NATIONAL LOW BIRTH WEIGHT SURVEY BANGLADESH, 2015

Institute of Public Health Nutrition

Directorate General of Health Services

Ministry of Health & Family Welfare

Government of Bangladesh

Social Sector Management Foundation

Flat B, Building # 13,

Road # 72, Gulshan-2

Dhaka, Bangladesh

National Low Birth Weight Survey

Bangladesh, 2015

PSSMRTD PARTNERS IN SOCIAL SECTOR MANAGEMENT
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Director
Institute of Public Health Nutrition (IPHN)
Directorate General of Health Services
Ministry of Health & Family Welfare
Government of the People's Republic of Bangladesh

Subject: Submission of the final draft

Kindly receive the final draft of the survey report on the 'National Low Birth weight Survey'. This has been developed based on the opinions and suggestions received in the two technical dissemination sessions that were organized by IPHN.

As per the last technical dissemination session suggestion, you are requested to kindly distribute this final draft among all the technical experts and participants of the two technical dissemination sessions for their final suggestions and views.

Regards

A M Zakir Hussain
CEO, SSMF and Team Leader
National Low Birth weight Survey

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Mohakhali, Dhaka 1212

Report prepared by:

Partners in Social Sector management Research Training & Development (PSSMRTD)

Flat B, Building No. 13

Road No. 72, Gulshan-2

Dhaka 1212, Bangladesh

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LIST OF ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
BMI	Body mass index
BRAC	Bangladesh Rural Advancement Committee
CEG	Core expert group
cm	Centimeter
CSBA	Community skilled birth attendant
C-section	Caesarian section
DGHS	Directorate General of Health Services
DPE	Directorate of Primary Education
DPHE	Department of Public Health Engineering
DWA	Department of Women Affairs
EDD	Expected date of delivery
EOC	Emergency obstetric care
ERD	External relation division
FM	Field Operations Manager
FS	Field supervisor
Fig	Figure
FWV	Family Welfare Visitor
g/ gm	Gram
HKI	Hellen Kellar International
HSC	Higher Secondary School Certificate
Ht/ ht	Height
ICDDR/B	International Center for Diarrheal Diseases Research/ Bangladesh
IMED	Information Monitoring and Evaluation Division
INFS	Institute of Nutrition and Food Sciences
IPHN	Institute of Public Health Nutrition
ISRT	Institute of Statistical Research and Training
IQ	Intelligent qoutient
IUGR	Intrauterine growth retardation
Kg	Kilogram
LBW	Low birth weigh
LMP	Last menstrual period
MCHTI	Maternal and Child Training Institute
MCWC	Maternal and Child Welfare Center
MoHFW	Ministry of Health & Family Welfare
MUAC	Mid upper arm circumference

N	Sample size
NGO	Non-government organization
NNS	National Nutrition Council
OR	Odds ratio
PI	Ponderal index
PRC	People's Republic of China
QC	Quality control
QI	Quality improvement
RFA	Resident Field Assistant
SACMO	Sub-assistant Community Medical Officer
SGA	Small for gestational age
SPSS	Statistical Package for Social Science
SSC	Secondary School Certificate
SSMF	Social Sector Management Foundation
TAPP	Technical Assistance Project Proforma
ToR	Terms of reference
UNGA	United Nations General Assembly
UNICEF	United Nations Children Fund
USA	United States of America
WHO	World Health Organization
Wt/wt.	Weight

FOREWORDS

PREFACE

ACKNOWLEDGMENT

We are grateful to the Institute of Public Health Nutrition, Directorate General of Health Services, Ministry of Health & Family Welfare, Government of the People's Republic in trusting us in conducting this nation-wide survey. We will fail in our expression of the deep sense of indebtedness if we do not mention in particular the names of Dr. Alamgir Hossain the former Director of the Institute and Line Director of the National Nutrition Services (NNS) and Dr. Muzaherul Islam the present Director and Line Director, for their unconditional support to the carrying out of this project. In the same breath we would also express our profound thanks to Dr Moudud Hossain Deputy Director of the Directorate General of Health Services and Program Manager, NNS and Mr. Aman Ullah, Deputy Program Manager respectively of NNS, especially for their supportive supervision and monitoring of field work, which has contributed to the improvement of the data collection process and accuracy.

We are thankful to our data collectors and supervisors. They were the most important foot soldiers of this survey. Their dedication and interest toward the work were amazing and beyond our a priori belief. We were in fact surprised to see how popular and friendly they were in the community. They knew the families of the women they followed up for an entire period of about nine months even before the study actually begun and also knew these women by name. The supervisors also exhibited their utmost dedication to the work. They in fact resided in the field for the entire period of this work.

The support received from our partners- Dhaka Shishu (Children) Hospital, Bangladesh Association for Maternal and Neonatal Health (BAMANEH) and the Institute of Nutrition and Food Sciences (INFS) of the Dhaka University, was unprecedented and truly valuable, which came in the form of technical advice and training to the field supervisors and quality improvement officers. Statistical analysis was done Dr. Taslim Sazzad Mallik of the Dept. of Statistics of Dhaka University. We are thankful to him also, for the hard work, he undertook.

Finally, we would like to express our gratitude towards our data entry and analysis partner- NK Enterprise. They have taken considerable amount of pain on different occasions in providing different pieces of information in summary form, besides what was agreed upon in the beginning- only data editing and entry for statistical analysis.

A M Zakir Hussain

Chief Executive Officer

Social Sector Management Foundation

SUMMARY

BACKGROUND

Low birth weight has been defined by the World Health Organization (WHO) as weight at birth of less than 2,500 grams[1], based on epidemiological observations that newborns weighing less than 2,500 g are about 20 times more likely to die than heavier babies.

Low birth weight is either the result of preterm birth (<37 weeks of gestation) or due to restricted fetal growth, i.e., due to intrauterine growth retardation. Low birth weight is also associated with poor cognitive development, and chronic adulthood diseases- type 2 diabetes, hypertension and cardiovascular disease.It also leads to poor health through reducing immunity and increasing susceptibility to disease. Intra-uterine growth retarded (IUGR) and LBW infants are more susceptible to hypoglycemia and to birth asphyxia. In a substantial number of studies they were seen to suffer from more diarrhea and pneumonia for a few months after birth, showing that LBW may also be a risk factor for post-neonatal death. Undernutrition in mid-pregnancy may also impair development of the immune system.

Weight at birth is a strong predictor for size in later life because most IUGR infants do not catch-up to normal size during childhood. Also, undernutrition that affects head circumference before 26 weeks of pregnancy has a greater impact on neurologic function than does undernutrition later in pregnancy. The adverse effects of early childhood undernutrition on behavior and cognitive development may not be fully redressed, even with better diet and care later.

LBW could be the main reason why more than 50percent of the children in South Asia are underweight. Infants who weigh 2,000-2,499 gm at birth have a four-fold higher risk of neonatal death than those who weigh 2,500-2,999 gm, and a ten-fold higher risk than those weighing 3,000 - 3,499 gm.

Factors affecting the duration of gestation and fetal growth, influence the birth weight. They relate to the baby, the mother, or the environment and play an important role in determining the birth weight and the future health of the infant. Birth weight is affected to a great extent by the mother's own fetal growth and her diet from birth to pregnancy, and determining her body composition prior to conception. Mothers in deprived socio-economic conditions tend to have low birth weight infants. In those settings, the infant's low birth weight emanates from the mother's poor nutrition and health over a long period, including during pregnancy, the high prevalence of infections, or from pregnancy complications, often related to poverty. Hard physical work during pregnancy may contribute to poor fetal growth.

Mothers who are younger (<20 years) or older (>35 years) have also been found to give birth to low birth weight newborns in comparison to those women who are aged 20-35 years. In 1992, as per WHO and UNICEF, the low birth weight rate for industrialized countries was around 7 per cent, and in less developed countries between 5 and 33 per cent, with an average of 17 per cent. Half of all low birth weight babies are known to be born in South-central Asia, where about 27 per cent of all infants weigh less than 2,500 g at birth. In Bangladesh, on the other hand, the first ever low birth weight survey conducted in 2003-2004, found the rate of low birth weight to be 36percent. In developing

[1] The 29th World Health Assembly (1976) agreed that: "Low birthweight is a weight at birth of less than 2,500 g (up to and including 2,499 g) irrespective of gestational age."

countries, the majority of LBW newborns are small, but are not born prematurely. Nevertheless, 6.7percent of LBW infants are born preterm in developing countries. In Bangladeshi cultural context it is difficult to identify preterm birth, as has been seen in this study, because women do not identify themselves as pregnant, unless they miss at least two or three menstrual cycles, for the sake of surety.

The fetus is known to increase maximally in length at 20-30 weeks of gestation, and in weight during the third trimester. Over-gestation has been found, in this study, contrarily to give birth to smaller length and low birth weight newborns.

Maternal undernutrition has been found to be the major determinant of IUGR in developing countries (about 50percent of all IUGR in rural areas of developing countries is attributable to low weight and short stature). Poor physical condition was a common feature among the pregnant women in this study-with average height being 5 feet and average weight 49.1 Kg (lesser in the rural areas) in the study areas. Majority of LBW is caused by premature delivery (in this study almost half were born premature with LBW), cigarette smoking during pregnancy, which is probably the most important cause of IUGR (no relation was found in this study between LBW and smoking), followed by low gestational weight gain (not a case in this survey, as the average weight gain during pregnancy was 8.2 Kg).There is increasing evidence that deficiencies of some micronutrients, such as folic acid, increase the risk of preterm delivery. Anemia was detected in 54.8 percent of the pregnant women in this study.

According to a WHO collaborative center study, a preconception weight of 40 kg (assuming average height is 150 cm) has been proposed as a useful cut-off for predicting IUGR risk in developing countries. Maternal weight during gestation predicts IUGR risk slightly better than pre-pregnancy weight because it considers weight gain both in pregnant women and the fetus. The study found that just a low maternal BMI was a poorer predictor of IUGRthan either pre-pregnancy maternal weight or attained weight during pregnancy. This implies that a controlled study is required on what would be the standard weight gain during the gestational period in Bangladesh and also what would be effect of different scales of weight gain on the babies born with different birth weight and length. At the same time finding the predictors of IUGR would also be warrantable.

Maternal height contributes to total maternal mass, but it has less value than weight for predicting IUGR. Low height is rather a good indicator of obstetric complications. Mid-pregnancy maternal weight gain and increments in thigh skin-folds were significantly associated with the newborn's length, weight and head circumference and were more effective predictor of birth weight and other newborn outcomes. In this study the pregnant women followed up had an average height of 150.1 cm and average weight of 55 Kg, the average BMI being 21.7. So BMI can hardly be the determinant of the 73 percent of IUGR that was experienced in this study. Follow up of the women based on their pre-pregnancy study may give some clue in this regard.

Supplementation of *moderately malnourished* women produces an increase in birth weight but has little impact on maternal weight gain. However, when *seriously malnourished* women are supplemented they cannot 'afford' to direct the energy to the fetus and therefore such supplementation improves maternal weight gain more than birth weight. This study has gauged into the feeding practices, consumption of none of fish, meat, egg, milk, fruit and vegetables could be considered as adequate as no more than 20percent of the families could say that they had good amount of consumption of these food items. Only one third of the families had good consumption of vegetables.

Adolescent pregnancy has been associated to a higher newborn mortality rate, low birth weight and still birth in newborns. These newborns are also prone to die within few weeks of their birth in comparison to babies born to women aged 20-24 years. Age at first marriage of the study women were: <18 years (69.8percent), >18 years (30.2percent) in this study. A comparative study would be useful to prove the ill effects of adolescent marriage.

Aim of this study

This study, being reported, was undertaken with the aim to provide nationally representative data on the prevalence of LBW including IUGR, and birth length of newborns, against which national interventions may be planned and implemented and progress may be measured towards the impact of relevant interventions.

Period of the study

The study was undertaken over a period of May 2015 to April 2016 (11 months) in the field. Three months were taken for data entry, statistical analyses and report writing.

METHODOLOGY OF THE STUDY

Data collection instruments were first developed in English by the team leader and the consultants, translated into Bangla, pre-tested, finalized and printed. Besides the questionnaire the other instruments used were: Salter and metallic spring type baby weighig machine (used in hospital delivery and home delivery respectively), wooden infantometer; bathroom scale; sphygmomanometer; glucometer and needle; gauze and spirit; thermometer; hemoglobin measuring strips; acetic acid and glass tube for measuring albumin in urine; and wooden length measuring scale.

One hundred and two data collectors, sixteen supervisors, four quality improvement officers, one field manager, one research officer, one team leader and four consultants were involved in data collection, assurance of data validity and for statistical analyses. Supervisors and quality improvement officers were trained for five days theoretically and practically, on interviewing and on taking clinical and physical measurements.

For the study one rural cluster (a community clinic catchment population) from each district was taken, based on the working area of the best known community skilled birth attendant (CSBA) in the district. Fifty pregnant women were identified (either through test kits or self declaration of the pregnant women) and listed by the CSBAs in each rural cluster. In urban areas 18 clusters were taken from among the most identifiable slums (from older districts), that are closest to the best known CSBA in the city/ town. Eighteen close-by non slum clusters were taken, in addition. From each of the urban clusters, slum or non-slum, 35 pregnant women were enlisted. The two urban clusters in Mymensingh were changed to rural clusters, to represent the proportionality of the rural and urban sample size, more or less (27:73 urban and rural sample units)

CSBAs were trained on collection of data on demographic, economic, educational, occupational, nutritional and feeding status and practices and other health status and practices; measuring physical, clinical and nutritional conditions of these women and also on measuring the weight and length of the newborns. Health care and practices during pregnancy were also recorded and medical conditions related to present and past pregnancies were also noted. Past and present child delivery practices, such as, place of delivery, conductor of child delivery, time of delivery, condition of the newborn at the

time of delivery, pregnancy outcome etc. were recorded. Finally the birth weight and the birth length of the newborns were recorded.

Each supervisor visited one of the data collectors every day and worked the whole day with the data collector. Supervisors' meetings were held once in two months in the project head office to review the questionnaires collected before coming to Dhaka, and to resolve issues encountered during data collection. These meetings also provided refreshers' training and involved the other partners of the study. Field Manager, research officer and the team leader visited the study clusters regularly (the team leader visited 40percent of the clusters). Field manager compiled the supervisory and QI officers' reports for the team leader. Manager, human resources also communicated with the supervisors and data collectors every day. IPHN officials (line director, program manager and deputy program manager) also visited survey works in the field

The total sample size was 4,500 pregnant women, of who 102 were missed on follow up, before their delivery. The sample size was determined based on an analytic design – a two sampled, two tailed test, with 95percent confidence level and 95percent power to detect difference, if any, between the two samples coming from different divisions.

Demographic, economic, social (literacy), and physical conditions (height and weight of husbands) and possible nutritional practices were collected once. Data on feeding practices were collected on weekly basis. Data on clinical (weight during pregnancy, blood pressure, anemia, blood sugar, urine in albumin) and medical conditions (illnesses or other medical complaints and problems, e.g., fever, eclampsia, edema, goiter etc.) were collected on a trimester basis an finally the child birth related information as the penultimate information.

Data were edited, coded, cleansed, entered and analyzed by the data management partner of the Social Sector Management Foundation. Data were treated statistically through the Statistical Package for Social Science (SPSS), version 20. Team leader kept track of data validity at data collection level and at data entry level. Reports were prepared through a consultation process between the consultants and the partners involved in the study. The report was finalized after inputs from the technical committee of the National Nutrition Services (NNS), the technical staff of the Institute of Public Health Nutrition (IPHN) and after two consecutive meetings of experts, held at IPHN.

FINDINGS

About 95 percent of pregnant women in this study were housewives. The literacy rate of the pregnant women in this study was as follows: illiterate (4 percent), 15.8 percent studied up to primary school without completion, 27.9 percent completed primary education, 31.5 percent studied up to SSC without completion, 11.8 percent completed SSC, 6.4 percent completed HSC and 2.6 percent was graduates and above).

Housing type-wise 7.2 percent of the studied women were living in houses made of mud, 0.6 percent in thatched roofed houses, 0.1 percent houses made of roof with polythine, 23.6 percent houses made of brick wall, 63.2 percent made of tin roof, 1.8 percent made of bamboo and 3.5 percent houses build with concrete roof and brick wall. The toilets being used were as follows: modern (9.3 percent), sanitary 81.9 percent), dug/pit (7.4 percent), hanging and open space (each 0.7 percent).

While 18 percent and 74 percent of the studied families were using tap and tube well water respectively for cleansing their utensil, 0.8 percent and 10.2 percent were using well and pond water for the same purpose. Among these families, 82.1 percent were using electricity for lighting their

houses, 8.1 percent solar energy and 10.9 percent oil lamps/ hurricane. Among these families, 63.3 percent had electric fan in their houses, 9.4 percent possessed motorcycles, 48.1 percent had television, 19.5 percent fridge, 2.7 percent car and 1.3 percent air-conditioner in their houses.

Economic status was assessed through saving situation in the studied families. Among them 21.7 percent were surplus families with saving at the end of every month, 43.7 percent had breakeven position, 29.7 percent families had to borrow now then and 4.9 families needed to borrow money every month. Sixty percent families were rearing cattle, 78.1 percent reared poultry and 18.1 percent other birds, e.g., pigeon.

Some health practices were explored. An estimate of 82.5 percent of TT-5 completion rate was found. However, regular intake of iron folate was seen in only about half of them (49.2 percent) and only 44.3 percent of them were found taking vitamin and calcium tablets regularly. Other practices were as follows: 42 percent good amount of rest (3.4 percent no rest at all), 40.8 percent adequate amount of mental peace (4.5 percent no mental peace at all), 52.7 percent adequate cleanliness (6 percent grossly untidy), 29.7 percent undertook no heavy work (but 6 percent had to undertake heavy work). Physically only 28.6 percent pregnant women said and appeared to be in good shape and 7 percent were in a very precarious situation.

The initial weight of the pregnant women was 49.1 Kg. Their husbands weighed 60.2 Kg on average. The average height of the husbands of the studied pregnant women was 161.5 cm or 5 feet 4 inches and their husbands measured 150.3 cm or 5 feet.

Among the studied families 41 percent had backyard garden for green leafy vegetables, 35.6 percent garden for solid vegetables, e.g., pumpkins, 31 percent had roots and tubers in their garden and 28.8 percent had tomatoes, eggplants etc. in their 42backyards. Papaya, banana, mango guava trees were present in more than 50 percent households.

Clinical features during pregnancy experienced by the studied pregnant women were as follows: fever (1.8 percent), edema (1.1percent), vomiting (3.6 percent), diabetes (2.3 percent) anemia (49.5 percent) and hypertension (3.7 percent).

Most of the newborns were boys and among the single born 53.5 percent were boys, among the multiple birth 59.4 percent were boys. However, death among live birth-wise boys were the majority also (59.1 percent).

The breakdown of the place of delivery is as follows: govt. hospital (24.5 percent), private hospitals/clinics (27.2 percent), NGO hospitals (4.5 percent) and home (42.3 percent), others (1.5 percent). The type of delivery was: vaginal (62.1 percent), Caesarian (35.5 percent) and others (2.4 percent). Caesarian rate, has been increasing year by year. Deliveries were conducted by: Trained hands (doctors, nurses, FWVs, SACMO): 55 percent; CSBA: 26.4 percent; untrained: 10.7 percent, relative/ neighbor: 7.9 percent

Complications during delivery, noted were: early rupture of amniotic sac: 26.1 percent; prolonged labor (>12 hours): 7.5 percent; abnormal presentation: 1.5 percent; bleeding/ convulsion: <0.4 percent; abortion: 4.7 percent; still birth: 1.8 percent; and maternal mortality: 8 (7 clearly due to pregnancy related causes) among 4,398 pregnancies;

The mean birth weight of infants in Bangladesh was recorded as 2,898 gm (average for boys was higher than girls and average weight more in non-slum than slum newborns. The LBW rate was 22.6

percent and more among girls and in slums. Birth weight showed an increasing trend up to 41st week of gestation from 37th week but among those who were over matures the birth weight was lower and so also the birth length albeit less pronounced. Birth weight was found to be associated, on a multiple regression test to be associated with sex of the baby, complication of pregnancy, season of delivery, initial weight of the pregnant women, saving status, and rest during pregnancy (Table 7.2). A trend was observed with mental peace and place of delivery.

Birth length was recorded higher in the rural areas, a slightly bigger length has been observed among the non-slum urban newborns, mainly because of higher number of boys in rural areas. No difference was marked between boy and girl newborns in this study.On linear regression birth length was noted to be associated with age of mother, pregnancy complication, Caesarian operation, education of mother, mental peace, initial weight of the pregnant women, delivery in government hospital, season of birth/ pregnancy and saving status (at 10% level of significance) (Table 6.4). There is trend between the length of newborn and height of the pregnant women and saving status but these associations were not significant.

RECOMMENDATIONS

Based on the above finding, plan needs to be adopted for reducing LBW and IUGR lower than 15percent. Plan and strategy need to be developed for preventing adolescent marriage, and child bearing in adolescence (before the adolescents attain a desirable weight before pregnancy). Attention is warranted towards reduction of the rising trend of Caesarian operations. Strict monitoring of the private hospitals is advisable. More care needs to be given to pregnancy care, e.g., adequacy of rest, reduction of psychological stress, ingestion of trace elements and adequacy of food in all the trimesters.

A more rigorous study is warranted over a period of three years, for identifying and enlisting newly married women, so that within the missing of their first menstrual period they are identified and confirmed as such, and all their pregnancy history is followed up for accurate estimation of LBW and IUGR and also to assess the determinants of LBW and IUGR, including the effects of the diets of the pregnant women by trimester, weight gain during pregnancy, pre-pregnancy weight and correct gestational period.

INTRODUCTION

Low birthweight (LBW) has been defined by the World Health Organization (WHO) as weight at birth of less than2,500 grams[2], based on epidemiological observations that newborns weighing less than2,500 g are about 20 times more likely to die compared to heavier babies[3]. Reduction of low birthweight incidence by atleast one third between 2000 and 2010 was one of the goals adopted in 'A World Fit for Children'- the Declaration and Plan of Action, of the United Nations General Assembly (UNGA) Special Session on Children in2002.

To deal with the influence of prematurity, a World Health Organization (WHO) Expert Committee proposed the term "IUGR-LBW" ("Intrauterine Growth Retardation - Low Birthweight")[4, 5]. This refers to infants born at term (>37 weeks of gestation) with LBW (<2,500 g). It replaces the older term "small-for-gestational-age" (SGA). It is often difficult or impossible to assess gestational age accurately. For example, using ultrasound rather than the reported date of the last menstrual period (LMP) lowers the estimated prevalence of SGA by about 30 to 50percent in developed countries[6,7]. In Asia, LBW (including preterm infants) estimates are only slightly higher than IUGR-LBW estimates.

Prevalence/ incidence of LBW and IUGR

At least 17 million infants are reported to be born every year with LBW, representing about 16% of all newborns in developing countries. Nearly 80% of all affected newborns with LBW *at term* are born in Asia (mainly south-central Asia, with Bangladesh having the highest incident rate in the world[8]); about 15% and 11% are born LBW *at term* in middle and western Africa respectively, and approximately 7% in the Latin American and Caribbean region.[9] The geographical incidence of LBW *at term* in selected Asian and African countries (Figures 1 and 2 respectively) confirm that many developing countries exceed the internationally recommended cut-off levels which should trigger public health action. Incident rates of >15% for LBW and >20% for intrauterine growth retardation (IUGR) indicate that LBW *at term* is a major public health problem.[10]

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[2]The 29th World Health Assembly (1976) agreed that: "Low birthweight is a weight at birth of less than 2,500 g (up to and including 2,499 g) irrespective of gestational age."

