	178	1352
12.0 - 17.9	1492	264	1756	1052	171	1223	747	125	872
18.0 - 23.9	1085	276	1361	745	191	936	585	147	732
24.0 - 29.9	735	212	947	493	135	628	367	96	463
30.0 - 35.9	379	166	545	262	115	377	206	99	305
Total	7699	1600	9299	5553	1106	6659	4065	808	4873

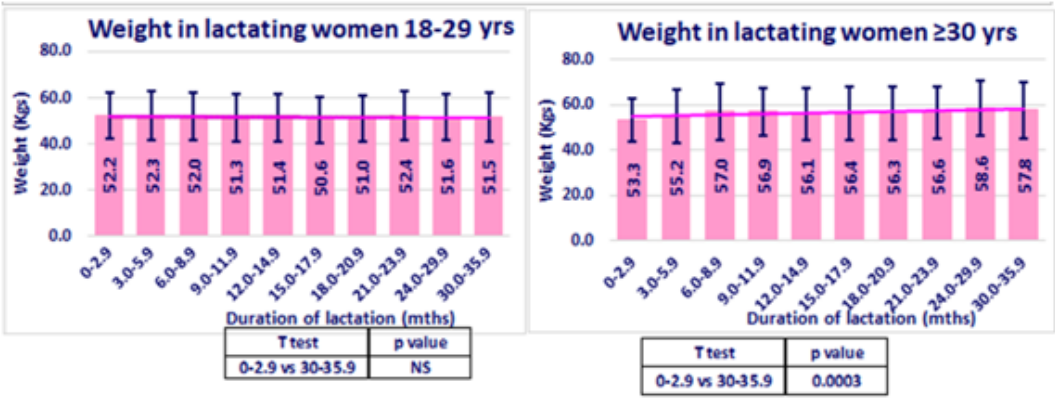


Figure 5
Weight in relation to duration of lactation

Changes in anthropometric indices in relation to duration of lactation

Height was taken only at the time of enrolment. Mean height of woman in the two age groups (Group A and Group B) during different duration of lactation is shown in Figure 4. There were no differences in the mean height of lactating women either in Group A and Group B in relation to duration of lactation, indicating that they were a homogenous group.

The duration of lactation at the time when different anthropometric measurements were taken in the two age groups is given in Table II.

Mean weight of lactating women in Group A was lower as compared to Group B across all durations of lactation. These

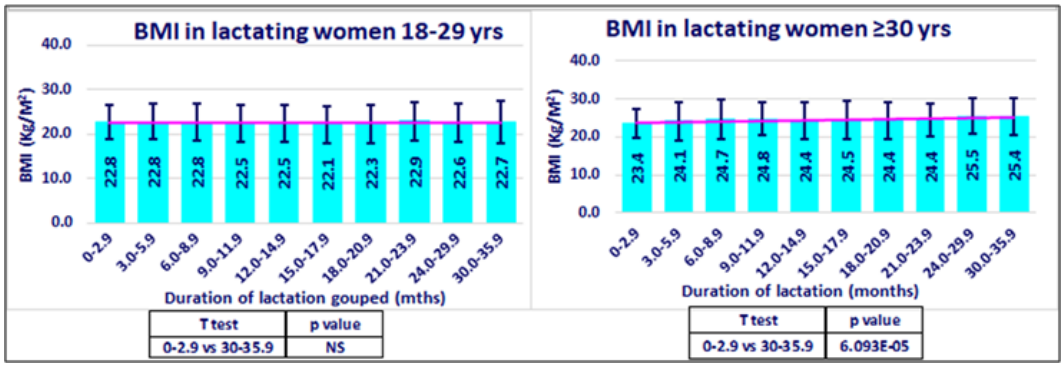


Figure 6
BMI in relation to duration of lactation

differences were substantial and statistically significant. There was a small reduction in the mean weight between 9 and 17 months of lactation in Group A. There was a 0.7 kg reduction in mean weight between 0-2 months and 30-35 months in Group A. This was not statistically significant. The lowest mean weight was seen in the 0-2 months of lactation in Group B. There was a small increase in the mean weight till 11 months; between 12-23 months the mean weight was similar; after 24 months there was further increase in the mean weight in Group B. There was an increase of 4.5 Kg in the mean weight between 0-2 months and 30-35 months in Group B (Figure 5) and this was statistically significant.