[3] Kramer, M.S., 'Determinants of Low Birth Weight: Methodological assessment and meta-analysis', Bulletin of the World Health Organization, vol. 65, no. 5, 1987, pp. 663 –737

[4] WHO (1995) Maternal anthropometry and pregnancy outcomes: a WHO collaborative study. Bulletin of the World Health Organization: Supplement to Volume 73.

[5] de Onis M, Habicht J-P (1996) Anthropometric reference data for international use: recommendations from a World Health Organization Expert Committee. American Journal of Clinical Nutrition 64: 650-658.

[6] Bakketeig L (1991) Ultrasound dating of pregnancies changes dramatically the observed rates of pre-term, post-term, and small-for-gestational-term. Iatrogenics 1: 174-175.

[7] Zhang J, Bowes WA Jr. (1995) Birth-weight-for-gestational-age patterns by race, sex, and parity in the United States population. Obstetrical Gynecology 86: 200-208.

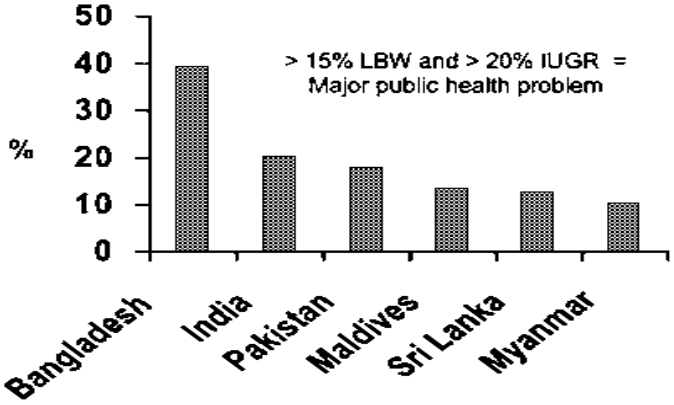
[8]Arifeen SE (1997) Birth weight, intrauterine growth retardation and prematurity: a prospective study of infant growth and survival in the slums of Dhaka, Bangladesh Doctor of Public Health dissertation, Johns Hopkins University, Baltimore MD.

[9]ACC/SCN (2000) *Fourth Report on the World Nutrition Situation*. Geneva: ACC/SCN in collaboration with IFPRI.

[10]deOnis M, Blössner M, Villar J (1998) Levels and patterns of intrauterine growth retardation in developing countries. *European Journal of Clinical Nutrition*52(Suppl. 1):S5-S15.

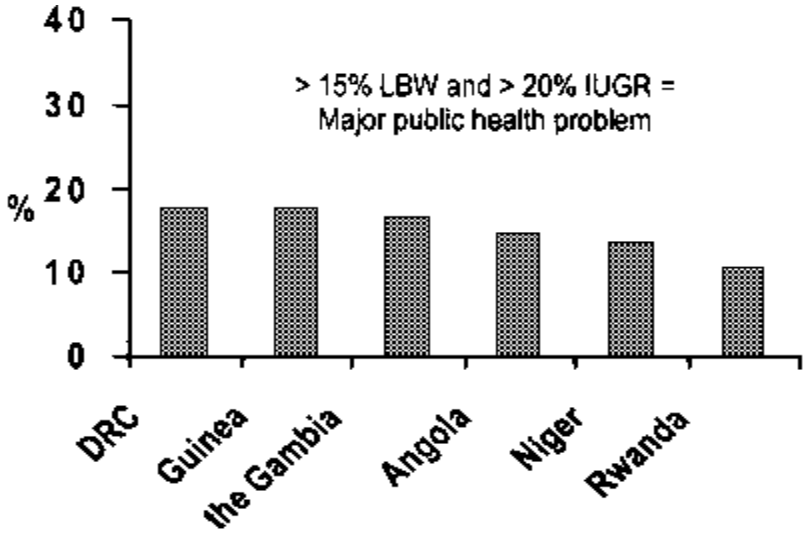
WHO and UNICEF published the first global, regional and country estimates of low birth weight rates in 1992.[11] At that time, the low birth weight rate for industrialized countries was found to be around 7 per cent, and in less developed countries it ranged between 5 and 33 per cent, with an average of 17 per cent. Half of all low birth weight babies are known to be born in South-central Asia, where about 27 per cent of all infants weigh less than 2,500 g at birth. Low birth weight levels in sub-Saharan Africa are around 15 per cent. Central and South America have, on average, much lower rates (10 per cent), while in the Caribbean the level (14 per cent) is almost as high as in sub-Saharan Africa. About 10 per cent of births in Oceania are low birth weight deliveries (WHO, UNICEF 2004). In Bangladesh, on the other hand, the first ever low birth weight survey conducted in 2003-2004 found the rate of low birth weight to be a whopping 36percent.[12]

Figure 1. Incidence of LBW *at term* in selected Asian countries



Source: de Onis et al. (1998) *Eur J Cl Nutr* 52(S1):S5.

Figure 2. Incidence of LBW *at term* in selected African countries



Source: de Onis et al. (1998) *Eur J CI Nutr* 52(S1):S5.

[11]World Health Organization, Low Birth Weight: A tabulationof available information,WHO/MCH/92.2,World HealthOrganization, Geneva, and UNICEF, New York, 1992

[12]Bangladesh Bureau of Statistics. Planning Division, Ministry of Planning Government of the People's Republic of Bangladesh. National Low Birth Weight Survey of Bangladesh 2005.

A regression equation, developed using data from 60 countries where both LBW and gestational age data were recorded (de Onis M. et al. 1998), can be used to convert LBW to IUGR-LBW. An important caveat is that both the LBW and IUGR-LBW definitions exclude newborns who weigh more than 2,500 g at birth, but less than the 3,300-3,500 g birth weight of well nourished infants in developing countries. Many of these "smaller than normal" infants are likely to have been IUGR and will probably suffer adverse functional consequences of their suboptimal weight. The IUGR-LBW category also excludes preterm infants who were IUGR. For these reasons, the IUGR-LBW category substantially underestimates the true magnitude of intrauterine growth retardation. Defining IUGR as a birth weight below the 10th percentile of the international 'birthweight for gestational age' curve[13], has given, on average, incidences that are 14.5 percent higher than when the IUGR-LBW definition is used (de Onis M. et al. 1998).

The highest incidences of LBW and IUGR-LBW are found in South Central Asia (28 percent, 33 percent respectively). The average prevalence is 11 percent of births in all developing countries, and about 21 percent in South-East Asia (de Onis M et al. 1998). Country-wise, the highest incidences for LBW and IUGR-LBW respectively are in: Bangladesh (50 percent, 39 percent), India (28 percent, 21 percent) and Pakistan (25 percent, 18 percent). In other Asian countries, the corresponding data are: Sri Lanka (19 percent, 13 percent); Cambodia (18 percent, 12 percent); Viet Nam and the Philippines (11 percent, 6 percent each); Indonesia and Malaysia (8 percent, 4 percent); Thailand (8 percent, 3 percent), and the People's Republic of China (PRC) (6 percent, 2 percent)(de Onis M, et al. 1998). These estimates however, have been noted to vary widely in different estimates and reports, as may be seen in the table (Table 1) below.[14]

Table 1. Incidence of low birth weight and intrauterine growth retardation

Country, location	Year	LBW (percent)	IUGR-LBW (percent)
People's Republic of China (Shanghai)	1981-1982	4.2	3.4
India (Pune)	1990	28.2	24.8
Indonesia (Bogor)	1983	10.5	8
Myanmar (rural and urban)	1981-1982	17.8	12.7
Nepal (rural)	1990	14.3	11.8
Nepal (urban)	1990	22.3	18.2
Sri Lanka (rural)	1990	18.4	15.8
Thailand (rural and urban)	1979-80	9.6	6.9
Viet Nam (Hanoi + 1 rural district)	1982-1984	5.2	4.2

Historically, because valid assessment of gestational age is often not available in developing countries, evidence of LBW has often been used as a proxy to quantify the magnitude of IUGR. The

[13] de Onis M, Habicht J-P (1996) Anthropometric reference data for international use: recommendations from a World Health Organization Expert Committee. American Journal of Clinical Nutrition 64: 650-658.
[14]http://www.unsystem.org/SCN/archives/npp19/ch08.htm#TopOfPage

incidence rate for LBW *at term* estimates IUGR conservatively, because when all infants below the 10th percentile of the birth weight-for-gestational-age reference are considered, approximately 24% or 30 million newborns in developing countries would be affected each year. Major constraints to deriving this estimate include both the quantitative and qualitative limitations of the available birth weight data. Most of the data available from different parts of the world are from clinic or hospital deliveries, whereas, in some regions of Africa and south-east Asia most infants are born at home and are not measured. There is a need to determine whether data from hospital-born infants in developing countries are representative of the large population born at home.

In Bangladesh, incidence of LBW is unacceptably high and majority of babies are born with birth weight below 3000 g. The salient findings of the National Low Birthweight Survey 2003-2004 were: mean birth weight: 2632g, incidence of LBW about 36% (for girls 38% and for boys 33%) and less than 1% were born with birth weight < 1500g and at least 77% of LBW infants were growth retarded[15]. The results of several other small scale surveys and studies in Bangladesh revealed that the prevalence ranges from 15% in an urban maternity hospital to 47% in a sub-district in the southeast region of the country[16,17,18,19].

Low birth weight is considered as an important indicator for monitoring progress towards the globally accepted health and nutrition related goals. Low birth weight is either the result of preterm birth (<37 weeks of gestation) or due to restricted fetal growth, i.e., due to intrauterine growth retardation (Kramer et al. 1987).

Incidence of LBW in the country is above the public health critical level (15%). Therefore, the extent of the problem related to LBW we are to assess fast, on the basis of which appropriate strategy can be undertaken to lessen the problem.

While in industrialized countries the epidemiology of low birth weight has been extensively studied, in less developed countries reliable data on low birth weight remain limited. A large number of child births occurring at home in developing countries prevent getting adequate and accurate information on birth weight.

Estimation of low birth weight in the society has some importance. The smaller the baby, the more important it is to monitor his or her growth in the weeks after birth. This is particularly important for infants at high risk of poor feeding and inadequate growth. It is imperative therefore to ensure accurate and reliable recording of birth weight.

[15]National Low Birth Weight Survey of Bangladesh, 2003-2004.

[16]Goodburn E, Chowdhury M, Gazi R. Low birth weight in rural Bangladesh. J Trop. Pediaatr.40:123, 1994.

[17]Shaheen R, Arifeen SE, de Francisco A. The optimal duration of nutrition supplementation for malnourished pregnant women. In: Findings of studies performed under the BINP operations Research Project. Vol 2., eds. Osendarp SMJ, Roy SK, FUCHS GJ. Dhaka: ICCDR,B,8-9.

[18]Arifeen SE, Black RE, Caulfield LE, et al Infant growth patterns in the slums of Dhaka in relation to birth weight , intrauterine growth retardation and prematurity. AmJ.Cli.Nutr. 72: 1010-1017, 2000.

[19]Dhar B, Mowlah G, Nahar S, Islam N. Birth weight status of newborns and its relationship with other anthropometric parameters in public maternity hospital in Dhaka, Banglaqdesh. J Health Popul.Nutr. 20: 36-41, 2002 .

The caveat in measuring birth weight is, even though birth weight is relatively easy to measure, it is not always measured accurately, or recorded, or reported correctly. On the other hand, while low birth-weight continues to be useful in focusing attention on a healthy start to independent life, it has also become increasingly evident that the cut-off value of 2,500 g may not be appropriate for all settings. Some countries with high incidence of low birth-weight do not necessarily have high mortality rates, as for example in Sri Lanka.[20]

Effect and impact of LBW

A study in Bangladeshfound mortality among very low birth weight babies to be 78 percent[21]. BDHS 2011 reported that, 7 percent of under – 5 mortality was directly related to pre-term birth, while 11 percent deaths were among neonates due to pre-term birth[22].The shorter the gestation period, the smaller would be the baby in terms of birth weight and birth length, and the higher the risk of death, morbidity and disability. It has been shown that the mortality range can vary 100-fold across the spectrum of birth weight and rises continuously with decreasing weight.[23]The risk of neonatal death for infants who are LBW weighing 2000-2499 g at birth is estimated to be four times higher than for infants weighing 2500-2999g, and ten times higher than for infants weighing 3000-3499 g.[24] LBW infants during the post-neonatal period (>28 days of age) also have high mortality and in some cases their risk may be greater than those for LBW infants during the neonatal period.[25,] LBW accounted for 69% of the ALRI deaths in India, and it is estimated that in Bangladesh, almost half the infant die from pneumonia or ALRI and diarrhoea could be prevented if LBW could be eliminated[26,]

Infants who weigh 2,000-2,499 g at birth have a four-fold higher risk of neonatal death than those who weigh 2,500-2,999 g, and a ten-fold higher risk than those weighing 3,000 - 3,499 g[27]. The more severe the growth restriction within the LBW category, the higher the risk of death. For example, weighing more than 2,500 g but less than 3,000 g at birth, also carries a greater risk for neonatal mortality and morbidity. This is especially true for infants with a low PI[28]. For a given birth weight, being born small because of preterm delivery is a stronger risk factor for perinatal mortality than if the smallness is due to growth restriction(Ashworth A. 1998). Understandably, being born preterm, with LBW carries the strongest risk of mortality (de Onis M et al. 1998). IUGR and LBW infants are more susceptible to hypoglycaemia and to birth asphyxia. In a substantial number of studies they were seen

[20] Pathmanathan, I., et al., Investing in Maternal Health: *Learning from* Malaysia and Sri Lanka, Health, Nutrition, and Population Series, World Bank, Washington, D.C., 2003.

[21]Sohely Yasmin, David Osrin, Elizabeth Paul and Anthony Costello. Neonatal mortality of low-birth- weight infants in Bangladesh. Bulletin of the World Health Organization, 2001, 79: 608-614.

[22]Bangladesh Demographic and Health Survey – 2011.

[23] Wilcox, A.J., 'On the importance – and the unimportance – of birthweight', International Journal of Epidemiology, vol. 30, no. 6, 2001, pp. 1233 –1241

[24]Ashworth A (1998) Effects of intrauterine growth retardation on mortality and morbidity in infants and young children. *European Journal of Clinical Nutrition* 52(Supplement 1):S34-S42.

[25]Ashworth A, Feachem RG (1985) Interventions for the control of diarrhoeal diseases among young children: prevention of low birth weight. *Bulletin of the World Health Organization* 63:165-184.

[26]. Datta N, Kumar V, Kumar L, Singhi S (1987) Application of case management to the control of acute respiratory infections in low-birth-weight infants: a feasibility study. *Bulletin of the World Health Organization* 65:77-82.

[27] Ashworth A (1998) Effects of intrauterine growth retardation on mortality and morbidity in infants and young children. European Journal of Clinical Nutrition 52: S34-S42.

[28]Villar J, de Onis M, Kestler E, Bolanos F, Cerezo R, Bernedes H (1990) The differential neonatal morbidity of the intrauterine growth retardation syndrome. American Journal of Obstetrical Gynecology 163: 151-157.

to suffer from more diarrhoea and pneumonia for a few months after birth[22], showing that LBW may also be a risk factor for post-neonatal death.

During the first weeks of life, wasted-LBW newborns were found to experience more morbidity[29,] (Villar J et al. 1990)[30], whereas stunted newborns were more likely to die during this time[31, 32]. This may reflect on the greater capacity for the LBW infant to catch up in weight and immune function. The impaired immune-competence of stunted infants is more likely to persist. In a retrospective study in The Gambia[33], it was observed that being born during and up to two months after the so-called "hungry season" was a strong predictor of mortality after 15 years of age. It was also associated with about a four-fold greater risk of dying between the ages of 15 and 45 years, and a ten-fold greater risk of dying between the ages of 35 and 45 years. The deaths were mostly related to infections, or to childbirth in women, and were probably caused by the effects of undernutrition *in utero* on poor development of the immune system.

Weight at birth is a strong predictor for size in later life because most IUGR infants do not catch-up to normal size during childhood. In Asian countries, such as Bangladesh, the PRC, India, Pakistan, the Philippines and Sri Lanka, the incidence of LBW predicts the prevalence of underweight during preschool and subsequent years[34].

Large number of studies revealed that IUGR infants (excluding preterm newborns) underwent partial catch-up growth during their first two years of life[35]. After age 2 years, there was little further catch-up and the IUGR infants remained stunted during the rest of their childhood, adolescence and adult life. At 17 to 19 years of age, males and females who were born IUGR-LBW were about 5 cm shorter and weighed 5 kg less than those who were not born IUGR-LBW. The magnitude of these differences is similar in developed and developing countries. This suggests that, undernutrition later in life among children does not magnify the impact of IUGR. Controlling for maternal height was seen to reduce the influence of birth weight on size at 17-19 years, but still birth weight remained a strong predictor. As stated earlier, low maternal height is in itself a reflection of prior undernutrition. Menarche and maturation are probably not delayed by being born IUGR[36].

[29] Kramer MS, Olivier M, McLean FH, Willis DM, Usher RH (1990) Impact of intrauterine growth retardation and body proportionality on fetal and neonatal outcome. Pediatrics 86: 707-713.
[30] Caulfield LE, Haas JD, Belizan JM, Rasmussen KM, Edmonston B (1991) Differences in early postnatal morbidity risk by pattern of fetal growth in Argentina. Paediatric Perinatal Epidemiology 5: 263-275.
[31] Cuttini M, Cortinovis I, Bossi A, de Vonderweid U (1991) Proportionality of small for gestational age babies as a predictor of neonatal mortality and morbidity. Pediatric Perinatal Epidemiology 5: 56-63.
[32] 26. Hoffman HJ, Bakketeig LS (1984) Heterogeneity of intrauterine growth retardation and reoccurrence risks. Seminars in Perinatology 8: 15-24.
[33] Moore SE (1998) Nutrition, immunity and the fetal and infant origins of disease hypothesis in developing countries. Proceedings of the Nutrition Society 57: 241-247.
[34] Mason, JB, Hunt J, Parker D, Jonsson U (1999) Investing in child nutrition in Asia. Asian Development Review 17 (1, 2): 1-32.
[35]Martorell R, Ramakrishnan U, Schroeder DG, Melgar P, Neufeld L (1998) Intrauterine growth retardation, body size, body composition and physical performance in adolescence. European Journal of Clinical Nutrition 52: S43-S53.
[36] Albertsson-Wikland K, Karlberg J (1994) Natural growth in children born small for gestational age with and without catch-up growth. Acta Pediatrica 399: 64-70.

Undernutrition that affects head circumference before 26 weeks of pregnancy has a greater impact on neurologic function than does undernutrition later in pregnancy[37]. The adverse effects of early childhood undernutrition on behavior and cognitive development may not be fully redressed, even when better diet and care are ensured later. The mean IQ scores at four years of age for each birth weight group, in some USA based studies were found to be higher with each subsequent birth weight bracket of 737-2,000 g; 2,000-2,500 g; and 2,500-3,000 g. A study of the association between IUGR and cognitive development and behavior in the first six years of life[38] concluded that deficits in performance of the IUGR group began to appear between 1 and 2 years of age. These deficits were larger in high risk ones; e.g., born smallest, or when IUGR occurred early in pregnancy. The size of the difference was less at 4 to 7 years of age. However, it is unclear whether IUGR followed by good postnatal nutrition has a measurable effect on cognitive or behavioral development in adolescence, because of dilution by many socio-environmental influences on development[39].

In the Guatemala longitudinal study, males and females at an average of 15 years of age, who were born IUGR, performed more poorly on tests of strength, compared to those born weighing at least 2,500 g[40]. Specifically, they could apply approximately 2 to 3 kg less force to a hand grip dynamometer. The lower work capacity of adults who were IUGR babies is mostly attributable to their lower fat-free mass. IUGR has a serious adverse impact on later work productivity and income generating potential. In developing countries, there is evidence that mortality from infections during early adulthood is higher in individuals who were malnourished *in utero (*Moore SE 1998).

Undernutrition is a leading cause of lifelong harm to productivity and earning potential[41], and to lowered educational attainment through impaired physical and mental development. It also leads to poor health through reducing immunity and increasing susceptibility to disease.

About60percent of women in South Asia and 40percent in South-East Asia are underweight (<45 kg), 40percent of them are thin, with body mass index (BMI) <18.5, and more than 15percent are stunted (<145 cm)[42]. Low birth weight adversely affects the health and development of the neonate. It is a risk factor for stunting, which starts *in utero*. LBW could be the main reason why more than 50percent of the children in South Asia are underweight[43]. The adverse consequences of LBW keep on showing up during childhood, and are passed on to the next generation when women, who have been chronically undernourished in their past, become pregnant. LBW and subsequent stunting are caused by undernutrition and other health problems. Improvements in maternal nutrition and health can increase birthweight, survival and physical and mental growth of children, and subsequent size, function and productivity later.

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[37] Harvey D, Prince J, Burton J, Parkinson C, Campbell S (1982) Abilities of children who were small-for-gestational-age babies. Pediatrics 69: 296-300.
[38] Grantham-McGregor SM (1998) Small for gestational age, term babies, in the first six years of life. European Journal of Clinical Nutrition 52: S59-S64.
[39] Hack M (1998) Effects of intrauterine growth retardation on mental performance and behavior, outcomes during adolescence and adulthood. European Journal of Clinical Nutrition 52: S65-S71.
[40] Haas JD, Murdoch S, Rivera J, Martorell R (1996) Early nutrition and later physical work capacity. Nutrition Reviews 54: S41-8.
[41] International Food Policy Research Institute (IFPRI), 2010. The Global Hunger Index (GHI), Available from: http://www.ifpri.org/book-8018/ourwork/researcharea/global-hunger-index.
[42] ACC/SCN (2000) Fourth Report on the World Nutrition Situation. Geneva: ACC/SCN in collaboration with the International Food Policy Research Institute.
[43] Ramalingaswami V, Jonsson U, Rohde J (1996) The South Asian enigma. In The Progress of Nations. New York: UNICEF, pages 10-17.