Mean BMI of lactating women in Group A was lower as compared to Group B across all durations of lactation. There was no change in BMI between 0 and 8 months of lactation in Group A. Thereafter there was a small reduction in the mean BMI till 20 months; subsequently there was a small rise. The mean BMI at 30-35 months was lower by 0.1 as compared to BMI at 0-2 months in Group A. This was not statistically significant. In Group B the lowest mean BMI was in the 0-2 months of lactation. Thereafter there was a progressive increase in the mean BMI till 30-35 months. The increase in the mean BMI between the 0-2 month of lactation and 30-35 months of lactation was 2 (Figure 6). This substantial difference in the mean BMI was statistically significant.

Changes in circumferential measurements in relation to duration of lactation

The mean MUAC across all durations of lactation was higher in women in Group B as compared to Group A. In Group A there was a small increase in the MUAC between 0 and 14 months of lactation. The increase in the mean MUAC at 0-2 months and 30-35 months was 0.4cm in Group A and

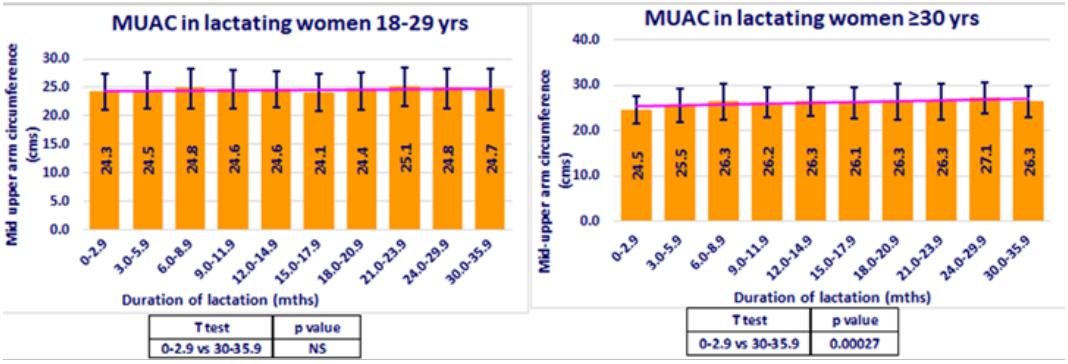


Figure 7
MUAC in relation to duration of lactation

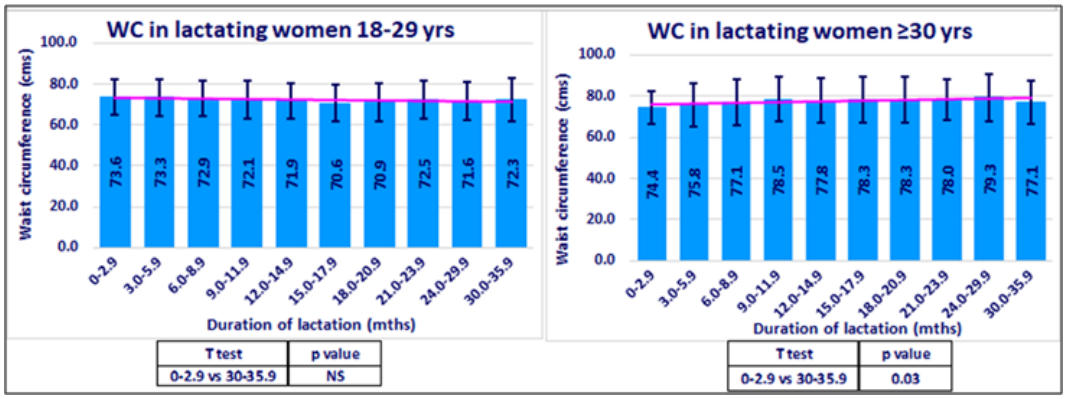


Figure 8
WC in relation to duration of lactation

this was not statistically significant. In Group B the lowest mean MUAC was seen in 0-2 months of lactation. There was a small increase in the mean MUAC till 11 months; thereafter it remained essentially unaltered. The increase in the mean MUAC between 0-2 month and 30-35 months of lactation was 1.8 cm in Group B (Figure 7) and this difference was statistically significant.