Infants born LBW are at risk to develop acute diarrhoea or to be hospitalized for diarrhoeal episodes at a rate almost two to four times greater than their normal birth weight counterparts.[44,45,46,47] Infants who are LBW risk contracting pneumonia or acute lower respiratory infections (ALRI) at a rate almost twice that of infants with normal birth weight; and more than three times greater if their weight is less than 2000g.[48,49] LBW is also implicated as a contributor to impaired immune function which may be sustained throughout childhood.[50,51,52]

Do LBW infants grow normally? What are the consequences of LBW on body size, composition, strength and cognitive development? Attaining full growth potential is especially important for women and girls in order to break the intergenerational cycle of LBW and have fewer delivery complications. Maternal height is not only a reflection of genetic make-up, but also reflects her dietary history. From societal, community and individual standpoints, adolescents and adults born with LBW generally have less strength and lower lean body mass resulting in decreased work capacity and lost productivity, which may cost nations billions of dollars.[53,]

When growth restriction *in utero* occurs early in pregnancy, infants exhibit symmetrical (or proportional) growth with length, weight, head and abdominal circumference all below the 10th percentile reference for a given gestational age (stunting). When growth restriction *in utero* occurs late in pregnancy, the infant exhibits asymmetrical (or disproportionate) growth with a normal length and head circumference, but low weight due mainly to a lower proportion of visceral and fat tissue (wasting).[54] Neonatal mortality rates are reported to be higher among asymmetrical IUGR infants, but if they survive, they have a better prognoses for long-term growth and development than that for symmetrical IUGR infants. IUGR infants catch-up partially in growth relative to their appropriate birth weight counterparts during their first one or two years of life. Thereafter, IUGR

[44]Bukenya G, Barnes T, Nwokolo N (1991) Low birthweight and acute childhood diarrhoea: evidence of their association in an urban settlement of Papua New Guinea. *Annals of Tropical Paediatrics* 11(4):357-362.

[45]Ittiravivongs A, Songchitratna K, Ratthapalo S, Pattara-Arechachai J (1991) Effect of low birthweight on severe childhood diarrhea. *Southeast Asian Journal of Tropical Medicine and Public Health* 22(4):557-562.

[46]Victora CG, Smith PG, Vaughan JP, Nobre LC, Lombardi C, Teixeira AM et al. (1989) Infant feeding and deaths due to diarrhea. *American Journal of Epidemiology* 129(5):1032-1041.

[47]Victora CG, Smith PG, Vaughan JP, Nobre LC, Lombardi C, Teixeira AM et al. (1989) Infant feeding and deaths due to diarrhea. *American Journal of Epidemiology* 129(5):1032-1041.

[48]Cerqueiro M, Murtagh P, Halac A, Avila M, Weissenbacher M (1990) Epidemiologic risk factors for children with acute lower respiratory tract infections in Buenos Aires, Argentina: a matched case-control study. *Reviews of Infectious Diseases* 12(S8):S1021-1028.

[49]Fonseca W, Kirkwood BR, Victoria CG, Fuchs SR, Flores JA, Misago C (1996) Risk factors for childhood pneumonia among the urban poor in Fortaleza, Brazil: a case-control study. *Bulletin of the World Health Organization* 74:199-208.

[50]. Chandra RK (1999) Nutrition and immunology: from the clinic to cellular biology and back again. *Proceedings of the Nutrition Society* 58(3):681-683.

[51]Chandra RK (1997) Nutrition and the immune system: an introduction. *American Journal of Clinical Nutrition* 66(2):460S-463S.

[52]Victora C, Smith P, Vaughan J, Nobre L, Lombardi C, Teixeira A et al. (1988) Influence of birthweight on mortality from infectious diseases: A case-control study. *Pediatrics* 81(6):807-811.

[53]Martorell R, Ramakrishnan U, Schroeder DG, Melgar P, Neufeld L (1998) Intrauterine growth retardation, body size, body composition and physical performance in adolescence. *European Journal of Clinical Nutrition* 52(Supplement 1):S43-S53

[54]Bakketeig LS (1998) Current growth standards, definitions, diagnosis and classification of fetal growth retardation. *European Journal of Clinical Nutrition*52(Supplement 1):S1-S4.

children maintain their place in the distribution and neither catch-up nor fall further behind. They remain about 5 cm shorter and 5 kg lighter as adults. Premature infants (who are usually asymmetric LBW), who survive their first year, have a much better prognosis in terms of future growth than IUGR infants. Despite their earlier disadvantage, preterm children gradually catch-up with their appropriate birth weight, term counterparts. Premature infants and IUGR infants should be studied as separate groups because they show different patterns of growth, morbidity and mortality. From a programmatic viewpoint these differences have enormous implications for intervention strategies and limitations of the approach of nutritional recovery of IUGR infants in early childhood.[55,56,57,58,59]

The fetal origins of disease hypothesis states that fetal undernutrition at critical periods of development *in utero* and during infancy leads to permanent changes in body structure and metabolism. These changes result in increased adult susceptibility to coronary heart disease and non-insulin dependent diabetes mellitus. There is also growing evidence that those adults born with LBW suffer an increased risk of high blood pressure, obstructive lung disease, high blood cholesterol and renal damage. Thus, a poorly growing foetus is an undernourished fetus prone to reduced growth, altered body proportions, and a number of metabolic and cardiovascular changes. It has been suggested that these changes are adaptations for fetal survival in a poor nutritional environment, and that these changes persist post-natally, contributing to adult chronic disease when nutrients are plentiful.

Neurological dysfunction is often associated with attention deficit disorders, hyperactivity, clumsiness, and poor school performance. Neurologic dysfunction, when present, seems to affect IUGR boys more than girls, and children of lower socioeconomic circumstances. If IUGR infants are symmetrical and head growth is affected, there seems to be more of an impact on neurological function and it is not clear whether interventions directed toward these infants will improve their outcome. For asymmetric IUGR infants, preventing asphyxia should reduce the prevalence of major and minor handicaps, especially cerebral palsy and mental impairment frequently seen in these infants[60,61]. IUGR is a much larger public health problem in developing countries than in industrialized countries and the outcomes are more likely to be aggravated by obstetric complications and perinatal problems, and later by poor health and nutrition as well as psycho-social deprivation.

In developing countries children are exposed to poor nutrition, high levels of infections, and other conditions of poverty, thus, their long term development is dependent to a large extent on the quality

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[55]Villar J, Smeriglio V, Martorell R, Brown C, Klein R (1984) Heterogeneous growth and mental development of intrauterine growth-retarded infants during the first 3 years of life. *Pediatrics* 74:783-791.

[56]. Albertsson-Wikland K, Karlberg J (1994) Natural growth in children born small for gestational age with and without catch-up growth. *ActaPediatrica*399(suppl):64-70.

[57]Fitzhardinge PM, Inwood S (1989) Long-term growth in small-for-date children. *ActaPaediatrica Scandinavia* 349(suppl):27-33.

[58]Hoffman H, Bakketeig L (1984) Heterogeneity of intrauterine growth retardation and recurrence risks. *Seminars in Perinatology* 8:15-24.

[59] Hass J, Balcazar H, Caulfield L (1987) Variations in early neonatal mortality for different types of fetal growth retardation. *American Journal of Physical Anthropology* 76:467-473.

[60]Goldenberg R, Hoffman H, Cliver S (1998) Neurodevelopmental outcome of small-for-gestational age infants. *European Journal of Clinical Nutrition*52(S1):S54-S58.

[61]. Harvey D, Price J, Bunton J, Parkinson C, Campbell S (1982) Abilities of children who were small-for-gestational age babies. *Pediatrics* 69:296-300.

of their environment. It is difficult to isolate the effects of IUGR from these factors in relation to cognitive development. Cognitive deficits appear to change over time. For instance, when IUGR infants were examined, no differences were found during the first year of life, but differences emerged during two and three years of age; and then differences disappeared at four to five years. Deficits have been found in children with very low birth weights, the smallest size, or with early IUGR (growth restriction prior to 26 weeks gestation). Since LBW occurs more often in deprived environments, it can serve as a marker for the associated poor outcomes throughout life. A length deficit at an early age (stunting) would be the best predictor of motor and mental development deficits.[62,63]

Determinants of LBW/ IUGR

Many factors affect the duration of gestation and fetal growth, and thus, the birthweight. They relate to the baby, the mother, or the environment and play an important role in determining the birthweight and the future health of the infant.[64]Birthweight is affected to a great extent by the mother's own fetal growth and her diet from birth to pregnancy[65], and determining her body composition prior to conception. Mothers in deprived socio-economic conditions tend to have low birthweight infants. In those settings, the infant's low birthweight emanates from the mother's poor nutrition and health over a long period, including during pregnancy, the high prevalence of infections, or from pregnancy complications, often related to poverty. Hard physical work during pregnancy may contribute to poor fetal growth.

Mothers who are younger (<20 years) or older (>35 years) have also been found to give birth to low birthweight newborns in comparison to those women who are aged 20-35 years[66, 6768]. Childbearing during adolescence imposes a greater demand on nutrition requirement, as the adolescent pregnant woman struggles to complete her own growth while also providing the nutrients to the developing fetus in her womb. Low birth weight has also been found to be more common among mothers of higher parities than those of parity 1-6 (Tin et al. 1994).

Certain prior experience; clinical, physical and nutritional conditions are known to influence pregnancy outcome (WHO and UNICEF, Low Birth Weight, 2004). Some of which have been described below.

- For the same gestational age, girls weigh less than boys, firstborn infants are lighter than subsequent infants, and twins weigh less than singletons;

[62]Hack M (1998) Effects of intrauterine growth retardation on mental performance and behavior, outcomes during adolescence and adulthood. *European Journal of Clinical Nutrition* 52(Supplement 1):S65-S71.
[63]Grantham-McGregor SM (1998) Small for gestational age, term babies, in the first six years of life. *European Journal of Clinical Nutrition* 52(Supplement 1):S59-S64.
[64] WHO Technical Consultation, 'Towards the development of a strategy for promoting optimal fetal growth', Report of a meeting (draft), World Health Organization, Geneva, 2004.
[65] WHO and UNICEF. Low Birth Weight. Country, regional and global estimates. 2004.
[66] Eisner V, Brazie JV, Pratt MW, Hexter AC. (1979). The risk of low birth weight. Am. J. Public Health 69:887-893.
[67] Tin TT, Thida M, Maung MM, Wai KT. (1994) Maternal infuences on low birth weight. Malays. J. Reprod. Health 12: 32-37.
[68] Dhar B, Mowlah G, Nahar S, Islam N. (2002) Birth weight status of newborns and its relationship with other anthropometric parameters in a public maternity hospital in Dhaka, Bangladesh. J. Health Popul. Nutr. 20: 36-41.

- Birthweight is affected to a great extent by the mother's own fetal growth and her diet from birth to pregnancy, and thus, her body composition at conception;

- Women of short stature, women living at high altitudes, and young women have smaller babies;

- Once pregnant, the mother's nutrition and diet, lifestyle (e.g., alcohol, tobacco or drug abuse)and other exposures (e.g., malaria, HIV or syphilis), or complications such as hypertension can affect fetal growth and development, as well as the duration of pregnancy;

- Mothers in deprived socio-economic conditions frequently have low birthweight babies. In those settings, the newborn's low birthweight is rooted in pregnant women's poor nutrition and health over a long period of time, including during pregnancy, the high prevalence of infections, or from pregnancy complications underpinned by poverty. Physically demanding work during pregnancy also contributes to poor fetal growth;

- Mothers who give birth to LBW infants tend to have a lower level of education[69,] (Dhar et al., 2003) and are of lower socio-economic status (Dhar et al., 2003),[70] than those who give birth to normal weight infants;

There are two main causes of LBW: being born small for gestational age, or being born prematurely. In developing countries, the majority of LBW newborns are small,but are not born prematurely. Nevertheless, 6.7percent of LBW infants are born preterm in developing countries[71].

The fetus is known to increase maximally in length at 20-30 weeks of gestation, and in weight during the third trimester[72]. Therefore, the timing of undernutrition or food supplementation to the pregnant women*in utero* has different effects on weight and length. Stunted (also called symmetrically or proportionately growth-retarded) infants have a normal ponderal index (PI) (i.e., weight/length^3) but their weight, length, head and abdominal circumferences are below the 10th percentile of reference values. On the other hand, wasted (asymmetrically or disproportionately growth retarded) infants have a relatively normal length and head circumference, but their body weights and PIs are low due to a lack of fat, or due to lean tissue. Wasting is thought to result from undernutrition that occurs late in pregnancy, when fat deposition is most rapid. In fact, only one percent of fetal body weight is fat at 26 weeks, compared to 12 percent at 38 weeks. However, stunting may represent undernutrition during the entire period of pregnancy[73]. For planning and program management, it is important to note that the postnatal development and function of wasted newborns is distinctly different from those borne stunted.

[69]Shoham-Yakubovich I, Barell V. (1988) Maternal education as a modifier of the association between low birthweight and infant mortality. Int. J. Epidemiol. 17: 370-377.

[70]Dickute J, Padaiga Z, Grabauskas V. et al. (2004) Maternal socio-economic factors and the risk of low birth weight in Lithuania. Medicina 40: 475-482.

[71] Villar J, Belizan JM (1982) The timing factor in the pathophysiology of the intrauterinegrowth retardation syndrome. Obstetrical Gynecology Survey 37: 499-506.

[72]Falkner F, Hozgreve W, Schloo RH (1994) Prenatal influences on postnatal growth: overview and pointers for needed research. European Journal of Clinical Nutrition 48: S15-S24.

[73] Villar J, Belizan JM (1982) The timing factor in the pathophysiology of the intrauterine growth retardation syndrome. Obstetrical Gynecology Survey 37: 499-506.

Undernutrition is the major determinant of IUGR in developing countries. It has been estimated[74] that about 50percent of all IUGR in rural areas of developing countries is attributable to small maternal size at conception (low weight and short stature), and low gestational weight gain. Other important causes include malaria in endemic areas[75] and maternal infections that can cause loss of appetite, higher nutrient losses-especially when requirement is high, abnormal placental blood flow or structure, or fetal infections[76].

In developed countries, majority of LBW is caused by premature delivery, cigarette smoking during pregnancy (probably the most important cause of IUGR), followed by low gestational weight gain and low BMI at conception[77]. There is increasing evidence that deficiencies of some micronutrients, such as folic acid, increase the risk of preterm delivery.

The WHO Collaborative Study on Maternal Anthropometry and Pregnancy Outcomes data (Villar J and Belizan JM 1982), between 1959 and 1989, conducted on 111,000 women in 25 populations across the world, show that being in the lowest quartile of pre-pregnancy weight carries an elevated risk of IUGR of 2.5, compared to the upper quartile. A preconception weight of 40 kg (assuming average height is 150 cm) has been proposed as a useful cut-off for predicting IUGR risk in developing countries. This would include more than 50percent of women in western India[78] and almost none in the USA. Clearly improving maternal weight prior to conception is an avenue to improve birthweight.

Maternal weight during gestation predicts IUGR risk slightly better than pre-pregnancy weight because it considers weight gain both in pregnant women and the fetus. Comparing women in the lowest quartile of attained weight to those in the highest quartile, the odds ratios (OR) for IUGR are 2.7, 3.0 and 3.1 at 20, 28 and 36 weeks of gestation respectively. When short (below average) maternal height was considered as well, the OR increased to about 3.5, whereas including below-average pre-pregnancy weight increased the odds ratio to closer to 4.0 (http://www.unsystem.org/SCN/archives/npp19/ch15.htm#TopOfPage).

Body Mass index (BMI) is defined as weight (in kg) divided by height (in m^2) squared. Maternal BMI represents fatness, but correlates with weight. There is an interaction between maternal BMI at conception, weight gain during pregnancy and birthweight. It is also clear that women with a low BMI and who do not gain adequate weight, are at greatest risk of delivering a LBW infant[79]. Likewise, pregnancy weight gain has a stronger positive effect on fetal growth in initially thinner women than in those who are fatter. In the WHO Collaborative Study (WHO 1995), mothers with a BMI in the lowest quartile were observed to be about twice as likely to produce an IUGR infant compared to those in the upper quartile. Thus, low maternal BMI was a poorer predictor of IUGR than either pre-pregnancy maternal weight or attained weight during pregnancy.

[74]Kramer MS (1987) Determinants of low birth weight: methodological assessment and meta-analysis. *Bulletin WHO* 65: 663-737.
[75]Tomkins A, Murray S, Rondo P, Filteau S (1994) Impact of maternal infection on foetal growth and nutrition. *SCN News* 11: 18-20.
[76]Tomkins A, Watson F (1989) Malnutrition and Infection. ACC/SCN State-of-the-Art Series Nutrition Policy Discussion Paper No. 5. Geneva: ACC/SCN.
[77] Kramer MS (1998) Socioeconomic determinants of intrauterine growth retardation. European Journal of Clinical Nutrition 52: S29-S33.
[78] Anderson M (1989) The relationship between maternal nutrition and child growth in rural India. PhD dissertation. Tufts University, Boston, USA.
[79]Institute of Medicine (1990) Nutrition during pregnancy. Washington DC: National Academy Press.

BMI as an indicator of IUGR risk has limitation as fatness, which reflects BMI, influences physiological adaptations to energy available during pregnancy. The thinnest women gain most weight during pregnancy and the fattest gain least. In fact, recommended pregnancy weight gains in USA (Institute of Medicine, 1990) and Europe are inversely proportional to BMI at conception. In Indonesia[80], Pakistan[81], Taipei, China[61] and rural Mexico[62], the highest pregnancy weight gains occurred in the thinnest women. For example, in the Pakistan study, women weighing < 45 kg postpartum gained 4.5 kg during one reproductive cycle. Those weighing 45-56 kg lost 0.6 kg, and those >56 kg gained 0.6 kg[60]. Total pregnancy weight gain, as noted in the Mexican study, was negatively related to preconception BMI, skinfolds, and percent body fat (correlation about -0.5), and thinner women also spontaneously consumed more energy during pregnancy[82]. Conversely, for women with a high BMI (>27) at conception, birthweight is practically independent of pregnancy weight gain(Institute of Medicine, 1990).

Interactions between pre-pregnancy BMI and gestational weight gain can be explained by the fact that the resting metabolic rate of fatter women is increased dramatically during pregnancy, thereby consuming more energy, heading towards a lower weight gain[83]. On the other hand, the metabolic rate of thin women may in fact even fall in early pregnancy[64]. Their energy requirement of pregnancy is apt to be much lower, and their pregnancy weight gain may be substantially more than that of fatter women.

Serum leptin concentration is strongly correlated with maternal BMI prior to pregnancy and in the second trimester[84]. Higher leptin is normally associated with a higher metabolic rate. In contrast, thinner women become more efficient at utilizing dietary energy for weight gain during pregnancy. This is especially true if their energy intake is low; an intervention with a protein-energy supplement in The Gambia did benefit birthweight[85].

Based on these considerations it does not seem useful to choose low BMI as the indicator of IUGR risk, compared to low pre-pregnancy weight or attained weight during pregnancy. It appears to be low lean tissue mass, rather than low fat mass (BMI), that predicts IUGR. However, contrasting conclusions have been drawn in other studies which showed that countries with higher percentages of LBW infants generally have a higher percentage of women with low body mass index (BMI) and a higher percentage of underweight children.[86,87]

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[80]Kusin JA, Kardjati S, Renqvist UH (1994) Maternal body mass index: the functional significance during reproduction. EuropeanJournal of Clinical Nutrition 48 (Supplement 3): S56-S67.

[81]Winkvist A, Habicht J-P, Rasmussen KM (1998) Linking maternal and infant benefits of a nutritional supplement during pregnancy and lactation. American Journal of Clinical Nutrition 68: 656-61.

[82]Martínez H, Allen LH, Lung'aho M, Chávez A, Pelto GH (1994) Maternal fatness in Mexican women predicts body composition changes in pregnancy and lactation. Advanced Experimental Medical Biology 352: 99-107.

[83] King JC, Butte NF, Bronstein MN, Kopp LE, Lindquist SA (1994) Energy metabolism during pregnancy: influence of maternal energy status. American Journal of Clinical Nutrition 59: 439S-445S.

[84] Williams MA, Havel PJ, Schwartz MW, Leisenring WM, King IB, Zingheim RW, Zebelman AM, Luthy DA (1999) Pre-eclampsia disrupts the normal relationship between serum leptin concentrations and adiposity in pregnant women. Paediatrics Perinatal Epidemiology 13: 190-204.

[85] Lawrence M, Lawrence F, Coward WA, Cole TJ, Whitehead RG (1987) Energy requirements of pregnancy in The Gambia. The Lancet 2: 1072-1076.

[86]. WHO (1997) National reports on the third evaluation of the implementation of "Health for All" strategies. New Delhi: WHO Global Database.

[87]deOnis M, Blössner M (1997) WHO Global Database on Child Growth and Malnutrition. Geneva: WHO.

The WHO Collaborative Study found that women in the lowest quartile of both low pre-pregnancy weight, and pregnancy weight gain (to week 20, odds ratio 5.6; or to week 36, odds ratio 5.6) were at highest risk of delivering an IUGR infant.

It has been estimated[12] that most women in South Asia gain little more than 5 kg rather than the 10-15 kg gain by women in developed countries. Weight gain is inversely related to BMI, as discussed above. So, it will be higher in thinner women as long as the energy-sparing adaptations associated with low fat mass can buffer any concurrent low energy intakes. It has been hypothesized that the degree of maternal undernutrition may affect the response to supplementation[88]. Supplementation of moderately malnourished women produces an increase in birthweight but has little impact on maternal weight gain. However, when seriously malnourished women are supplemented they cannot 'afford' to direct the energy to the fetus and therefore such supplementation improves maternal weight gain more than birthweight[89, 90]. This needs to be tested in more studies. Using weight gain as the only predictor of IUGR therefore would be risky.

Energy intakes are so low for many women in developing countries that the adaptive mechanisms cannot actually improve on low pregnancy weight gain. It has been estimated that women in developing countries who weigh 44-55 kg would deliver an infant with birthweight >3 kg if they gained 10.5 kg during pregnancy (WHO, 1995). This would be a much higher weight gain than the 5-9 kg range that usually occurs.

Maternal height contributes to total maternal mass, but it has less value than weight or BMI for predicting IUGR (WHO, 1995). Low height is rather a good indicator of obstetric complications such as obstructed labour and need for assisted delivery (WHO 1995). It is therefore useful to refer short women to appropriate childbirth facilities.

Mid-pregnancy maternal weight gain and increments in thigh skinfolds were significantly associated with the newborn's length, weight and head circumference and were more effective predictor of birthweight and other newborn outcomes than the maternal measures in late pregnancy. Similarly, low income teenagers in USA were almost twice as likely to deliver an IUGR newborn if they gained inadequate amounts of weight in the first half of pregnancy, regardless of whether their weight gain caught up by the end of pregnancy[91].

Birth weight is not the only important outcome affected by the timing of supplements given to pregnant women. Evidence from The Gambian study suggests that undernutrition in mid-pregnancy may impair development of the immune system, because infants born two to three months after the hungry season were later seen to have a higher rate of adult morbidity (Moore SE 1998).

[88] Pelto G, Dickin K, Engle P (1999) A Critical Link: Interventions for Physical Growth and Psychological Development: A Review. Geneva: Department of Child and Adolescent Health and Development, WHO.
[89]Winkvist A, Habicht J-P, Rasmussen KM (1998) Linking maternal and infant benefits of a nutritional supplement during pregnancy and lactation. *American Journal of Clinical Nutrition* 68: 656-61.
[90]Olson RK (1994) Developing indicators that predict benefit from prenatal energy supplementation. Ithaca, New York: Cornell University.
[91]Hediger ML, Scholl TO, Belsky DH, Ances IG, Salmon RW (1989) Patterns of weight gain in adolescent pregnancy: effects on birth weight and preterm delivery. Obstetrical Gynecology 74: 6-12.