The mean WC across all durations of lactation was higher in women in Group B as compared to Group A. In Group A the mean WC was highest in the 0-2 months. Subsequently there was a small reduction in the WC between 3 and 17 months of lactation. The reduction in the mean WC between 0-2 months and 30-35 months was 1.3 cm in Group A and

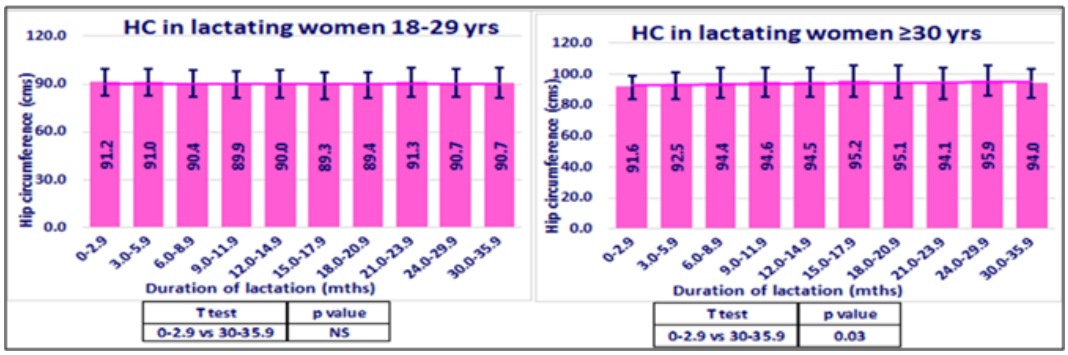


Figure 9
HC in relation to duration of lactation

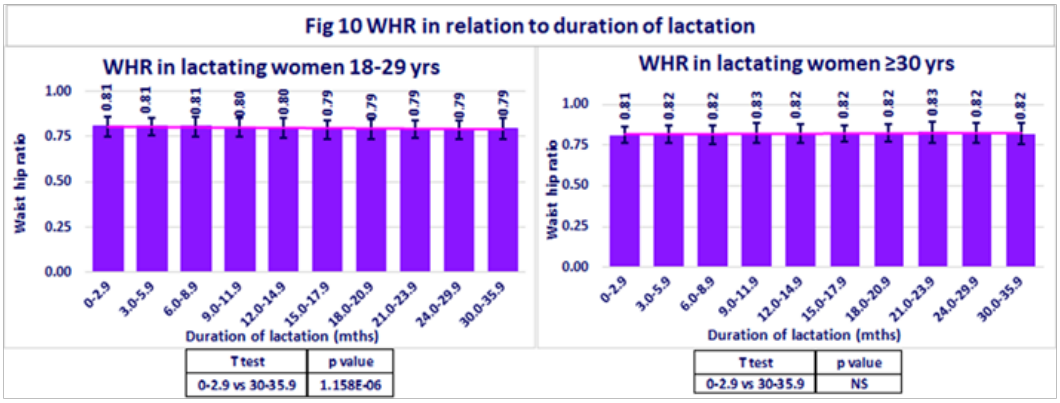


Figure 10
WHR in relation to duration of lactation

this was not statistically significant. In Group B the lowest mean WC was seen in the 0-2 months of lactation. There was a progressive increase in the mean WC till 29 months. The increase in the mean WC between 0-2 months and 30-35 months was 2.7 cm (Figure 8); this difference was statistically significant.