Evidence for an effect of iron supplements on preterm delivery and birthweight is still weak[92,93].In low income, mostly Afro-American women in USA, those with low folate intakes and low serum folate concentrations at the end of the second trimester had twice the risk of preterm delivery[94]. Zinc's role in cell division, immune-competence, and hormone metabolism, raises interest, with regard to its effect on pregnancy outcome, including birth weight. Cochrane meta-analyses however, found no effects of zinc supplementation on pregnancy outcomes or on maternal or fetal mortality or morbidity[95]. Calcium supplementation during pregnancy reduces the risk of hypertension, pre-eclampsia and eclampsia, and lowers the blood pressure of the neonate[96]. A Cochrane meta-analysis of randomized controlled clinical trials showed that this effect was strongest in women with lower calcium intakes (<900 mg per day), and that preterm delivery was reduced in women at high risk of developing hypertension. In India, calcium supplementation of women withlow calcium intakes substantially reduced the risk of hypertension and eclampsia[97]. It seems that daily supplementation with 1-2 mg calcium is required to produce this response

A review of 24 non-nutritional pregnancy interventions found that only two improved birthweight[98]. These were smoking cessation, which lowered LBW by about 20percent, and anti-malarial prophylaxis. Data from 11 trials, on more than 3,000 women in endemic areas for malaria, showed the strongest effect of anti-malarials on prima-gravidae, where birthweight increased by 112 g[99].

Physical labor by pregnant women in the third trimester was associated with lower birthweights[100, 101, 102] and more placental infarcts, compared to women who remained at home (Naeye RL, and Peters EC, 1982). Working had the strongest negative association with fetal growth in mothers who were underweight at conception, had low pregnancy weight gain, and whose work required standing. Research has shown that adolescents who are still growing are likely to give birth to a smaller baby than mature women of the same nutrition status[103, 104]. This is probably due to competition fornutrients

[92] Allen LH (2000) Anemia and iron deficiency: Effects on pregnancy outcome. American Journal of Clinical Nutrition 71 (Supplement 5): S1280-84

[93] Rasmussen KM (2001) Is there a causal relationship between iron deficiency or iron-deficiency anemia and weight at birth, length of gestation and perinatal mortality? Journal of Nutrition 131: 590S-603S.

[94]Scholl TO, Hediger ML, Schall JI, Khoo CS, Fischer RL (1996) Dietary and serum folate: Their influence on the outcome of pregnancy. American Journal of Clinical Nutrition 63: 520-525.

[95]Mahomed K (2000) Zinc supplementation in pregnancy. Cochrane Database Systematic Reviews: 16.

[96]Belizán JM, Villar J, Bergel E, del Pino A, Di Fulvio S, Galliano SV, Kattan C (1997) Long-term effect of calcium supplementation during pregnancy on the blood pressure of offspring: follow up of a randomized controlled trial. British Medical Journal 315: 281-285.

[97] Purwar M, Kulkarni H, Motghare V, Dhole S (1996) Calcium supplementation and prevention of pregnancy induced hypertension. Journal of Obstetrical Gynaecology Research 22: 425-30.

[98] Gülmezoglu M, de Onis M, Villar J (1997) Effectiveness of interventions to prevent or treat impaired fetal growth. Obstetrical Gynecological Survey 52: 139-49.

[99]Garner, P, Gülmezoglu AM (2000) Prevention VersusTreatment for Malaria in Pregnant Women. Cochrane Review. Oxford, UK: The Cochrane Library. Update Software.

[100]Launer LJ, Villar J, Kestler E, de Onis M (1990) The effect of maternal work on fetal growth and duration of pregnancy: a prospective study. British Journal of Obstetrical Gynaecology 97: 62-70.

[101]Naeye RL, Peters EC (1982) Working during pregnancy: Effects on the fetus. Pediatrics 69: 724-7.

[102] Henriksen TB, Hedegaard M, Secher NJ (1995) Standing and walking at work and birthweight. Acta Obstetrical Gynecology Scandinavia 74: 509-516.

[103]Frisancho AR, Matos J, Leonard WR and Yaroch LA (1985) Developmental and nutritional determinants of pregnancy outcome among teenagers, American Journal of Physical Anthropology 66: 247-261.

[104]WHO (1995) Physical status: The use and Interpretation of Anthropometry: Report of a WHO Expert Committee. WHO Technical Report Series No. 854. Geneva: WHO.

between the growing adolescent and the growingfetus[105, 106]and poorer placental function[107] which in turn increases the risk of LBW and neonatal mortality[108]

Following are the most common factors identified as causes of IUGR and pre-term deliveries as mentioned by Kramer[109] :

Genetic and constitutional factors: Infant sex, maternal height, maternal pre-pregnancy weight, maternal hemodynamics and paternal height and weight;

Demographic and Psychosocial factors: Maternal age, socio-economic status, education, occupation and income), maternal psychological factors, marital status;

Obstetric factors: Parity, birth or pregnancy interval, intrauterine growth and gestational duration in prior pregnancies, prior abortion (spontaneous, induced), sexual activity, prior still birth or neonatal death, prior infertility, in utero exposure to diethyl stilbesterol;

Nutritional factors: Gestational weight gain, caloric intake, energy expenditure, work and physical activity, protein intake/ status, micronutrient intake(vitamins and minerals);

Maternal morbidity during pregnancy: General morbidity, episodic illness, pregnancy induced hypertension, urinary tract infection, genital tract infection and malaria;

Antenatal care: First antenatal care visit, number of antenatal care visit and quality of antenatal care;

Toxic exposure: Cigarette smoking, tobacco chewing, narcotic addiction and other toxic exposure.

[105] Brabin L, Brabin BJ (1992) The cost of successful adolescent growth and development in girls in relation to iron and vitamin A status. American Journal of Clinical Nutrition, 55: 955-958.
[106]Scholl TO, Hediger ML, Ances IG, Belsky DH, Salmon RW (1990) Weight gain during pregnancy in adolescence: predictive ability of early weight gain. Obstetrical Gynecology 75: 948-953.
[107]Olson CM (1987) Pregnancy in adolescents:A cause for nutritional concern? Professional Perspectives 1:1-5.
[108]Zeitlin, M. F., J. D. Wray, J. B. Stanbury, N. P. Schlossman, Meurer JJ (1982) Nutrition and Population Growth: The Delicate Balance. Cambridge UK: Oelgeschlager, Gunn and Hain.
[109]Kramer M. Determinants of low birth weight: methodological assessment and meta analysis.Bulletin of the WHO, 1987-65,(5) 663-737.

OBJECTIVES OF THE SURVEY

1. To estimate the prevalence of low birth weight (LBW), intrauterine growth retardation (IUGR), mean birth weight and mean birth length in Bangladesh.

2. To examine the associations between LBW, IUGR, birth weight and birth length with maternal characteristics

The aim of the survey was to provide nationally representative data on the prevalence of LBW including IUGR, and birth length of newborns to estimate the scale of one of the indicators of public health nutrition related problem in the country and to provide baseline data against which national interventions may be planned and implemented accordingly and then progressmay be measured towards the impact of relevant interventions that will be taken up in future.

METHODOLOGY

a) Survey area

To obtain the national prevalence of low birth weight (LBW), intrauterine growth retardation (IUGR) and birth length of newborns in Bangladesh as per the objective of the study, the survey was conducted in the rural and the urban areas, including urban slums in all the districts of the seven divisions of the country.

b) Survey population

Women as well as adolescent couples of child bearing age who missed one or two menstrual periods and believed themselves to be pregnant (confirmed by a pregnancy test) were enrolled in the survey and followed till delivery. In fact however, in many cases the women who suspected to be pregnant, however, did not reveal or declare themselves of their pregnancy status. The reason, which came to notice late into the study, was *lack of confidence or insecurity on the part of these pregnant women, about lasting of their pregnancy, and be publicly known as failures in carrying pregnancy to fruition*.

c) Hypothesis and the relevant variables

The proposed study tested an 'equality of proportions in two independent groups', i.e., like in any analytic study it tested some hypotheses. The analysis started with a null hypothesis, which stated that there is no difference between the two compared independent groups (i.e., Ho: p1 = p2), where the *dependent variables were: birth-weight, and birth-length*. The independent variables, the effect of which was tested on the dependent variables are for example, locations (*urban and rural areas by divisions*), *socio-economic status, food habits/ practices, nutritional conditions, clinical and physical conditions* etc.

d) Sample size

The formula that was used for determining the sample size was as follows:

$$N = \frac{(Z_{2\alpha}\sqrt{2\bar{P}\bar{Q}} - Z_{2\beta}\sqrt{P_1Q_1 + P_2Q_2})^2}{(P2 - P1)^2}$$

Where:

P_1 = the rate of low birth weightin one population was taken as 15percent and P_2 =the rate of the same variable in another population as 47percent(or of economy in two different groups of population respectively).

$\bar{P}$ = average of P_1 and P_2

$\bar{Q} = 1.0 - \bar{P}$

For this two tailed test $Z_{2/\alpha}$was taken to be 0.05 and $Z_{2./\beta,}$ the power, to be 0.95. The P1 and P2 rates taken were 15percent and 47percent respectively.

The sample size according to the above stipulations was rounded to 4.500. An urban and rural ratio of 27:73 was taken respectively for dividing the sample size according to the urban: rural population ratio, which in absolute numbers are 1,200 and 3,300 respectively.

e) Sampling technique

A community clinic catchment population in rural areas of each of the 64 districts, and the population of a well defined urban slum in each of the 19 old districts (except Mymensingh) were the unit clusters in this study. The clusters in both rural and urban areas were selected based on the working areas of the community skilled birth attendants (CSBAs), who were most well known for their skill

and dedication (first learnt from the civil surgeon/ deputy director family planning, then confirmed from the upazila health & family planning officers/ upazila family planning officers. In case of difference in the opinions, those of civil surgeons/ deputy directors of family planning were honored, since reputation up to that level should be more authentic). In Mymensingh instead of taking two urban clusters, two rural clusters were taken to represent the rural and urban population proportions (27:73 urban and rural sample ratio, as stated above).

f) Inclusion and exclusion criteria

Inclusion criteria:

1. Willing to participate in the survey (non-willingness was kept at a minimum to avoid membership or volunteer bias)
2. Last menstrual period (LMP) confirmed through pregnancy test or missing of two to three menstrual cycles/periods
3. Planned place of delivery within the reach of data collector
4. All normal cases including C-section cases.
5. No medical cases in pregnant/ study women or newborn (heart disease, uncontrolled hypertension and severe diabetes, complicated delivery, placenta previa, sick newborn) were excluded, since these as independent variables may be effect modifiers or confounders

Exclusion criteria:

1. Unwilling to participate;
2. LMP is not confirmed;
3. Plan for delivery and measurement, which are difficult to reach to data collector (was kept as minimum as possible to avoid any be bias);
4. Medical conditions that complicated pregnancy outcome or status or newborn.

g) Recruitment of data collectors

Supported by the Directorate General of Health Services and the Directorate General of Family Planning, community level skilled birth attendants (CSBAa) were recruited from each rural cluster (for rural areas). They are local residents with long history of serving in the locality, with good acquaintance and understanding with the local population and the study individuals. The other conditions for their selection was based on their previous performance, for which opinions were taken from the relevant managers, i.e., civil surgeons/ deputy directors of family planning of district level, further confirmed by immediate managers, i.e., upazila health and family planning officers/ family planning officers and in some cases from their direct supervisors, i.e., health inspectors/ family planning inspectors. The selected data collectors themselves were trained skilled birth attendants, non-pregnant, were about 30 to 35 years of age, have borne children in the past, and have at least a higher secondary level of schooling. In the urban areas of the 18olddistricts (excluding Mymensingh) the MCWC field staff or locally popular NGO workers were the data collectors.

The data collectors were responsible for identifying pregnant women in their assigned cluster, monitoring the pregnancies, collect data on socio-economic, housing and demographic characteristics of the pregnant women, their and their husbands' anthropometric measurements, and health and nutritional scope in the family (one time); their physical, clinical, psychological and medical conditions (anemia, diabetes, blood pressure, weight, albumin in urine, degree of rest and heavy work and psychological condition during pregnancy);and micronutrient supplementation (iron, calcium, vitamins, consumption of iodated salt) every trimester during their entire pregnancy period; dietary

practices (on a weekly basis- recall of 24 hours); delivery plan and site; medical condition of newborn and pregnant women during delivery; complications of pregnancy; outcome of the pregnant women and the newborn during and after birth; and finally measuring birth weights and birth lengths of the newborns within 24 hours of delivery.

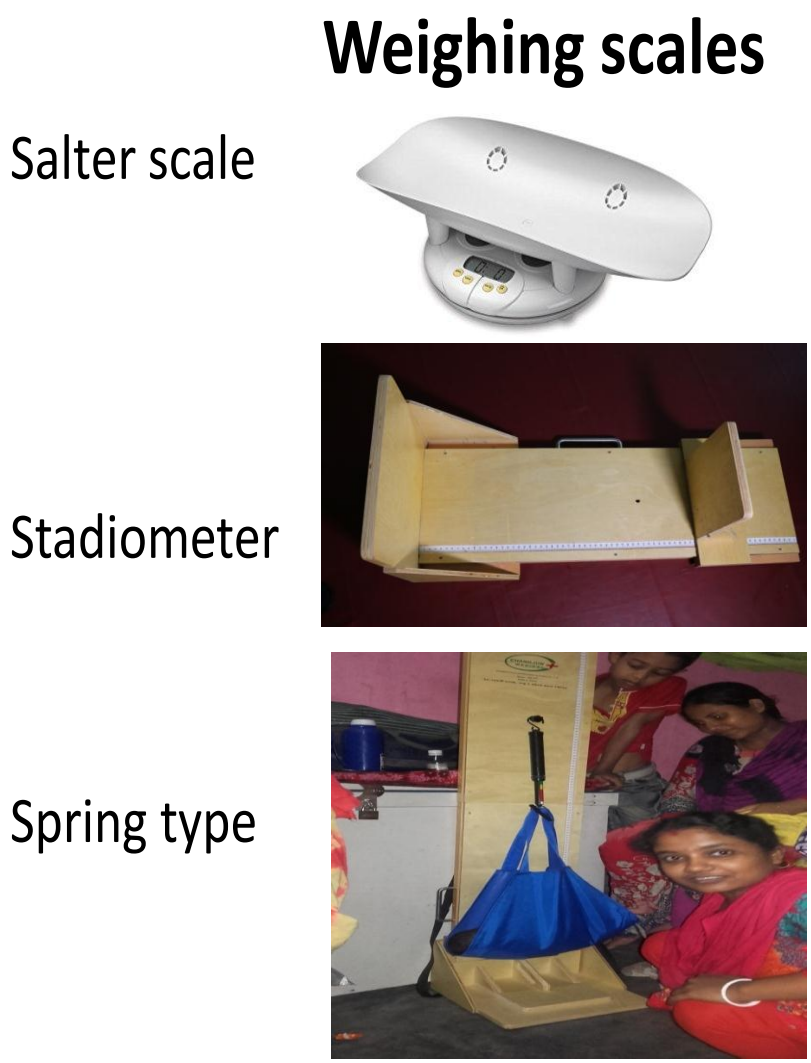
A total of 83 data collectors were recruited upfront for about 9 months. They then selected their assistants – from one to four (in hard to reach areas). This was done to ease data collection, which also ensured data validity (measuring a newborn's length is in fact quite tedious and almost impossible to take measurement of, by an individual singly). This strategy also covered for those who were unable to collect data due to illness or some other cause. In light of these situations ultimately 118 data collectors were deployed, either as the primary/ lead data collectors or their assistants.

The reasons for selection of CSBAs were as follows: their acceptability to the community is exceptionally good, they are doing such job in their area for decades together, they identify pregnant women when they go for providing domiciliary services and they conduct deliveries in their job areas. Therefore, taboos of measuring the birth-weight and birth-length, particularly in rural and urban slum areas can be minimized significantly. Selection of any other type of data collectors, who are either not conversant with the work they will require to do or are not familiar with the local people or are not free and frank on the matters that they will be supposed to do, will hardly be able to overcome these handicaps even after a thorough training and finest of skills. Another advantage of recruiting them was the fact that their skill in providing maternal and neonatal health services will further improve through practical practice through this Project, i.e., by taking various measurements in a pregnant woman, the different outcomes of pregnancy and their associated factors.

h) Measuring instruments

in health facilities birth was measured with Salter scale. In case of home deliveries, metallic spring type scales were used with a piece of flat cloth hung at the end to lay the newborns on. Wooden Stadiometers, measured to the nearest centimeter, were used for measuring length of the newborn. Salter scale has a precision of 10g. Mechanical Baby Weighing Scale Spring type has a precision of 100g.

Fig 1. Instruments used for measuring weight and length of newborn



The weighing scales were calibrated to '0' just before use every time. Measurements and measuring scales were also checked by the supervisors, quality improvement officers, SSMF managers and team leader during their field visits. The weighing of newborns was measured to the nearest 50 gm (average of two to three measures was taken in spring type) and the infantometer/ stadiometer reading was taken to the nearest cm. Instruments giving incorrect readings were replaced on the same day, if reported in the morning hours to SSMF, through hand delivery, other-wise the following day.

h) Recruitment of Supervisors and QI Officers

Sixteen field supervisors (FS) were recruited to do supportive supervision and monitor the activities of data collectors. One FS was responsible for 4 clusters, i.e., 4 data collectors and their assistants in 4 districts. Supervisors were graduates and masters degree holders with prior experience as field staff of SSMF for at least five years (four were from BAMANEH- one of the four partner organizations). They belonged to both the sexes. Supervisors were recruited at national level.

To ensure quality of data collection four Quality Improvement (QI) officers were recruited. On average, each of the QIs covered4 supervisors and the data collectors in 16 districts assigned to them.

These districts were also covered by SSMF officials (manager, field operation; team leader, project manager and research officer directly and the Manager, Human Resources indirectly). The team leader himself visited 40percent of districts (all district Sylhet, and Chittagong divisions and some of Dhaka division).

i).Measurement process

Length of a newborn was taken by using a stadio/ infantometer, which has a hard flat horizontal platform of wood. It has a fixed vertical head piece and a movable foot piece. Baby was laid flat on the cloth being used for wrapping the baby, but without any cloth over it. The crown of the head of the baby was fixed firmly but gently against this head piece by the assistant of the data collector. The Data collector then pressed the knees of the baby to flatten and straighten the curved legs of the baby with one hand and with the other she moved the vertical leg piece of the instrument to touch the ball/ heel of the baby. The measurement of length was noted in centimeter based on where the leg piece stops against the ball of the foot, beside which the instrument has markers in centimeter.

Birth-weight was taken within health facilities with the help of Beam Balance/ Salter Scale[110], as shown in the photograph here, with an accuracy range of 10 g. When taken at home, the birth weight was taken with metallic spring type measuring scale, which has accuracy range of 100 g. For accuracy the weight measurement at home was taken two or three times. We must report the fact here that almost all birth-weight was taken within 24 hours, in some cases even within four hours, However, this measurement was taken after the first incidence of breastfeeding of the newborn in a sizable number of newborns, as ethically we could not and did not ask the mothers to defer breastfeeding until they were weighed.

Means and proportions were worked out along with confidence intervals (and standard deviations) of **t**he measurement of birth-length and birth-weight. No smoothing was done on non-linear means and standard deviations (the sample size was considerably higher than the previous studies and the standard deviations were very small). The influence of factors which influence birth weight was assessed by using a multiple regression model through categorization of birth weight into- above and below 2.5 Kg. In case of birth length a linear regression was done, since no universal categorization is available on it. No adjustment was done on variables for its inclusion in the model when its inclusion changed the estimates for the odds ratio by 10percent or more, as was done in the 2003-2004 study[111] (this technique in fact is resorted to for selecting a best fit model for statistical test).

k) Data collection process

Data collectors used a questionnaire (attached) to record the following information from the study individuals and their newborns:

- age, height and weight of the pregnant women studied and their husbands (but in the result section only two age brackets were given – less or more than 18 years of age, since hardly any pregnant woman was found who was above 35 years of age);
- educational attainment and occupation of the study individuals and their husbands;

[110] Indian Health Service Infant Guidelines: Measuring Infants. The Federal Health Program for American Indians and Alaska Natives.https://www.ihs.gov/HWM/infantguidelines/

[111] Maldonado G, Greenland S. Simulation study of confounder-selection strategies. Am J Epidemiol. 1993; 138(11): 923-936

- family size and living conditions;
- reproductive history: parity, birth gaps, place of delivery, previous pregnancy outcomes;
- family demographic status, i.e., number of living children and their ages;
- individual birth weights;
- individual birth lengths;
- gestational period and weight gain during pregnancy;
- socio-economic status;
- economic status (measured in terms of household assets and savings, rather than income in monetary terms, as it is usually less reliable. Economic status was finally analyzed through saving status);
- housing condition and living conditions and practices;
- health conditions and practices;
- vaccination;
- presence or absence of disease;
- medication;
- geographical location;
- pregnancy care;
- rest;
- physical exertion;
- mental condition;
- physical condition;
- personal cleanliness;
- food habits and practices;
- complications during past and present pregnancy, and during delivery;
- date, time and place of delivery;
- conductor of delivery;
- pregnancy outcome;
- perceived health condition of the new-born;
- biochemical/ clinical condition of the study individuals: blood pressure, blood sugar and anemia, urine in albumin; pre-eclampsia (pitting edema), eclampsia;
- mean birth weight;
- mean birth length;
- gestational period and
- intra-uterine growth retardation.

Each pregnant woman was given a "Notification Card" indicating her name, address, cell number and other information needed to locate the woman when she delivers. One member from each household of the enlisted pregnant woman was chosen to inform the data collectors about the birth immediately during or after delivery, so that the data collectors can reach the place of delivery (home or hospital) promptly to take birth-weight and birth-length as early as possible and definitely within 24 hours (although literature-wise, measurement within 72 hours of birth is acceptable, this study has invariably collected data within 24 hours). Exclusively breast-fed newborns typically loss as much as 10% or more of their birth weight after 72 hours, before beginning to gain weight again thereafter. By 48 hours, almost 5% of babies born vaginally and 10% of those born by cesarean delivery lost at least 10% of their birth weight. By 72 hours, 25% of Caesarean delivered infants lost at least 10% of their

birth weight.[112] The data collectors motivated the pregnant woman, her husband, family members and others- relatives, and neighbors for hospitalized delivery, which also ensured ease and accuracy of taking measurements.

Data was collected over a period of eight months, beginning with the identification and recruitment of the pregnant women from June to August 2015, when the study women were identified with pregnancy into their first or second months, with expected date of delivery in the months of March and April, which ultimately was found to end in May 2016.

Gestational age determination was found to be one of the most challenging jobs in conducting such survey in developing countries like Bangladesh as majority of women cannot remember date of missing period at the later stages of gestation. To ensure the accurate duration of gestation, data collectors enlisted all women who missed one or two menstrual cycles, tested them for pregnancy and empanelled as pregnant. A fortnightly home visit was made to the capture the women who missed their period before it is too late and the date is forgotten. The expected date of delivery (EDD)was calculated from the last menstrual period (LMP). All pregnant women were registered into a hard bound (to stand rough handling over a period of eight months) hard copy questionnaire. As was found later, some women, even though pregnant, did not declare their status as pregnant as a rural tradition, until they were sure that they will be able to retain their pregnancy. This perhaps was a precautionary measure on their part to prevent themselves being dubbed as unable of carry pregnancy.