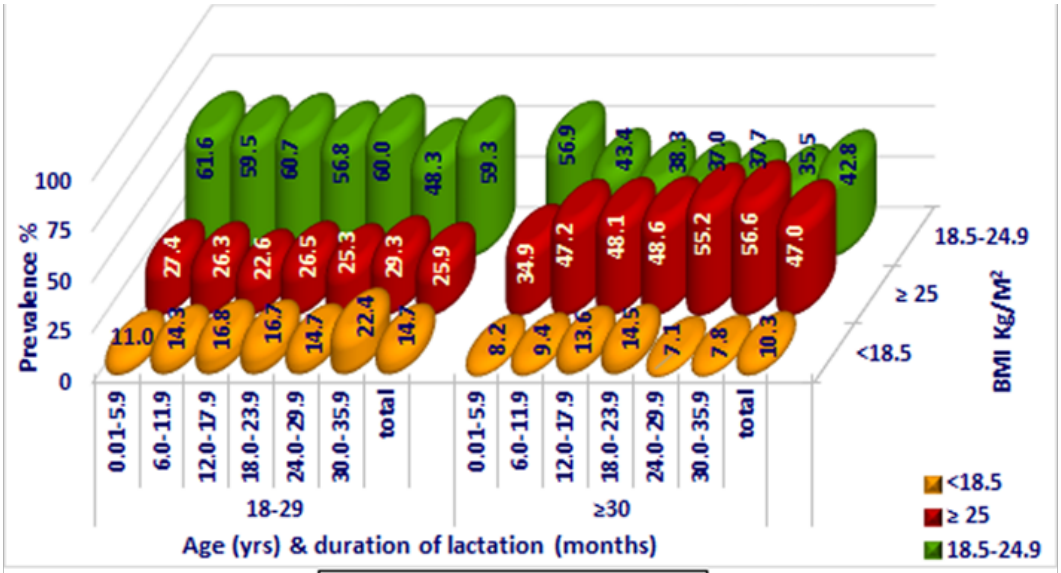
The mean HC across all durations of lactation was higher in women in Group B as compared to Group A. In Group A the mean HC was highest in the 0-2 months. Subsequently there was a small reduction between 0-2 and 18-20 months of lactation. The reduction in the mean HC between 0-2 months and 30-35 months was 0.5 cm in Group A; this difference was not statistically significant. In Group B the lowest mean HC was seen in 0-2 months of lactation. There was a progressive increase in the mean HC till 29 months. The increase in the mean HC between 0-2 months and 30-35 months was 2.4 cm (Figure 9); this difference was statistically significant.

The mean WHR was marginally higher in Group B group as compared to Group A across all durations of lactation. In Group A the mean WHR showed a small decline between 0-2 and 30-35 months which was statistically significant. In Group B mean WHR remained essentially unaltered across all different durations of lactation (Figure 10) the difference between 0-2.9 and 30-35.9 months was not statistically significant.

Changes in nutritional status and adiposity in relation to duration of lactation

Both in Group A and B, there was a small increase in under-nutrition rates in lactating women 35 months (22.4%), and these differences were statistically

significant. Even at 0-5 months about a quarter of the women in Group A were over-nourished. There was some reduction in over-nutrition up to 17 months; thereafter there was a rise in over-nutrition rates. The difference in the prevalence of over-nutrition between 0-5 months and 30-35 months was 1.9% in Group A. This difference was not statistically significant. In Group B under-nutrition rate was 8.2% in the 0-5 months, 14.5% in 18-23 months and 7.8% in 30-35 months. There was a reduction of 0.4% in under-nutrition rates between 0-5 months and 30-35 months. This difference was not statistically significant. In Group B 34.9% were over-nourished at 0-5 months of lactation. There was sharp rise in over-nutrition rates in the 6-11 monthst group; there was a plateau between 12-23 months and another sharp rise at 24-29 months which persisted; at 30-35 months 56.6 % were over-nourished.



0-5.9 vs 30-35.9		
Age yrs	X^2 test BMI	p value
18-29	UN	1.432E-09
	ON	NS
≥ 30	UN	NS
	ON	3.292E-06

Figure 11
Changes in nutritional status (BMI) in relation to duration of lactation

Over-nutrition rates increased by 21.7% between 0-5 months and 30-35 months (Figure 11) and this was statistically significant.

Prevalence of abdominal adiposity as assessed by high WC (≥80cm) as well as truncal adiposity as assessed by high HC (HC ≥102 cm) was higher in Group B as compared to Group A across all durations of lactation. In both Group A and B prevalence of abdominal adiposity was nearly twice that of truncal adiposity. These differences were statistically significant. In Group A there was a progressive fall in the prevalence of high WC from 22.2% to 15.8% between 0-5 and 12-17 months; subsequently there was a rise and at 30-35 months 23.3% had high WC. There was an increase of 1.1% of high WC between 0-5 and 30-35 months of lactation. This difference was not statistically significant. Prevalence of high WC was 28.6% in the 0-5 months in Group B. There was a progressive rise in high WC with increasing duration of lactation. The increase in prevalence of high WC between 0-5 and 30-35 months of lactation in Group B was 13.1%. The substantial rise in abdominal adiposity was statistically significant. Changes in truncal adiposity (high HC) showed a similar trend (Figure 12) but the differences between 0-5 and 30-35 months were not significant either in Group A or Group B. Abdominal adiposity rates were nearly double that of truncal adiposity rates in both Group A and B; these differences were statistically significant.

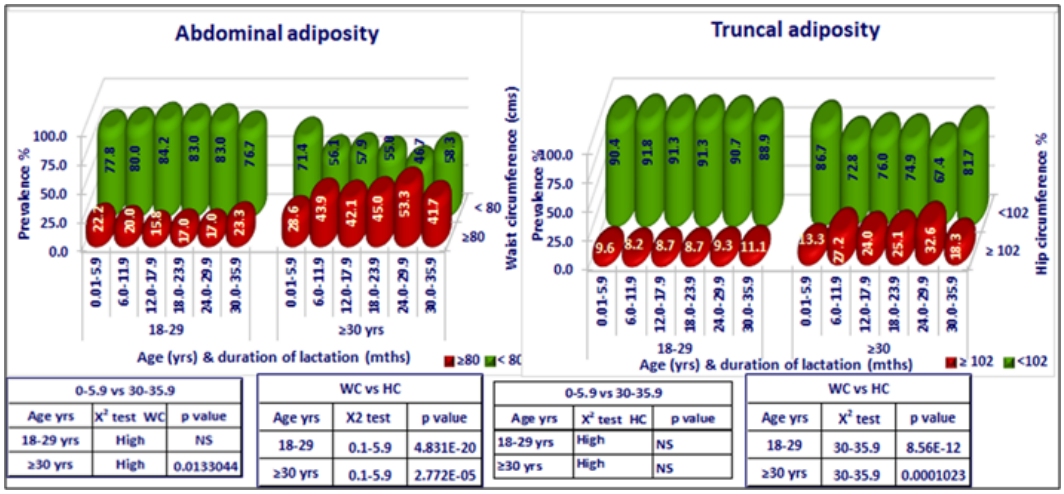


Figure 12
Adiposity in relation to duration of lactation

Discussion

Studies on effect of lactation on nutritional status of lactating women have to take into account both adequacy and duration of lactation. Our institution had undertaken community based mixed longitudinal study in urban low middle income group families to assess infant and young child feeding practices and growth in under-three children[16] and concurrently assessed the nutritional status of lactating mother in these families. Data from the study on under-three children showed that over 90% of infants at 2 months and over 2/3rd at 5 months were solely breast-fed. Breast feeding continued beyond 11 months in 85% of children and nearly 2/3rds at 23 months; about 1/5th of the mothers stated that they continued breast feeding their children mostly at night even beyond 35 months. Mean z scores for weight-for-age in children did not show any deterioration in the first 18 months[16]. These data suggest that in this community, frequency, quantity and duration of breast feeding were adequate to support growth of children in the first 18 months.

Lactation involves additional maternal energy expenditure for breast milk production - estimated to be about 500 kcal/day and this is likely to have an impact on their nutritional status[3]. The mean values for anthropometric indices in lactating women (Group A and Group B) were compared with corresponding mean values in NPNL women in the 18-29 and ≥30 years age group (Figure 2) from the same community[15]. In both age groups lactating women weighed significantly less, had lower mean BMI, MUAC, HC and WC as compared to non-lactating women (Figure 2). In both age groups, lactating women had higher under-nutrition and lower over-nutrition rates as compared to NPNL women of the same age group (Figure 3). Adiposity as assessed by WC and HC was higher in NPNL group as compared to lactating women in 18-29 and ≥ 30 years age groups. Meeting the additional expenditure of milk production appears to be responsible for the lower body weight, higher under-nutrition, lower over-nutrition and lower adiposity rates in lactating women as compared to their NPNL counterparts.

Data from the present study indicate that in Group A there was no persistent deterioration in nutritional status or reduction in adiposity early in lactation or with increasing duration of lactation up to 36 months. This is perhaps because these women are from food secure households and physical activity household work and childcare were predominantly sedentary. In Group A there was a progressive fall in the prevalence of high WC from 22.2% to 15.8% between 0-5 and 12-17 months; subsequently there was a rise and at 30-35 months 23.3% had high WC. The initial reduction might be due to post-

delivery changes in abdominal muscle tone and reduction in abdominal fat. The rise in prevalence of over-nutrition, high WC and HC in the 30-35 months might be due to fat deposition because of lower energy expenditure in breast milk production during waning lactation.