Data collectors were expected to visit each pregnant woman once a week throughout the pregnancy for collecting their food practice. During each visit, the data collectors were supposed to collect information on food habits, pregnancy-related medical/ physical condition. Data collectors were also expected to collect information on a three monthly basis on the ante-natal care practices, anemia, blood sugar, blood pressure, weight gain during pregnancy, micronutrient supplementation and albumin in the urine of the pregnant women. It was however, difficult to ensure that all the data collectors visited the pregnant women on a weekly basis. So they were requested to collect food habit related information at least through cell phone. A few data collectors nevertheless were found to doctor food habits of the study individuals based on their previous week history. In the final analysis the weekly food habit was not entered, instead the information collected during the home visits made every trimester was used, as it was authentic.

After the delivery, information about delivery, including date, time and place of delivery; the sex, weight, length and the perceived health condition of the new-born were recorded in the provided card. The data collectors also recorded additional information, e.g., on complications during pregnancy, delivery and in the immediate post-partum period.

The card/ questionnaire that was developed for this survey was in English first, developed in light of the study done in 2003-2004 by the Bangladesh Bureau of Statistics. The present study instrument had some additional features content-wise and technique-wise. It was translated into Bangla, pre-tested and modified and used for data collection.

To obtain local support for the survey, appraisal meetings were held with the local officials such as the Upazila Health and Family Planning Officer, Upazila Family Planning Officer and MCWC

[112] *Valerie J. Flaherman. Breast-fed Newborns: How Much Weight Loss Is Normal?* Medscape Medical News *http://www.medscape.com/viewarticle/835626*

medical officers and also with the immediate supervisors of the data collectors, e.g. health inspectors. Relevant NGO officials were also consulted, in some of the areas.

Follow up schedule: Of particular importance was the follow up of the pregnant women, once they were identified as pregnant through a due test, to see if they develop any disease that affect fetus in utero or the women in pregnancy. Every identified pregnant woman was tested for medical conditions, i.e. pre-eclampsia (pitting edema at the ankle and albuminuria), frank goiter, any cardiac disease, and eclampsia in every trimester, besides the other tests mentioned above. Those who would be found with any of these diseases or any other uncontrolled medical conditions were to be referred for an appropriate treatment and released from the study.

Table 1) List of instruments and equipment

Name of instruments/ equipment/ reagents	Number
Pregnancy confirmatory strip	4500
Metallic spring type baby weighing scale	102
Infantometer/ stadiometer for measuring length of newborn (wooden)	83
Bathroom scale for pregnant women	83
Height measuring tape	102
Thermometer	102
Sphygomomanometer	83
Glucometer	83
Blood sugar measuring strip and needle	4500
Hemoglobin measuring paper strip	83 books
Acetic acid	130 liters
Test tube	200

m) Controlling biases

Selection bias- controlled through an appropriate sampling technique and exclusion and inclusion criteria, which have been described above.

Information bias: (i) Selective memory bias (ii) Volunteer bias (iii) Hawthorne effect (iv) positive signal bias (v) misclassification bias due to mis-recording of identity by the data collectors or due to error in measuring instruments. These were controlled through an adequate and effective training.

Interaction or confounding: controlling through statistical technique.

n) Training for quality improvement

A full glimpse was given, of the Project, to the supervisors and quality improvement officers, as they were the trainers in turn, to the data collectors. The idea for a full fledged training to them emanates from two considerations. Firstly, they should look in control and confident when they act as trainers to

the data collectors. This may happen only when they are fully conversant about the Project and its instruments. Secondly, full knowledge about the Project will ensure their commitment to the Project and its activities.

The training was conducted in two steps. In the first step, all the supervisors and QI officers were given three days training at Dhaka on collection of socio-demographic data, anthropometric measurements (of pregnant women and newborn children) and all aspects of the survey administration including the techniques used to monitor the data collectors' activities in the field. Training was given in two batches (8 supervisors and 2 QI officers in each batch). The training sessions were jointly conducted by experts of SSMF, INFS, Dhaka Shishu hospital and BAMANEH. Representatives from IPHN were invited to be present during training sessions. Two days practical training was conducted thereafter at the Maternal and Child Health Training Institute (MCHTI), Azimpur/ Shahid Sohrawardy Medical College Hospital/ and in the Nari Maitree Maternity in Mohammadpur, Dhaka. This training was on how to weigh and measure the length of a newborn.

In the second step, the training of the data collectors was held at Mother and Child Welfare centers (MCWC),Upazila Health Complexes/ Union Health & Family Welfare Centers/ Community Clinics, as per convenience and availability of facility of child birth. Trained FS and QI officers conducted these trainings. Team leader of the Project oversaw and monitored this event. Data collectors were trained to take anthropometric measurements of pregnant women (height and weight), to determine the date of LMP and expected date of delivery (EDD) and anthropometry of newborns (birth weight and length) and to collect other information as per the questionnaire. The training included one day classroom training and two days practical training in hospitals.

Training given to the data collectors was based on the implications of the pregnancy outcome in the future life of the children born with handicaps at the time of birth. This is expected to inculcate a sense of importance in the mind of the data collectors about the work they are expected to do. Emphasis then was given on how to measure length and weight of newborn babies, besides measuring/ recording gestational period. Practical training was given on the instruments which they will use.

o) Monitoring and Supervision Plan

Monitoring and supportive supervision was provided to the data collectors, who conducted the following activities: (i) follow up of pregnancies over a period of 8/9 months- from the first/ second month of pregnancy until child birth (as the Project period was limited to a total of 10 months initially), (ii) assist in getting some biochemical parameters of pregnant women measured in community clinics (anemia, blood sugar, blood pressure, albuminuria, frank goiter and edema), (iv) pathological conditions (disease), toxemia of pregnancy, any obstetric complication during pregnancy and child birth, malaria, tuberculosis and (iv) conduct measurement of newborns – gestational age, birth weight, birth-length, socio-economic and demographic data, housing condition, geographical location of the study individuals, food habits and scope of nutrition at domestic level and other condition of the enlisted pregnant women as mentioned above.

There were layers of monitoring and supervision. The first line of supervision and monitoring was done by the supervisors. The second layer was formed by the QIOs and the third one by the Project management, team leader and consultants.

The supervisors visited homes to check if the data collectors were visiting the enlisted pregnant women and recording the required data through home visits. They also checked the data cards

maintained by the data collectors on a monthly basis, to ensure timeliness and completeness of data besides their accuracy. The supervisors visited each data collector once a week, compiled a monthly report, according to a reporting form based on the field situation and submitted to the team leader. Supervisors also checked the accuracy of the measuring instruments and measuring techniques practiced by the data collectors, sometime on the spot. Occasionally supervisors followed the data collectors to take measurements from newborns (team leader of the Project also had a few occasions to accompany the data collectors to measure the newborns within 24 hours of their birth).

The QI officer independently visited the clusters, supervised the activities of data collectors and supervisors, and reported to SSMF on a weekly basis, based on a reporting form, sometimes over phone. The QI officers reviewed the compiled reports of supervisors and kept the head office informed of all the issues in the field. QI officers solved the local problems if any, liaised with the head quarter in case of serious issues. QIOs also visited the enlisted pregnant women to verify data collection process, its timeliness, completeness, inquire about the welfare of the pregnant women and provide health advices.

The Project Manager and Manager, Field Operations spent bulk of their time in the field to provide supportive supervision and monitor the progress of the Project outputs. They orientated and re-orientated the field staff to keep their zeal high. Team leader visited 40percent of the study districts to monitor and advise the data collectors and supervisors and ensure validity of data collection.

A Project review and advisory team was formed with representatives from all the four partners of the Project, i.e. SSMF, BAMANEH, Dhaka Shishu Hospital and INFS, Dhaka University. The team met every two months, when the field staff came to SSMF for bimonthly Project progress review. The team reviewed the progress of the work and provided advice as per relevance and requirement.

p) Data Management Plan

Bimonthly meetings were held with the supervisors and quality improvement officers in SSMF office. Up-to-date filled up questionnaires collected from data collectors and brought by the supervisors to the meeting were checked on sample basis and inquiries and discussions were held on data quality-validity, timeliness and completeness. Other problems, in data collections, if any, were discussed and solutions offered or helped with.

Completed study instruments/ questionnaires were submitted to SSMF, in every bimonthly meeting by the supervisors, for those pregnant women who already delivered. Data were rechecked by the study personnel in the head office of the Project.

Data editing and cleansing were done before the entry of data. No coding was necessary, as all the questions were structured. A software was developed for data entry. Data entry was started in the second week of May and completed in end-May 2016. Internal consistency of data was also checked as and when data was being entered. Data was summarized and analyzed into the dependent variables and independent variables. Data analysis schedules were developed in the meantime and analyzed data was fitted into the schedules in the form of cross tabs. Data entry was supervised from time to time by the team leader.

The pregnancy outcomes recorded were: birth on term/ pre-term birth, maternal death, abortion, still birth; birth-weight after full gestational period (intra-uterine growth retardation); birth-length after complete gestational period.

Biochemical and clinical parameters of pregnant women included were: anemia, blood sugar, blood pressure, albuminuria; pathological conditions (diseases), including toxemia of pregnancy, frank goiter, edema, tuberculosis and malaria; any obstetric complications during pregnancy and child birth; and finally the gestational age.

Data was analyzed using SPSS 20 version. A multiple regression test was done when birth weight, as the dependent variable, was dichotomized into those who weighed more or less than 2.5 Kg at birth. Linear regression was done when birth length, as the dependent variable, was used as a continuous variable. The two dependent variables were unadjusted, and used as recorded.

q) Ethical issues

The study embarks on a very touchy area- pregnancy, which has lots of taboos around it. Working with the pregnant women in rural setting may be quite sensitive – given the practices, belief and attitude towards the physiological status in a woman's life. During training of the supervisors and quality improvement officers, emphasis was given on treating the study individuals with dignity and respect, not only on human considerations but also because this would be important for reducing and controlling bias in response.

Although no physically intrusive interventions (except finger prick for estimating anemia and blood sugar) was needed in this study, care was taken to do no harm to the pregnancy status of the women who put their trust on thedata collectors. Advice was given to these women to take up proper ante-natal care. Advice was given to them to initiate early breast feeding, take up proper post natal care, child and maternal nutrition care during lactating period, proper weaning practices (balanced diet, well-mixed food from different sources), contraception and immunization. Data collectors were told to delist the enlisted pregnant women and refer them, if any was suffering from complex stages of any disease.

Verbal informed consent was obtained from each household head and respondent (pregnant woman) for taking their anthropometric measurements (height and weight), other biochemical parameters, socio-demographic characteristics and weight and length of newborns. The pregnant women were also oriented on the danger signs of pregnancy, so that in case of emergency the pregnant women can realize it and take remedial measures without any sort of delay.

Introduction

RESULTS

The results shown in this section are based on percentages, and compares the estimates obtained from the seven divisions, between the urban and the rural areas within the divisions and between slum and non-slum population within each urban area of the seven divisions. Valued readers might note that of the 4,500 pregnant women, 102 were lost during follow up.

Family characteristics of the studied pregnant women

Religion

Among the study population (N=4,398) 91.5 percent were Muslims- 93.3 percent in urban areas (slum and non-slum areas with almost equal distribution) and 90.7 percent in rural areas; 7.0 percent were Hindus- 7.1 percent in rural areas and 6.5 percent in urban areas (slum and non-slum areas showed almost equal distribution); 1.4 percent were Buddhists- 2.0 percent in rural areas; 0.2 percent were Christians, evenly distributed in urban (non in slums) and rural areas.

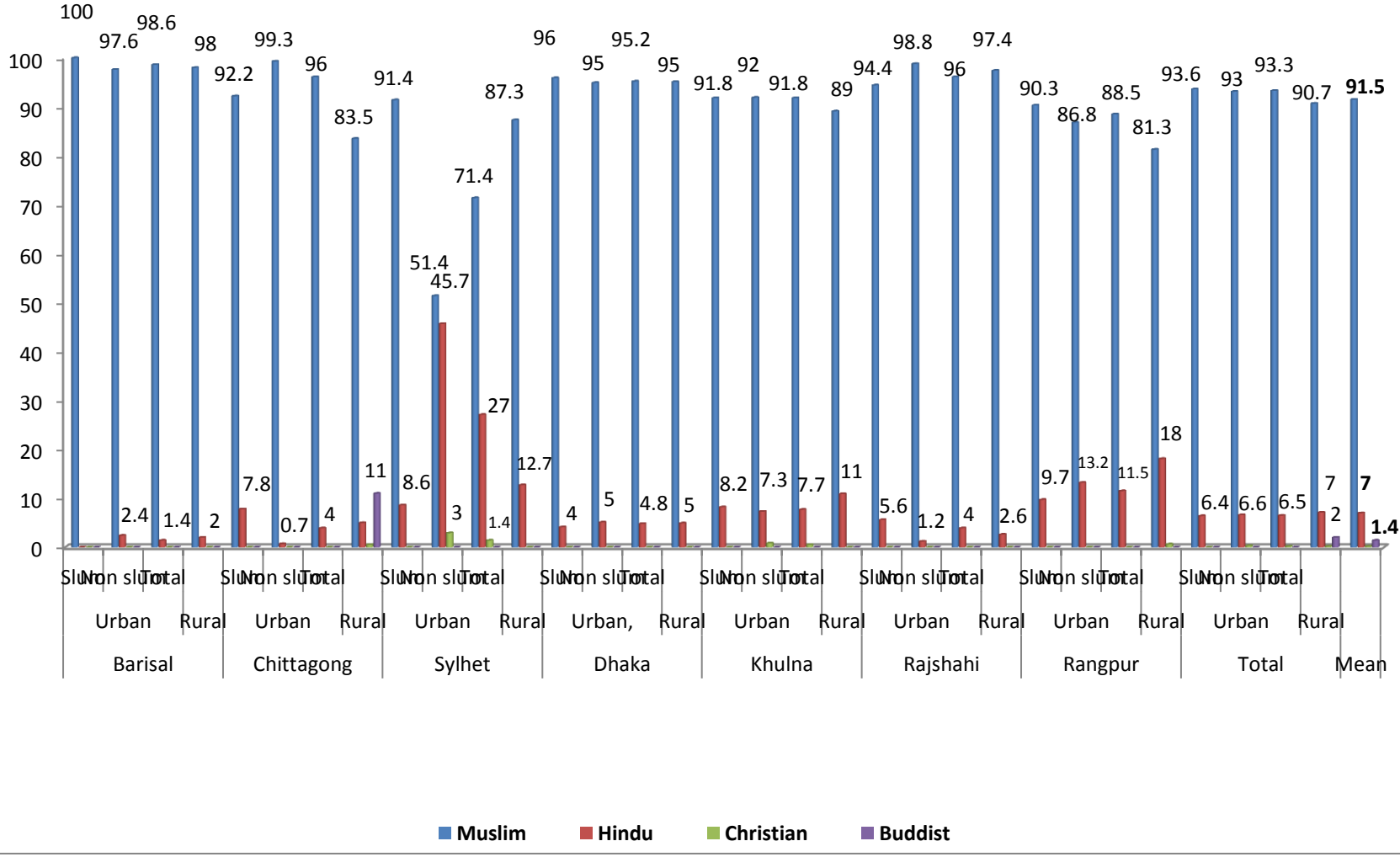
More than 95 percent of the families were Muslim in Barisal, Chittagong urban areas, Dhaka, and Rajshahi divisions. On Khulna about 90 percent were Muslims, nominally less in rural areas. More than 80 percent but less than 90 percent were Muslims in Rangpur division. Sylhet urban areas had the lowest percentage of Muslims- 71.4 percent, where 27.1 percent were Hindus. In Rangpur rural 18.1 percent; in Sylhet rural areas 12.7 percent and in Khulna rural areas 10.9 percent were Hindus. The highest concentration of Buddhists- 11.0 percent, were noted in Chittagong rural areas. More Christians were seen in Sylhet urban areas (1.4 percent) and then in Rangpur rural Chittagong rural and Khulna urban areas (Fig 1).

Family structure

The average family size among the 4,398 respondents, was 4.5 persons, with 4.4 in urban areas (4.3 persons in slums and 4.5 in non-slums) and 4.6 in rural areas, without much difference by sex (data not shown). Chittagong, Barisal and Sylhet have higher than the average, with women counting nominally more than men.

Of all the studied families (N=4,398), 2.2 percent were headed by women. This was zero percent in Barisal and Sylhet urban areas; highest in Chittagong (4.3 and 3.7 percent respectively in urban and rural areas) and then in Rangpur urban areas (4.6 percent). Other divisions had lower than the average number of families headed by females (data not shown). There was hardly any difference between slum and non-slum areas.

Fig 1. Religion by division and urban (slum and non-slum) and rural areas (N=4,398)



Occupation

Majority of the pregnant women in this study were housewives- 95.1 percent; 94.1 percent in urban areas (without any difference between slum and non-slum areas) and 95.3 percent in rural areas. While in no other study locations the studied pregnant women (N=4,398) were drivers of manual vehicles, in Rangpur rural areas b0.9 percent of them were actually driving such vehicles (before pregnancy). Working in tobacco fields among them was seen in 0.3, 0.2, and 0.2 percent respectively in Rangpur, Chittagong and Khulna rural areas. Among them 0.3 percent were disabled in Rangpur rural areas. Of these pregnant women 0.3 percent each was cultivating either their own or someone else's land- 0.2 percent in urban (peri-urban) areas (more among the slum based families, especially in someone else's land cultivation) and 0.4 percent in rural areas- highest in Rangpur, Chittagong and Dhaka rural areas in that order and in Rajshahi urban (peri-urban areas). More of them were engaged in their own lands in urban (peri-urban) areas (seen only in Rajshahi). None was involved in cultivation in Barisal and Sylhet divisions and Rangpur, Khulna and Dhaka urban areas. Among the 0.5 percent who was housemaids, 1.3 percent was working in urban areas (2.1 percent in slum and 0.6 percent in non-slum areas) and 0.3 percent in rural areas. Among the study women, 0.6, 0.2, and 0.2 percent were involved in small, medium and large scale businesses- all small scale businesses were distributed equally among urban and rural areas- 0.6 percent; medium scale business was seen in 0.5 percent pregnant women (0.7 and 0.3 percent in slums and non-slum areas respectively). Large scale business was seen among 0.2 percent slum and 0.1 percent non-slum women in urban areas. Large scale business women were seen in Barisal, Khulna urban and Rangpur rural areas (0.2 percent). Medium scale business women were not seen Rajshahi division, in Barisal, Dhaka and Rangpur urban areas, and Khulna and Sylhet rural areas. Small scale business women were not seen in Barisal, Chittagong and Rajshahi urban, and Sylhet rural areas. Fig. 2 shows the salient occupations of the pregnant women and their husbands. In urban areas 2.7 percent and 0.9 percent pregnant women were serving as non-officer level staff in non-slums and slums respectively, while 0.2 percent and 0.6 percent slum and non-slum pregnant women were working in private or public sectors as officers.

Among husbands of the pregnant women in this study, small scale business (19.1 percent on average- 22.3 percent in urban and 17.8 percent in rural areas), cultivation (15.8 percent in own land and 15.2 percent in someone else's land- 5.8 and 11.8 percent in urban and 19.7 percent and 16.6 percent rural areas respectively), government or private sector non-officers (12.5 percent -14.6 percent and 11.7 percent in urban and rural areas respectively), artisans (8.6 percent), driver of engine vehicles and non-engine vehicles (8.3 percent and 5.8 percent respectively), and medium scale businesses were the main occupations of the husbands of the pregnant women in this study. Cultivation was more common in the rural areas of Rangpur, Rajshahi. Sylhet, Khulna divisions and Dhaka (rural areas). Small scale business was more common in Sylhet division, and in urban areas of Rangpur, Chittagong, Dhaka and Rajshahi. Most of the husbands working as non-officers in the public or the private sector were seen in urban Rajshahi and except in Barisal, where more were seen in rural areas, a slightly higher number were seen in the urban areas of all the divisions. No husband was seen working in tobacco field. Among the husbands 0.2 percent were not involved in any occupation during the survey, as they were physically disable, while 0.6 percent were jobless in each of the urban and rural areas, mostly in Sylhet urban (4.3 percent), Rangpur urban and Khulna rural areas. Rajshahi urban, Sylhet rural and Chittagong urban areas did not have any jobless husbands. Chittagong urban (0.4 percent), Rajshahi and Rangpur rural areas (0.3 percent each) had some consultant husbands. Among the husbands 16 percent were officers in the public or te private sectors (1.9 percent and 1.5 percent in the urban and rural areas respectively); mostly in Barisal and Rajshahi and least in Rangpur and Dhaka divisions, followed by Sylhet and Chittagong divisions (Fig 2).

More husbands of the pregnant women were working in different occupations, except in business and service sector in public or private offices/ enterprises. While large scale businesses were the occupation of 2.4 percent of non-slum husbands, 1.4 percent of them were living in slums despite owning large scale businesses. This was slightly less than those living in rural areas. While 2.8 percent of the non-slum husbands were working as officers (in public or private, 0.7 percent of them were living in slums. The jobless rate was the lowest among the slum based husbands- only 0.2 percent. This showed that physically they were more capable of undertaking work, although among them 0.2 percent were physically handicapped, while in non-slums the rate was 0.3 percent and in rural areas it was 0.1 percent.

Literacy

More husbands were illiterate than their wives (6.5 percent versus 4.0 percent). This is much more pronounced in slums, and then in rural areas; while in non-slums more pregnant women were illiterate, although the difference is not remarkable (Fig 3). Among those who could not complete primary level of education, 18.9 percent were husbands and 15.8 were pregnant women. In urban slums, the rates were higher than the national average and reverse (23.8 percent for pregnant women and 20.8 percent for husbands). In the rural areas the situation was comparatively better but worse than urban non-slums. Among those who completed primary level of education 27.9 percent were the pregnant women and 25 percent their husbands. The rates were higher in urban areas, in particular in slums (35.2 percent pregnant women and 31.7 percent of their husbands). Among those who completed secondary level of education more were husbands (12.4 percent to 11.8 percent). This was better in non-slum urban areas, but rural areas fared better than slum areas (although slum husbands had slightly higher percentage 12.6 percent to 11.5 percent husbands in rural areas). Among higher secondary, graduate and higher level of education, 9 percent were the pregnant women and 12.5 percent were their husbands. Among them, the non-slum urban pregnant women were 11.6 percent and their husbands 19.6 percent and in urban slums these were 5 percent and 7.8 percent respectively.