Unlike Group A, women from Group B gained weight and adiposity throughout the period of lactation. The reduction in mean weight in Group A between 0-2 and 30-35 months was 0.7 Kg but in Group B during the same periods there was a weight gain of 4.5 Kg. In Group B the lowest over-nutrition, high WC and HC were seen between 0-5 months. There was a progressive rise in over-nutrition, high WC and HC with increasing duration of lactation. The prevalence of over-nutrition was 34.9% in the 0-5 months of lactation and 56.6 % at 30-35 months; high WC and HC showed a similar trend. Clearly there is a positive energy balance in older lactating women leading to weight gain and adiposity during lactation. Studies from well-nourished lactating women from developed countries have shown that in majority of these women pregnancy and lactation resulted in residual gain in weight as compared to pre-pregnancy weight[6-8]. It appears that in India too there is residual weight gain in lactating women not only among the well-to-do but also among older lactating women from urban low middle income group.

Every effort was made to inform these women that:

- they are gaining weight and are becoming over-nourished;
- high over-nutrition rates are associated with risk of Non-Communicable Diseases (NCD); and
- they should increase discretionary physical activity to halt further rise in over-nutrition.

Nutrition and health education regarding increase in physical activity to halt the rise in over-nutrition in these women did not result in increased discretionary physical activity, because these women felt tired after completing household and child care chores and wanted to relax.

There were substantial differences in nutritional status and adiposity between women in the 18-29 and ≥30 years age group both in lactating women and non-lactating women. This difference appears to be due to the effect of age on nutritional status of women in this community. In the study period all over-nourished women irrespective of age and duration of lactation were informed that they were over-nourished and were advised to increase physical activity. This advice was seldom followed because of the practical difficulties faced by these women. They lived in small tenements, with LPG stoves and piped

water; household work was sedentary but time consuming. When they completed these and child care work, they felt like relaxing and watching TV. Their houses were small and cramped; in their areas there were no well-paved well-lit roads where they could walk. There is urgent need to improve access to areas where they can take up discretionary physical activity for preventing further increase in over-nutrition.

The prevalence of abdominal adiposity (WC ≥ 80 cm) and truncal adiposity (HC ≥ 102 cm) both in lactating and NPNL women in the 18-29 and ≥ 30 years age groups is very high. Prevalence of abdominal adiposity is twice that of the truncal adiposity in all the four groups. Abdominal adiposity is associated with increased risk of metabolic syndrome and higher risk of cardiovascular diseases. There is an urgent need to provide health education and ensure that that these women do go to the health and wellness centres, get their blood pressure and blood glucose checked and get appropriate advice regarding physical activity and medication if needed. Early detection and effective treatment of NCD will reduce the complications and severity of these diseases in these reproductive age women.

Conclusion

Data from the study indicate that across age groups under-nutrition rates are low in lactating women from urban low middle income group; there is no persistent increase in under-nutrition rates during lactation. It may be possible to achieve substantial reduction in under-nutrition in lactating women by identifying the individual lactating woman who is under-nourished, providing her with nutrition education and take home rations continuously and monitoring weight changes and improvement in nutritional status.

Over nutrition is emerging as a major problem both in lactating and non-lactating women in this community. The weight gain and increase in over-nutrition during lactation was small in women in 18-29 years age group but high in ≥30 years sage group. Nearly a third of the lactating and non-lactating women in 18-29 years age group were over-nourished; in the ≥30 years age group over half the women were over-nourished. Prevalence of adiposity especially abdominal adiposity is high; consequently risk of cardiovascular diseases and diabetes is high. Lactating women are in contact with the health services for child immunisation. These contacts should be used to check their nutritional status, blood pressure and blood sugar especially in those who are over-nourished. It is imperative that health education to promote discretionary physical activity in home settings as well as in the vicinity of home were taken up and progress monitored so that the rise in over-nutrition and risk of non-communicable diseases in women is halted and later reversed.

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Theme: Triple Burden of Malnutrition in India: A Research Update

Certificate for Oral Presentation

This is to certify that ~~Dr./~~Ms./~~Mr.~~ Anshi Goel has orally presented on the topic of **Dual nutrition burden in women from low middle income group,** at NAMS-NFI SYMPOSIUM, held on 18th October, 2019 at the Kamla Raheja Auditorium, NAMS House, New Delhi.

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