Although more urban pregnant women and their husbands are educated than their rural counterparts, but when compared, the rural rates are higher than the slum rates. Comparatively more in urban non-slum areas are educated at higher levels than slum population in Barisal, Sylhet, Rajshahi,

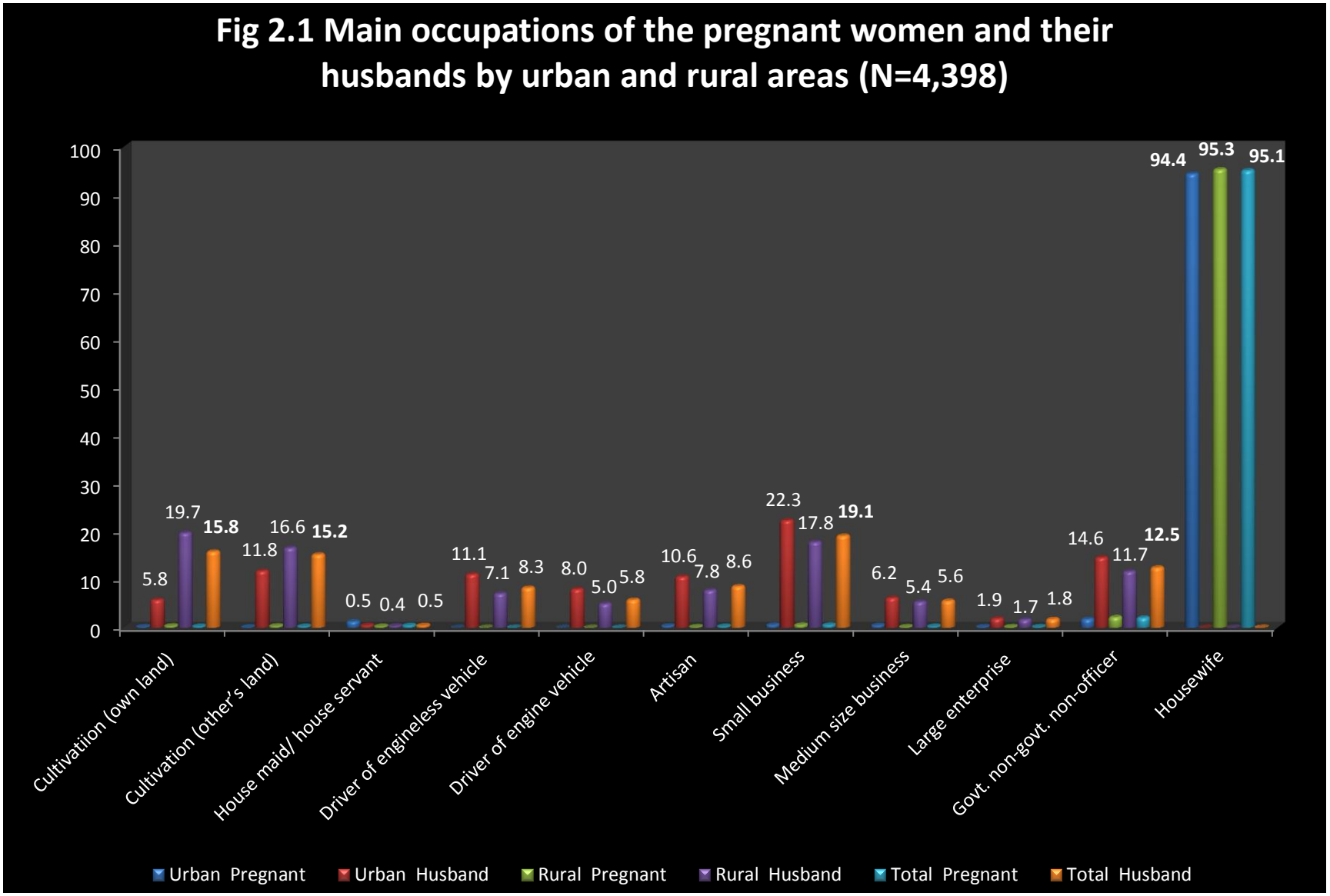


Fig 2.1 Main occupations of the pregnant women and their husbands by urban and rural areas (N=4,398)
100
90
80
70
60
50
40
30
20
10
0
5.8
19.7
15.8
11.8
16.6
15.2
0.5
0.4
0.5
11.1
7.1
8.3
8.0
5.0
5.8
10.6
7.8
8.6
22.3
17.8
19.1
6.2
5.4
5.6
1.9
1.7
1.8
14.6
11.7
12.5
94.4
95.3
95.1
Cultivatiion (own land)
Cultivation (other's land)
House maid/ house servant
Driver of engineless vehicle
Driver of engine vehicle
Artisan
Small business
Medium size business
Large enterprise
Govt. non-govt. non-officer
Housewife
Urban Pregnant
Urban Husband
Rural Pregnant
Rural Husband
Total Pregnant
Total Husband

Fig 2.2 Occupations of the husbands of the pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

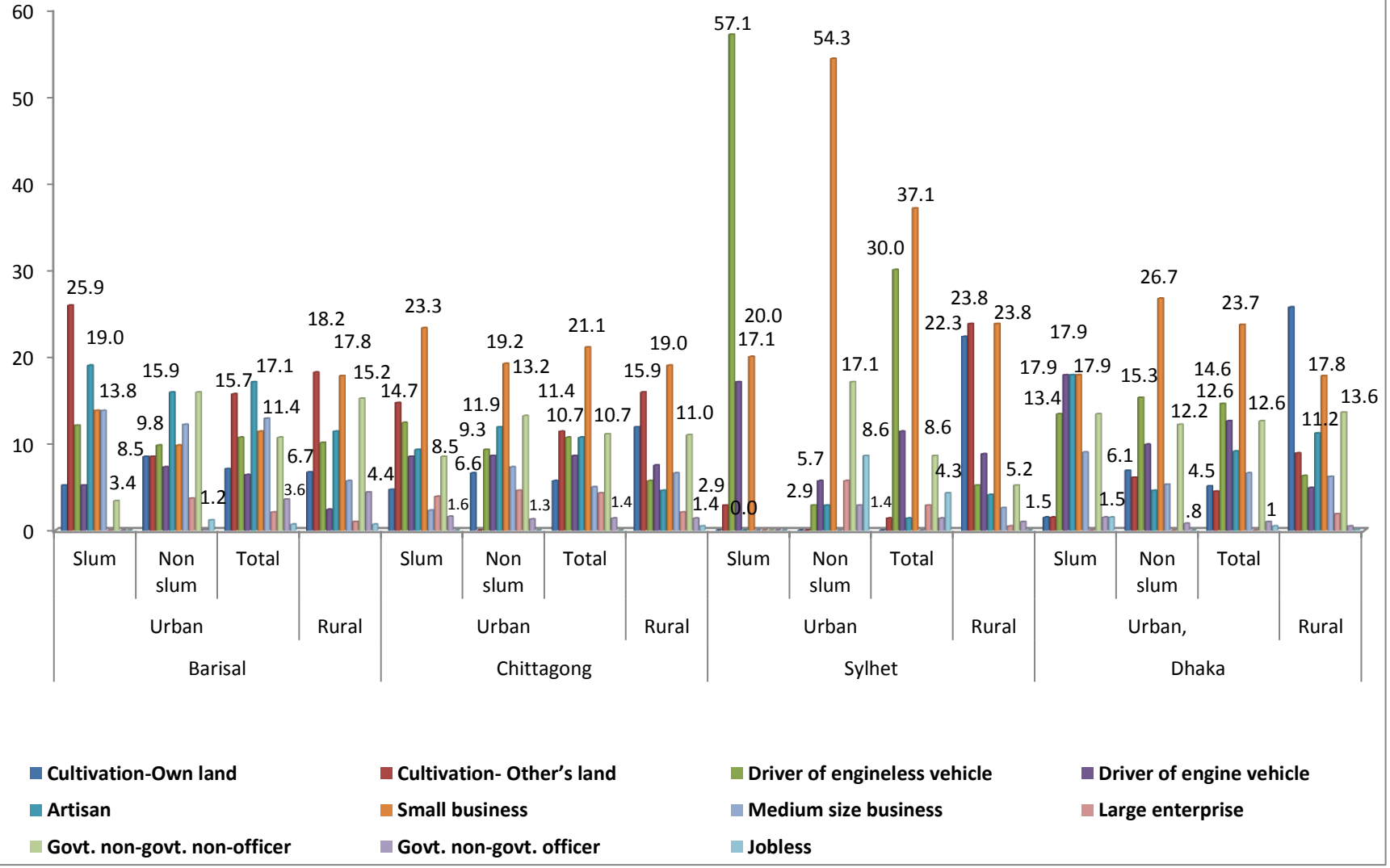


Fig 2.3 Occupations of the husbands of the pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

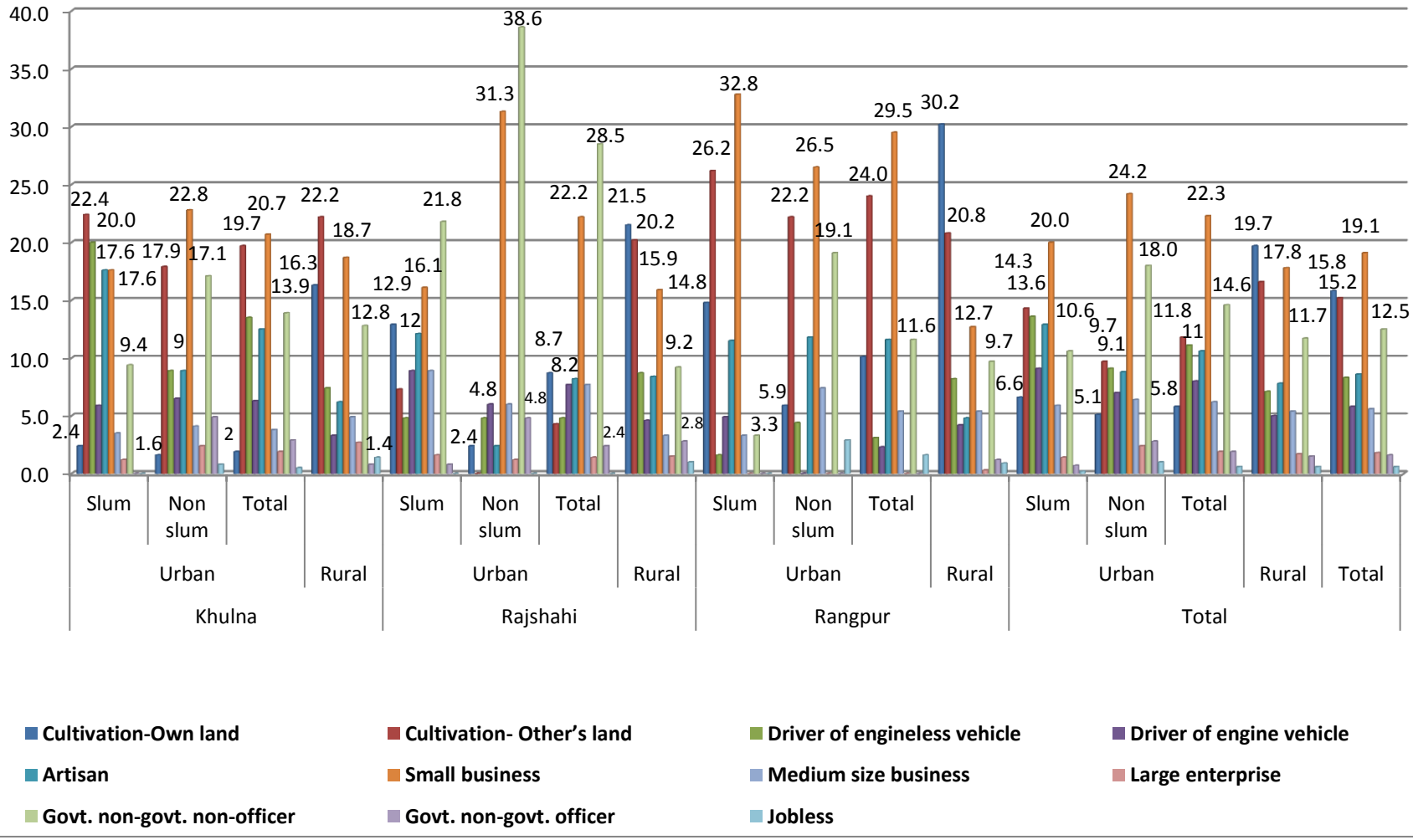


Fig 3.1 Literacy of pregnant women and their husbands (summary) by urban (slum and non-slum) and rural areas (N=4,398)

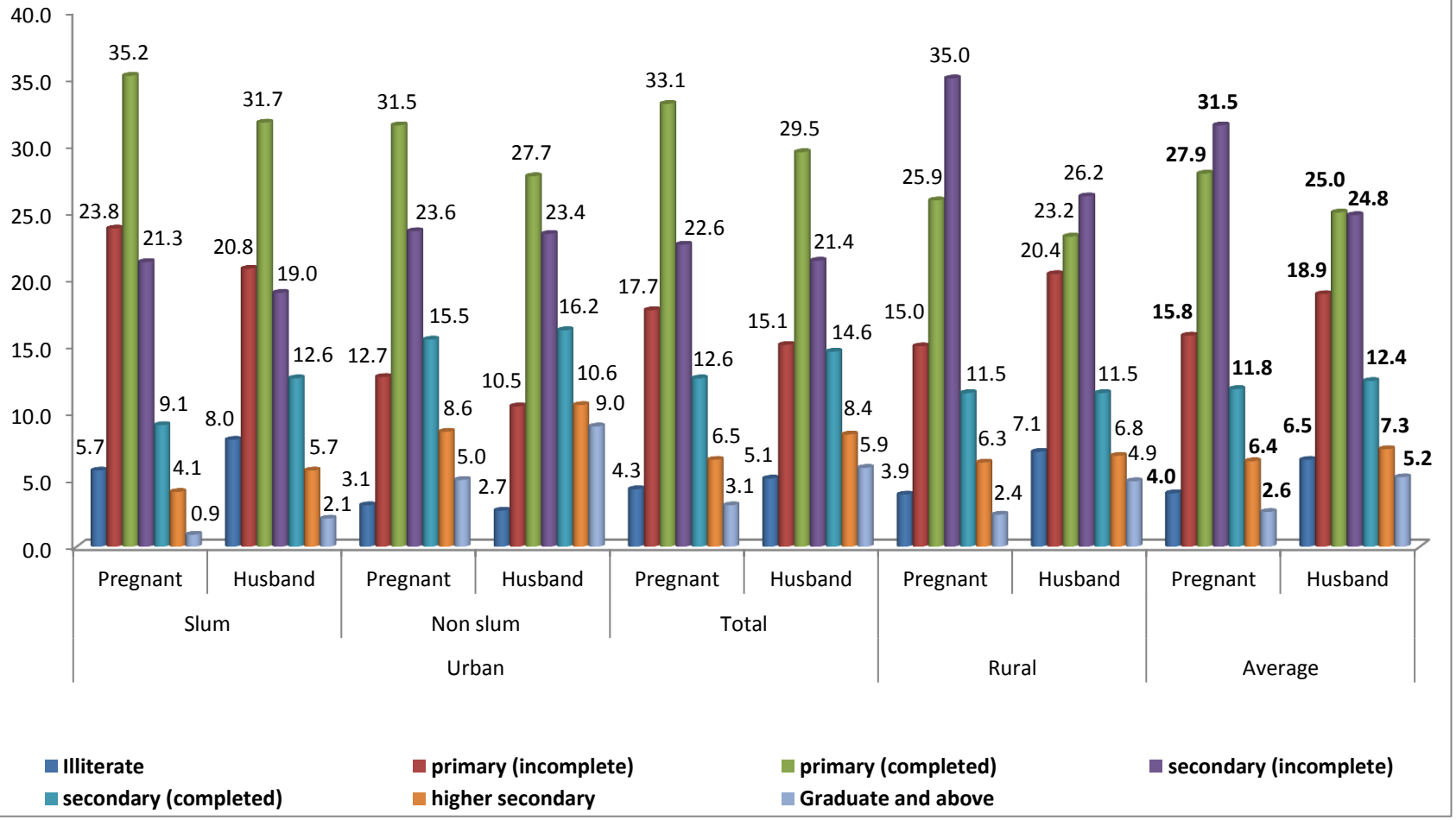


Fig 3.2 Literacy of pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

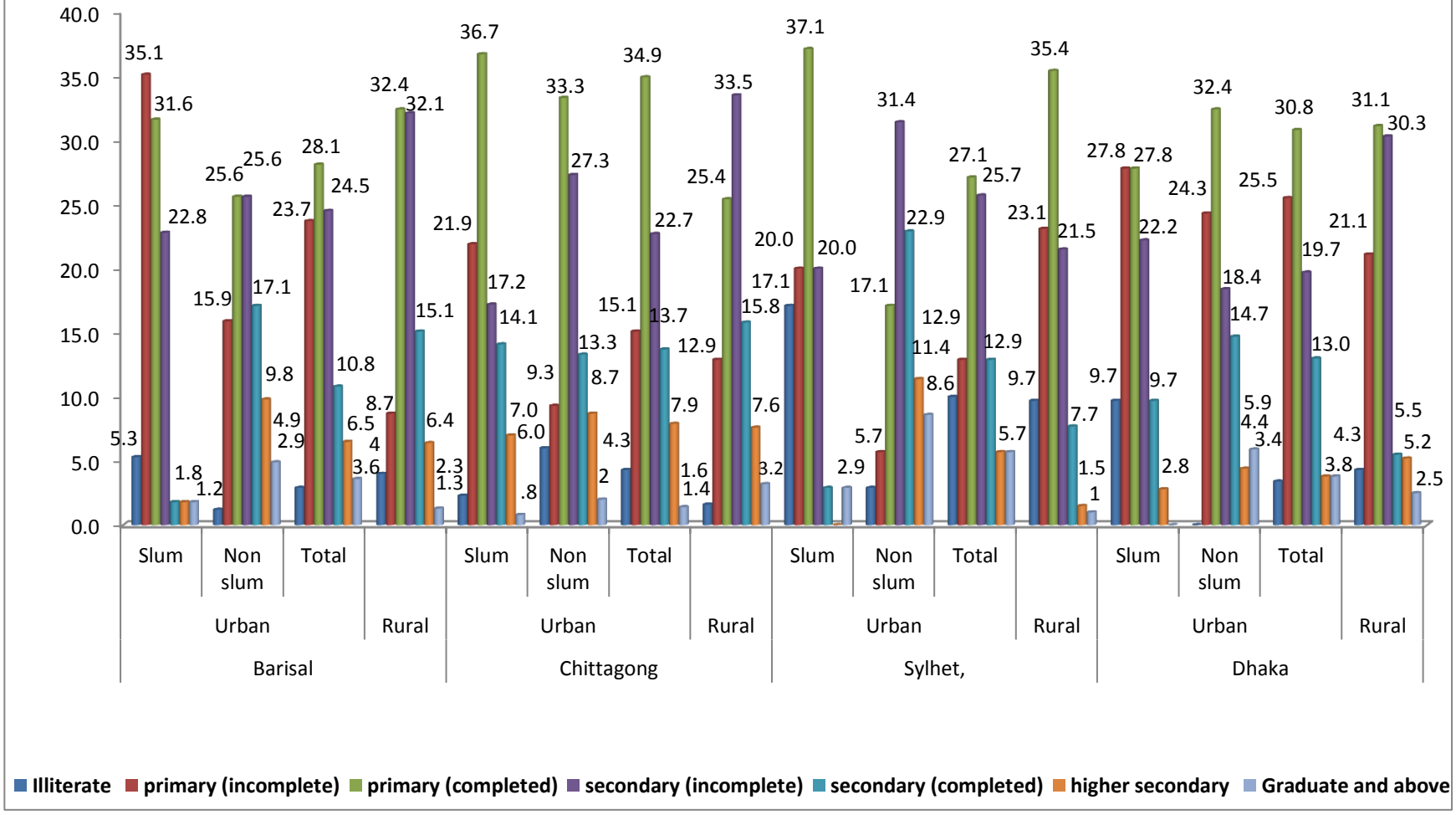
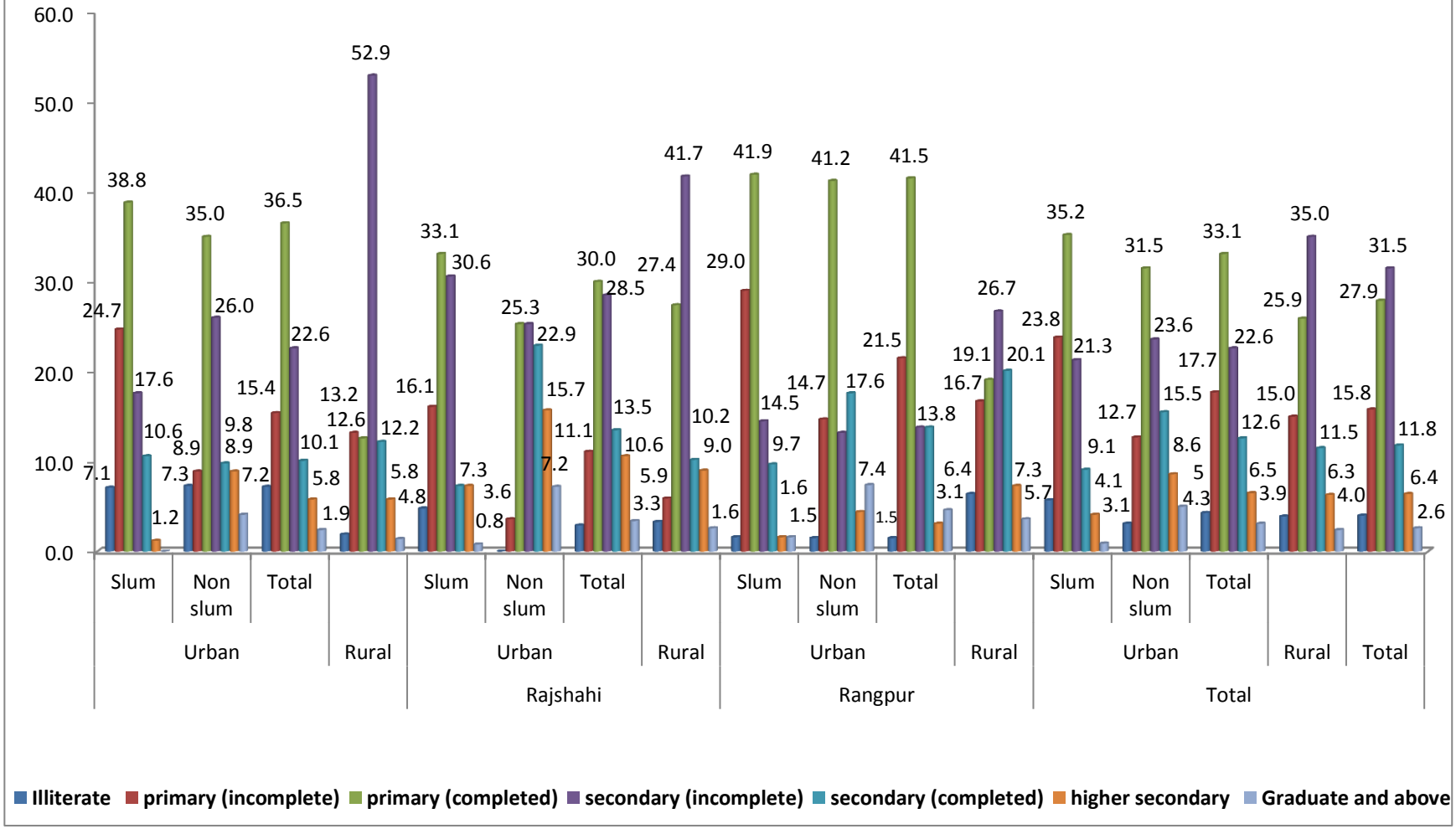
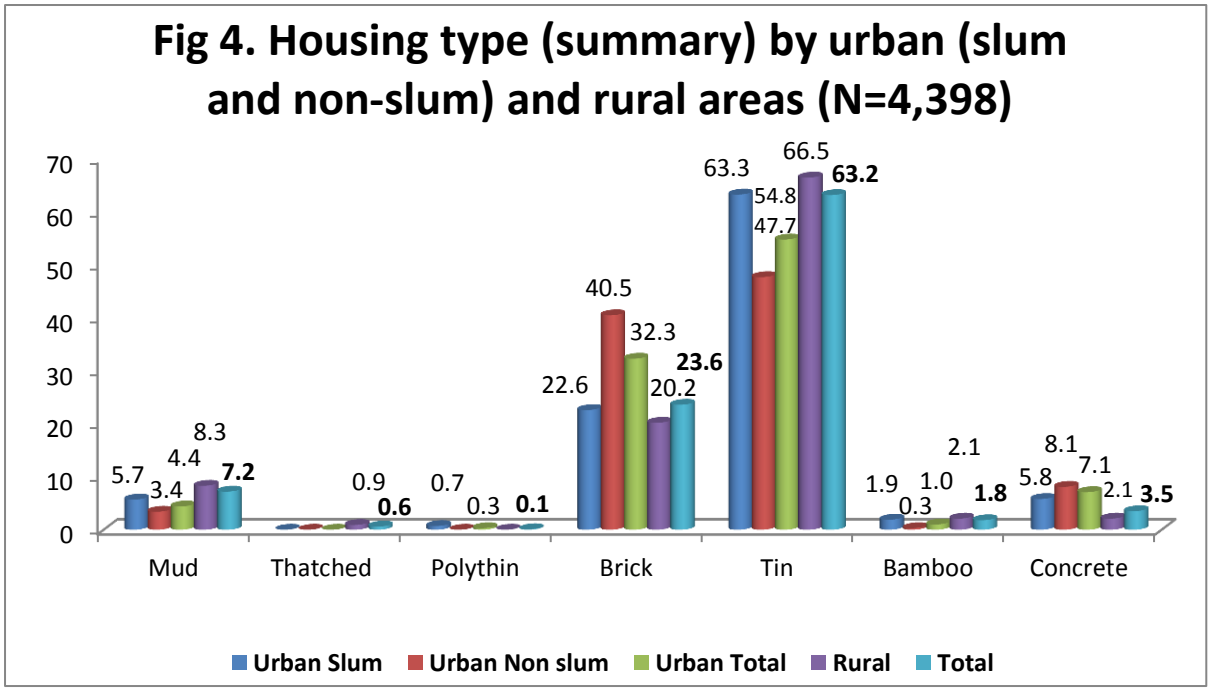


Fig 3.3 Literacy of pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)



Living standard

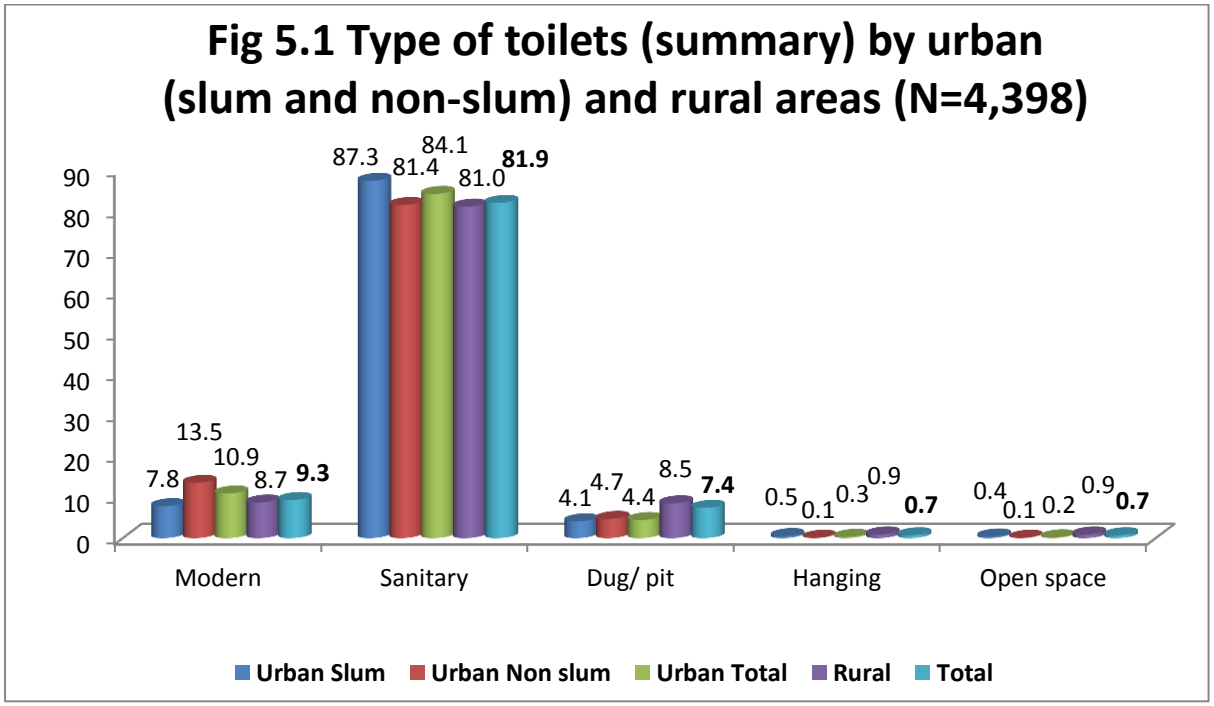
Housing type



Among all the families (N=4,398) studied, 7.2 percent were living in mud houses (Fig 4)- 8.3 percent in rural areas, and 4.4 percent in urban areas (5.7 percent in urban slums). No thatched house was observed in urban areas, while in the rural areas 0.9 percent of the houses were thatched (on average this was 0.6 percent). Polythene based houses were seen only in urban slums (0.7 percent, on average the rate was 0.1 percent). On average 23.6 percent houses among 4,398 families were made of brick walls, 20.2 percent in rural areas and 32.3 percent in urban areas (40.5 percent in non slum areas and 22.6 percent in slums). Among 63.2 percent households made of tin wall and roof on average, 66.5 percent were in rural areas, 54.8 percent in urban areas (47.7 percent and 63.3 percent in non-slum and slum areas respectively). While 1.8 percent of the houses were built with bamboo wall and roof on average, 2.1 percent were seen in rural areas and 1.0 percent in urban areas (1.9 percent in slums and 0.3 percent in non-slum areas). In total 3.5 percent of the houses had concrete roof, in rural areas the rate was 2.1 percent less than the urban slums- 5.8 percent. In urban non slum areas 8.1 percent of the houses were concrete built (7.1 percent on average in urban areas).

Tin houses were more common in Barisal, Rangpur, Dhaka and Chittagong. Concrete houses were more common in Rajshahi, Chittagong, Khulna and Dhaka. In Sylhet division as a whole, and in Barisal slums no concrete houses came within the selected samples. Concrete houses that got selected in this study were the least in Barisal and Rangpur. Mud houses were the commonest in Sylhet and Khulna and Rajshahi. Brick houses were commonest in Sylhet, Chittagong, Rajshahi and Khulna.

Type of toilet



9.3 percent families were using modern commode/ pans, 81.9 percent water seal latrines, 7.4 percent dug wells/ pit latrines, 0.7 percent were using hanging latrines/ open field each. The rural estimates were 8.7 percent, 81.0 percent, 8.5 percent and 0.9 percent each respectively. The corresponding urban estimates were: 10.9 percent, 84.1 percent, 4.4 percent, 0.3 percent and 0.2 percent respectively (non-slum and slum figures were 13.5, and 7.8; 81.4 and 87.3; 4.7 and 4.1 t; 0.1 and 0.5 and 0.1 and 0.4 percent respectively. The rate of usage of modern toilets was highest in the non-slum urban areas, followed by the rural areas, which was higher than the urban slums. While water seal latrine use was higher in urban slums, its use rate was almost equal in urban non-slums and rural areas. The rate of use of dug well/ pit, hanging and open spaces was more in rural areas than in urban slums. But even in urban non-slum areas some pit/ dug well latrines were found to be in use and so also hanging latrines and open spaces, albeit a very negligible percentage (0.1 percent each).

Chittagong and Rajshahi division families were in highest percentage, found using modern toilets. None of the families in Rangpur division, who perhaps were using modern toilets, were in the net of the families sampled. Dhaka, Sylhet, and Rangpur families were in the highest number among those who were using water seal latrines, followed by Khulna and Barisal. In Barisal and Khulna divisions none was found using open space. In Rangpur, Sylhet, Rajshahi, Chittagong and Dhaka rural areas some families were using open space. In Chittagong urban areas (both slum and nonn-slum) and Rangpur slums some families were using open space. Hanging latrines were in use in Barisal urban slums and rural areas; Chittagong slums; Sylhet, Khulna, and Rajshahi rural areas and Rangpur non-slum urban and rural areas- highest rates being in Barisal and Rangpur (Fig 5).

Fig 5.2 Type of toilets by division and urban (slum and non-slum) and rural areas (N=4,398)

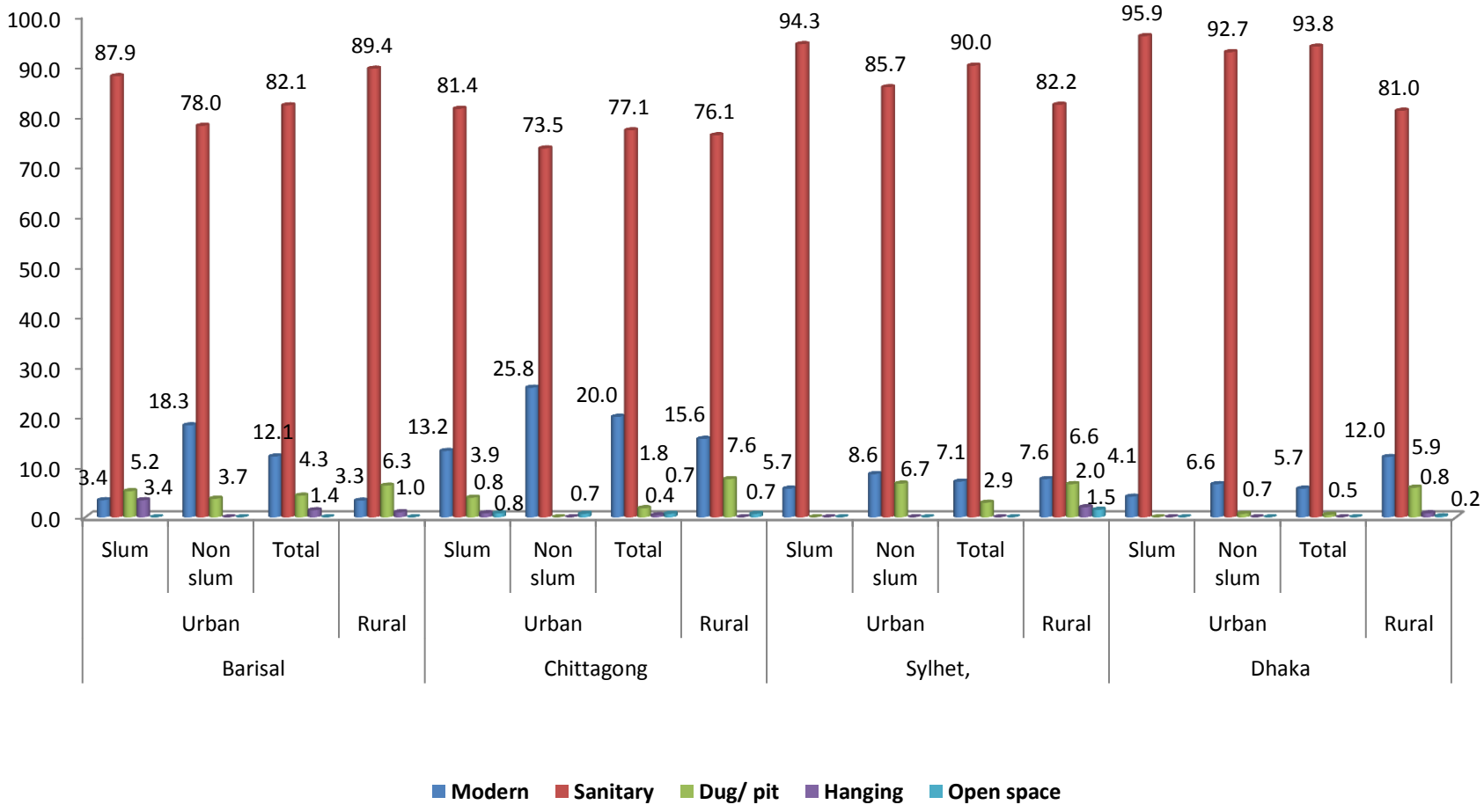
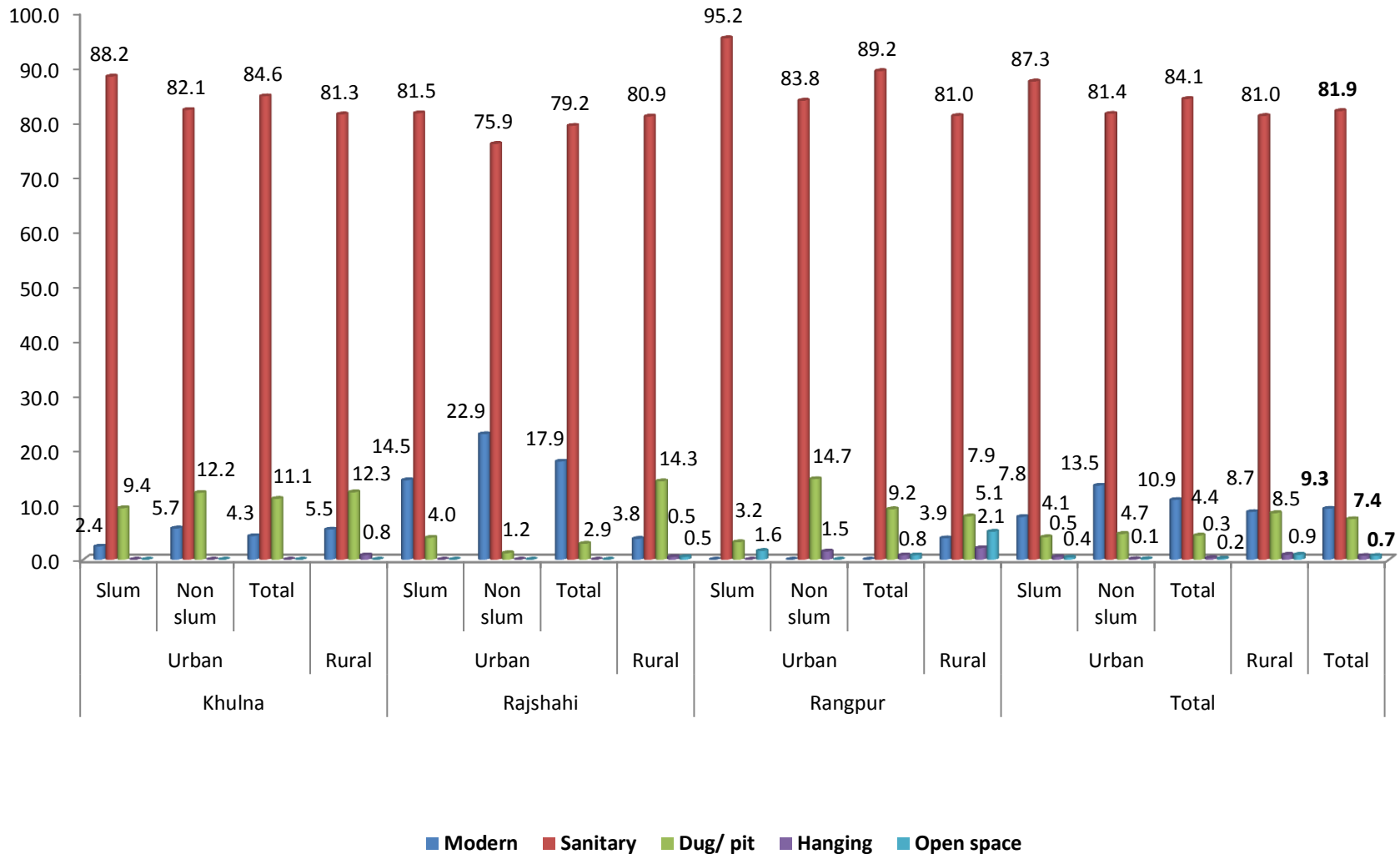
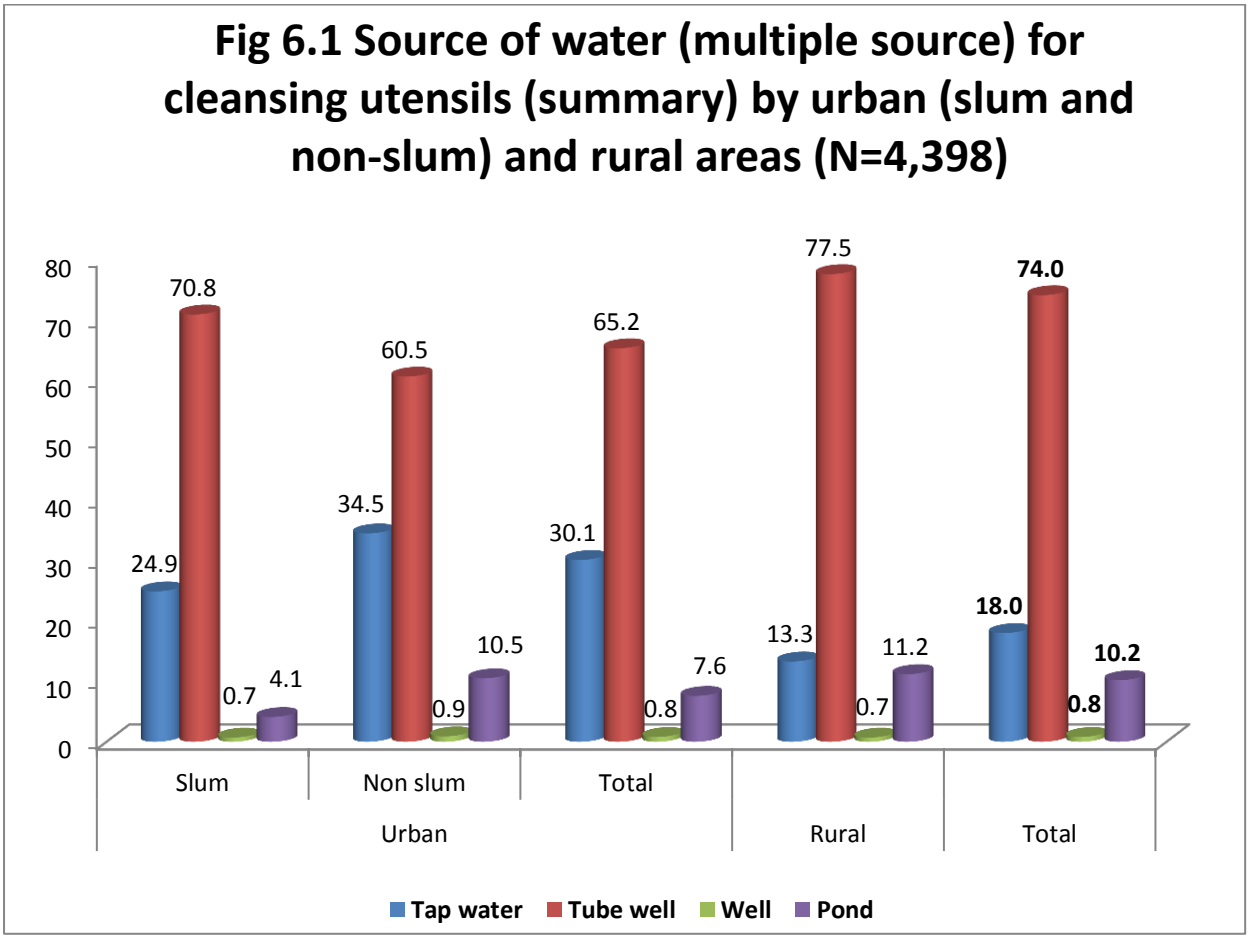


Fig 5.3 Type of toilets by division and urban (slum and non-slum) and rural areas (N=4,398)



Source of water for cleansing utensils



Among the 4,398 families 18 percent were using tap water for cleansing their utensils- 13.3 percent in rural areas, 30.1 percent in urban areas (24.9 percent in slums and 34.5 percent in non-slums). Tube well water was the most popular source of water- 74.0 percent on average, 77.5 percent in rural areas and 65.2 in urban areas (70.8 percent and 60.5 percent in slums and non-slum areas respectively). Well water is used by 0.8 percent families more or less in every location studied. Pond water was in use in 10.2 percent families, 11.2 percent rural areas, and 7.6 percent in rural and urban areas respectively (4.1 percent in slums and 10.5 percent in non-slum areas) (Fig 6.1 to 6.3).

Tap water was most common in Sylhet and Dhaka urban areas, and least in Rangpur. Tube well was the most common source in Rangpur, Rajshahi and Chittagong. No pond water was used in Sylhet and Rajshahi urban areas. Pond water was more commonly used in Barisal (46.5 percent in rural areas), Chittagong and Rangpur non slum areas, and Khulna. Dhaka families also used pond water in a very small percentage of families- about 1.0 percent.

Fig 6.2 Source of water for cleansing utensil by division and urban (slum and non-slum) and rural areas (N=4.398)

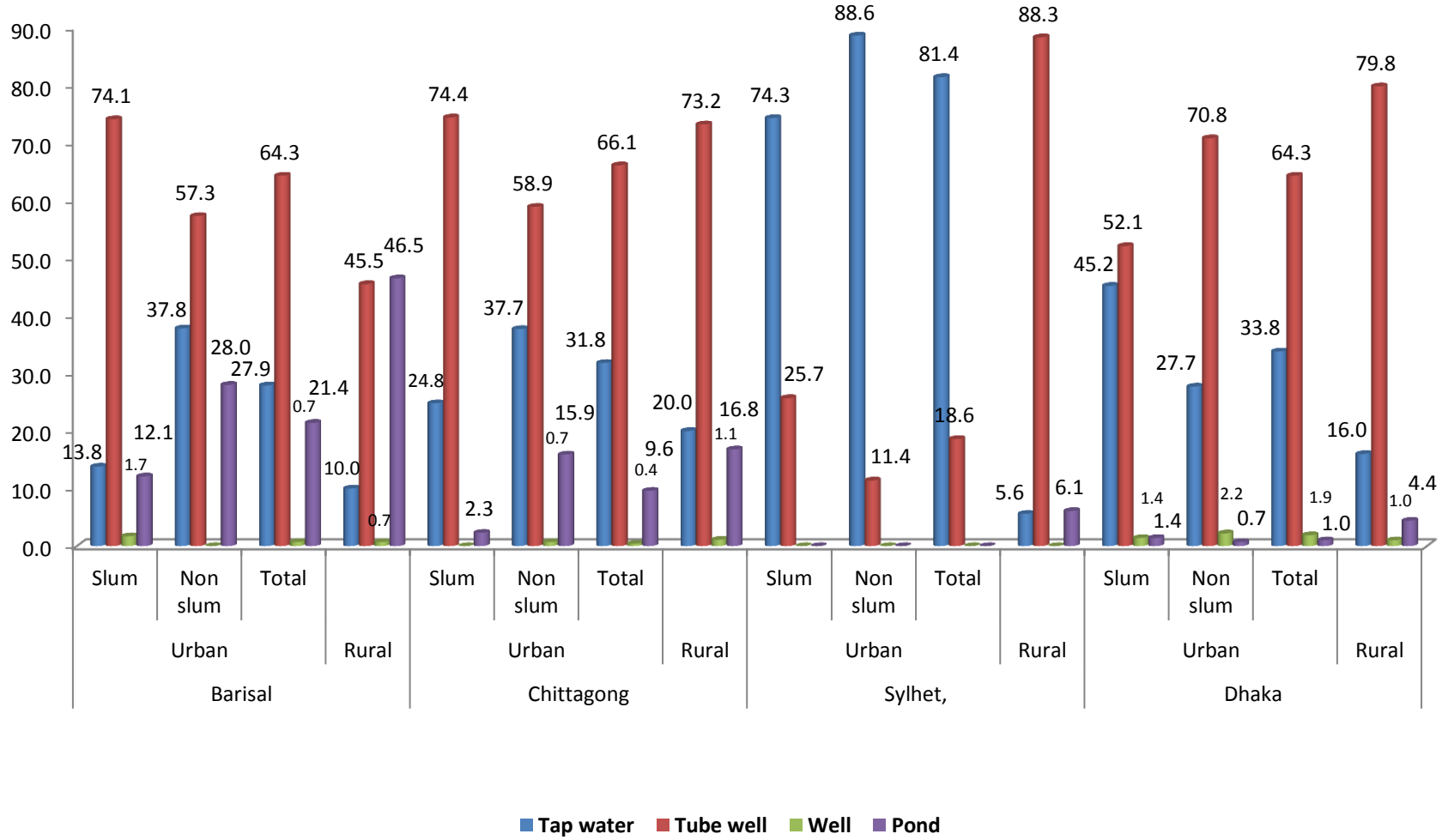
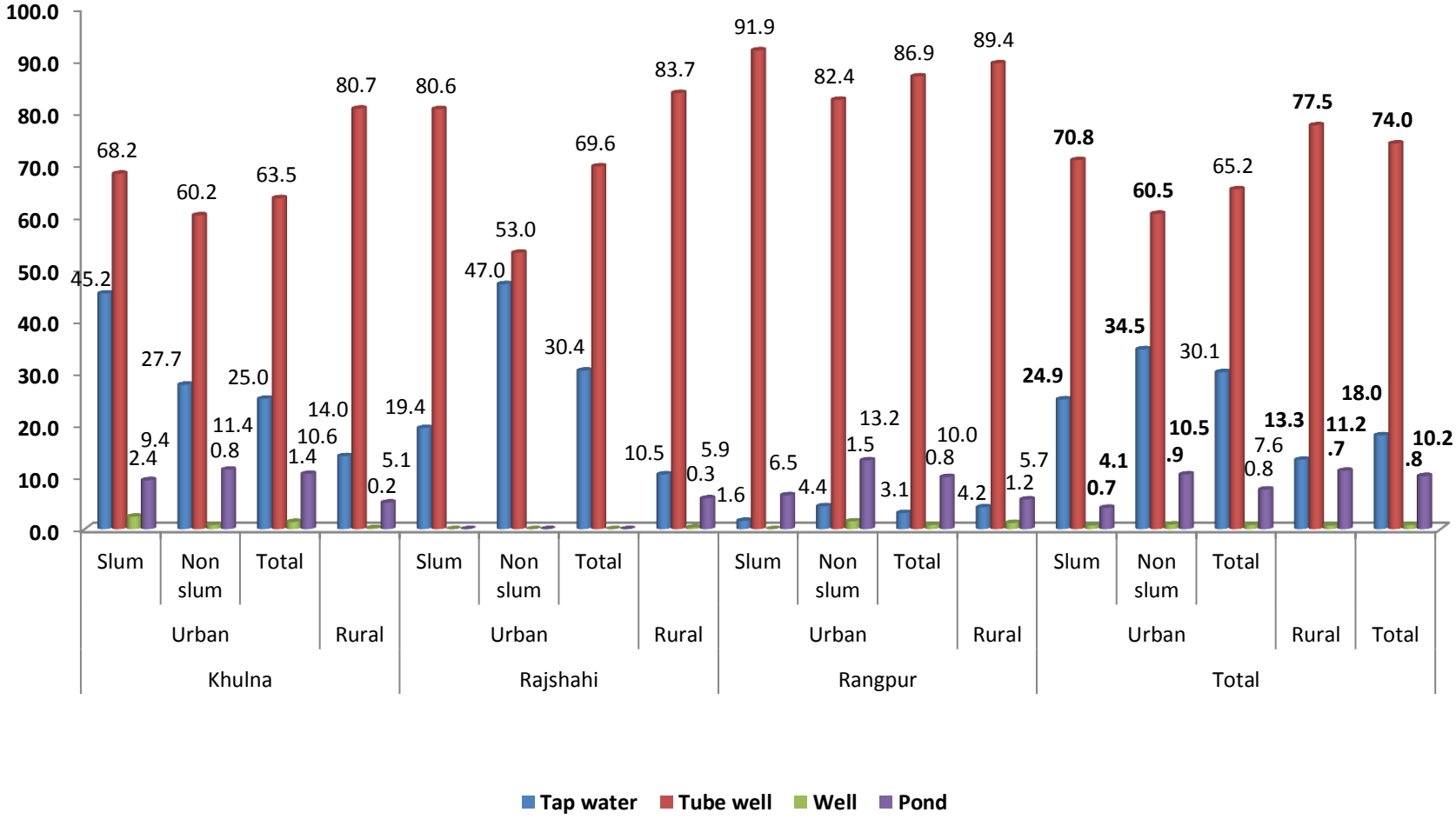
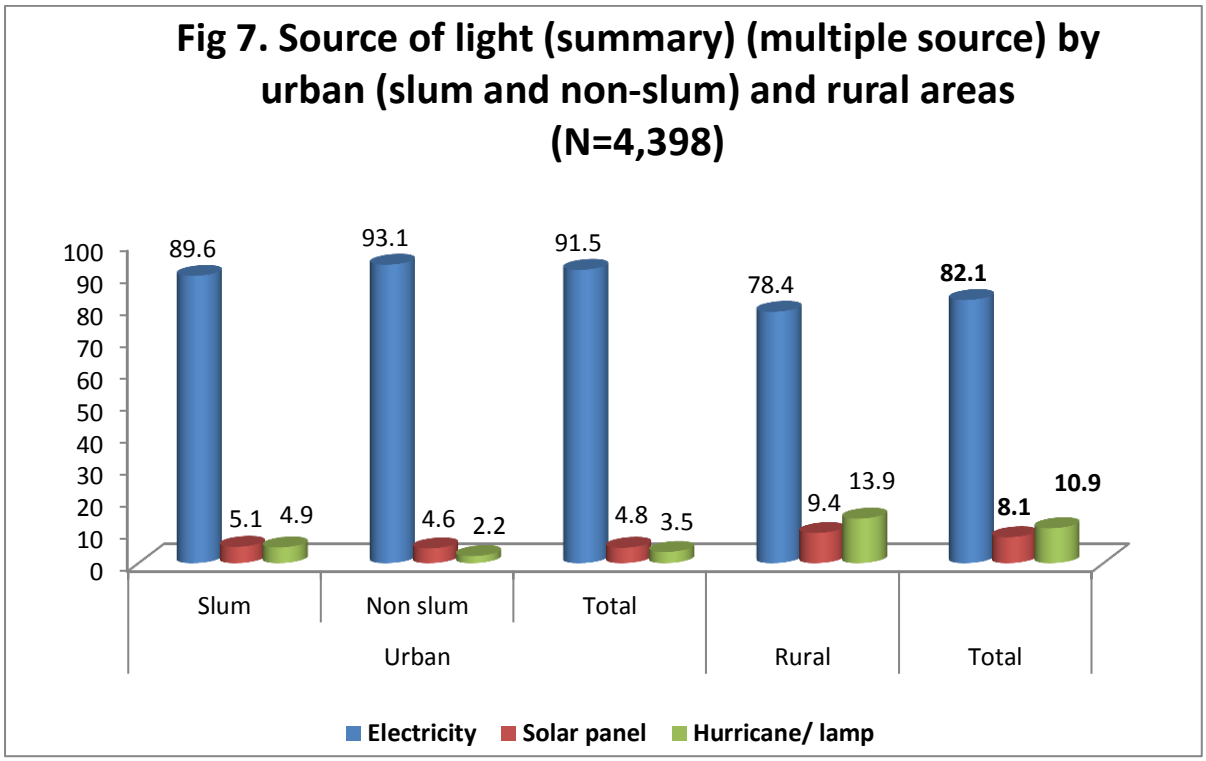


Fig 6.3 Source of water for cleansing utensil by division and urban (slum and non-slum) and rural areas (N=4,398)



Source of light

Electricity was the source of light in 82.1 percent of the study families, in 8.1 percent families solar panel was the source of light, while in 10.9 percent families it was oil lamp/ hurricane, on average (Fig 7). In rural areas the source of light was electricity, solar panel and lamp/ hurricane in 78.4 percent, 9.4 percent and 13.9 percent families respectively. In urban areas the corresponding percentages were: 91.5 percent, 4.8 percent and 3.5 percent for electricity, solar panel and oil lamp/ hurricane - 93.1 percent, 4.6 percent and 2.2 percent in non-slum and 89.6 percent, 5.1 percent and 4.9 percent in slum.



In Sylhet, Khulna and Rajshahi and Dhaka electricity was the source in the highest number of urban families. The smallest number of families using electricity as the source of light was observed in Barisal, the next highest number was in Chittagong. Sylhet, Barisal, Rangpur, Khulna rural areas had the lowest number of families using electricity as the source of light In Barisal, Sylhet, Khulna and Dhaka rural areas solar panel use was relatively higher. Barisal had the highest number of families using oil lamp/ hurricane, next were Chittagong, Sylhet, Rajshahi, Khulna and Dhaka rural areas. Sylhet urban area families were not using any oil lamp/ hurricane. It was also lowest in Dhaka and Khulna divisions.

Demographic characteristics

Age at marriage

Among the pregnant women in this study 69.8 percent married before the age of 18, the legal age of marriage of girls. In rural areas this was 69.5 percent among the studied females. In the urban areas the corresponding rate was 70.4 percent. When broken into slum and non-slum. While 68.3 percent of non-slum women married before 18 years of age, in urban slums 73.0 percent married before they reached 18 years of age. This is also higher than the rural areas. This shows that females married little earlier in urban slums than rural area counterparts and in rural areas they married little earlier than the urban non-slum males and females (Fig 8).

The situation is particularly bad in Sylhet and then in Rangpur, and in Rajshahi urban areas, and Dhaka and Khulna rural areas. The situation in Chittagong division as a whole, and in Dhaka and Khulna urban areas is better in case of males. Among females more married before 18 years of age in Rangpur rural areas, Rajshahi as a whole (especially in urban slums). Sylhet, Dhaka and Chittagong showed a better situation on marriage of women before the age of 18 years. Barisal slum and Khulna rural areas were bad in this regard.

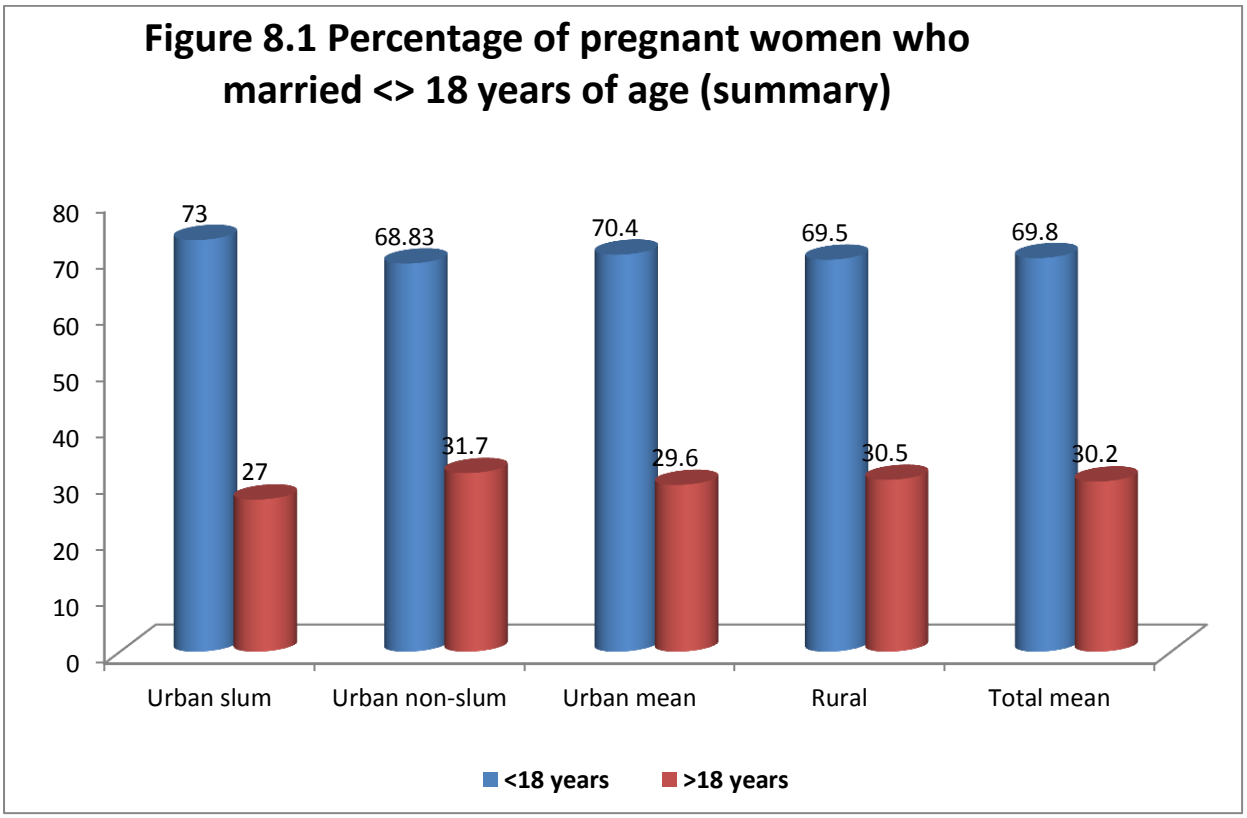
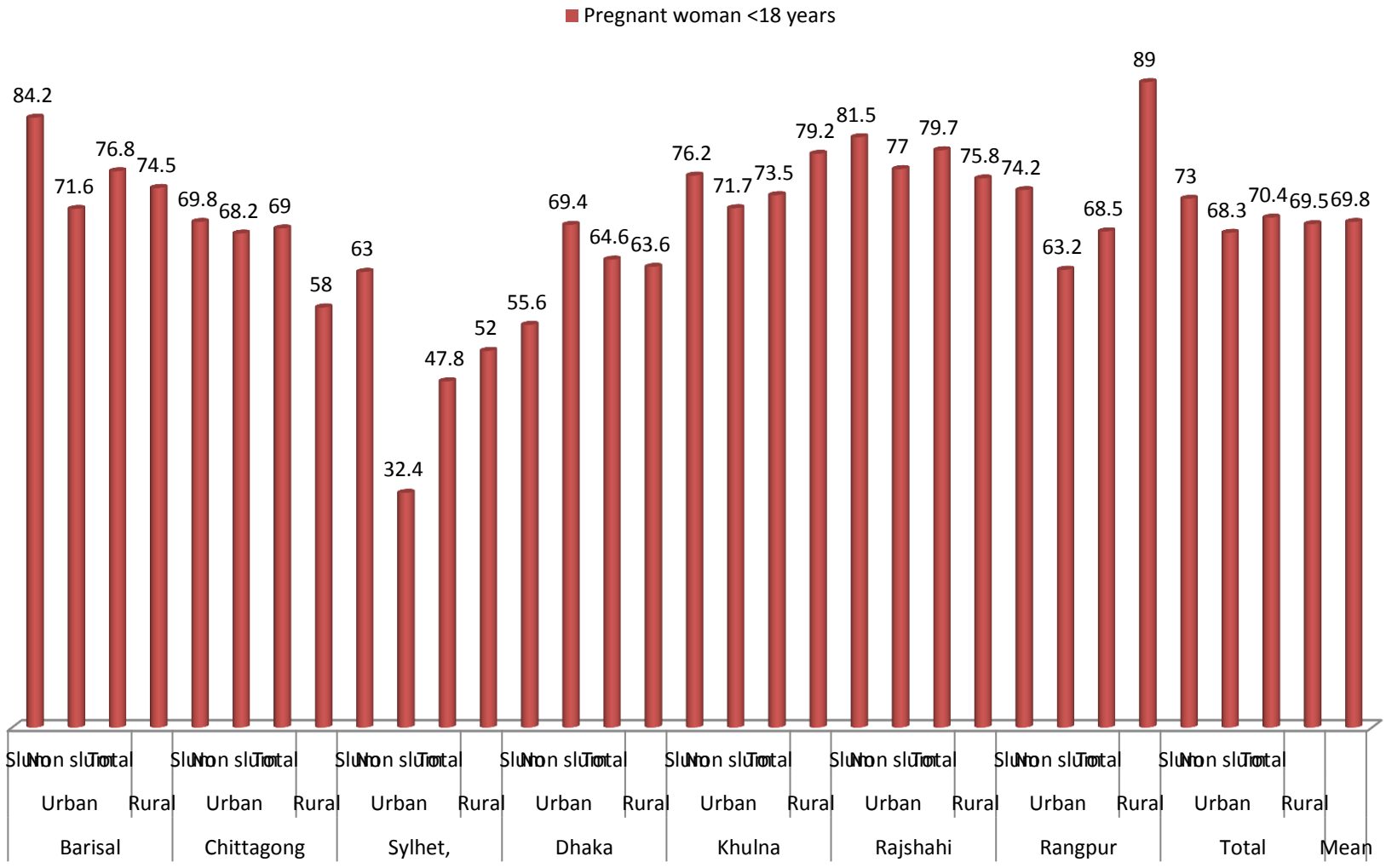


Fig 8.2 Age at marriage of pregnant women <18 years by division and urban (slum and non-slum) and rural areas (N=4,398)



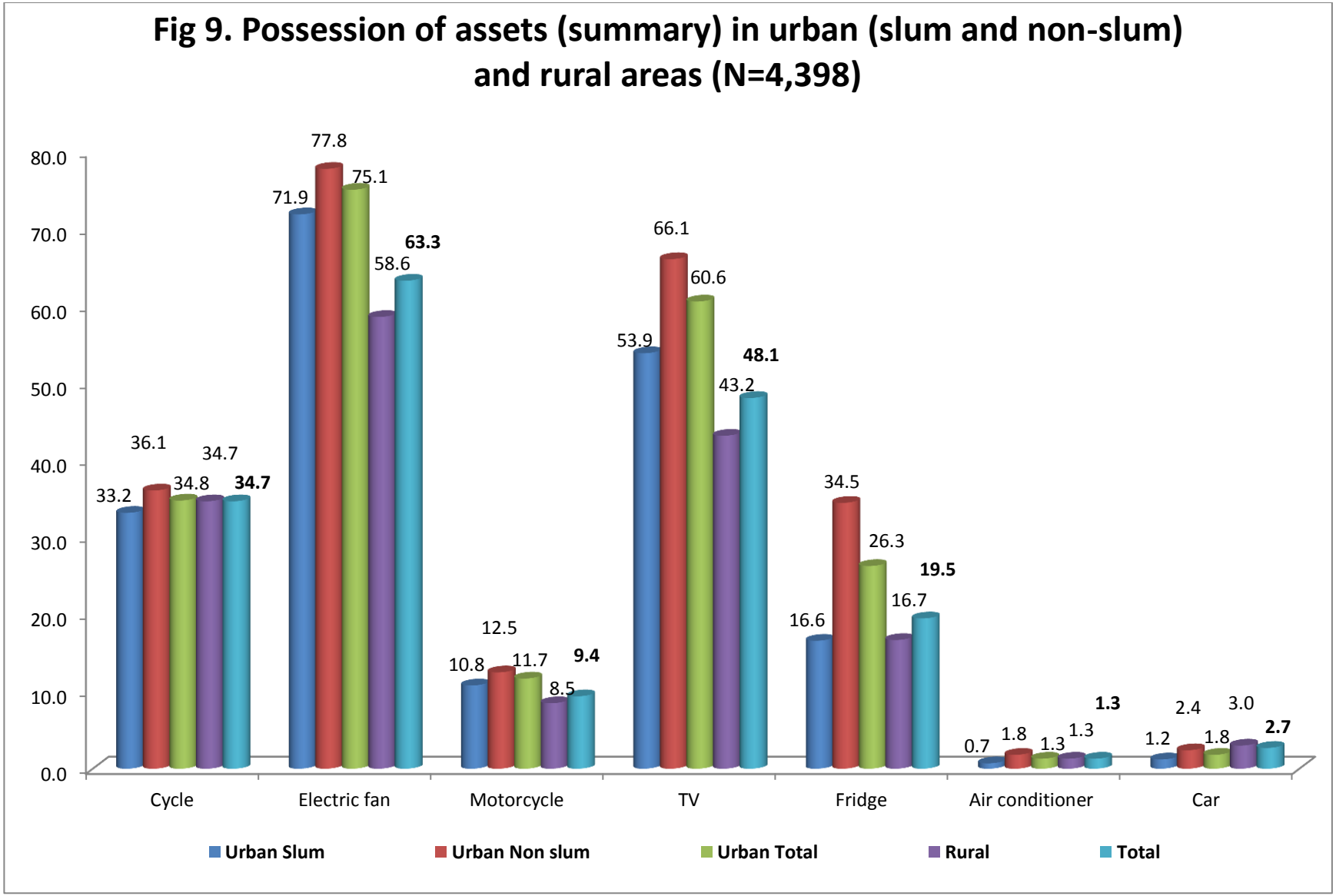
Economic condition

Among the studed families (N=4,398) 34.7 percent owned bycycle, 63.3 percent electric fan, 9.4 percent motorbyke, 48.1 percent television, 19.5 percent refrigerator, 1.3 percent air-conditioner and 2.7 percent motorcar (Fig 9). In rural areas the corresponding estimates were: 34.7 percent, 58.6 percent, 8.5 percent, 43.2 percent, 16.7 percent, 1.3 percent and 3.0 respectively for bycycle, electric fan, motorbyke, television, refrigerator, air-conditioner and motorcar. In urban areas the estimatesin aggregate was: 34.8 percent, 75.1 percent, 11.7 percent, 60.6 percent, 26.3 percent, 1.3 percent and 1.8 percent respectively and the breakdwon was 33.2 percent and 36.1 percent in slum and non slum areas respectively for bycycle; 71.9 percent and 77.8 percent for electric fan in slum and non slum areas respectively; 10.8 percent and 12.5 percent for motocycles respectively in slum and non-slum areas; 53.9 percent and 66.1 percent for television in slum and non-slum areas respectively; 16.6 percent and 34.5 percent for refrigerator in slum and non-slum areas; 0.7 percent and 1.8 percent air-conditioner in slum and non-slum areas respectively; and 1.2 percent and 2.4 percent motorcar in slum and non-slum areas respectively.

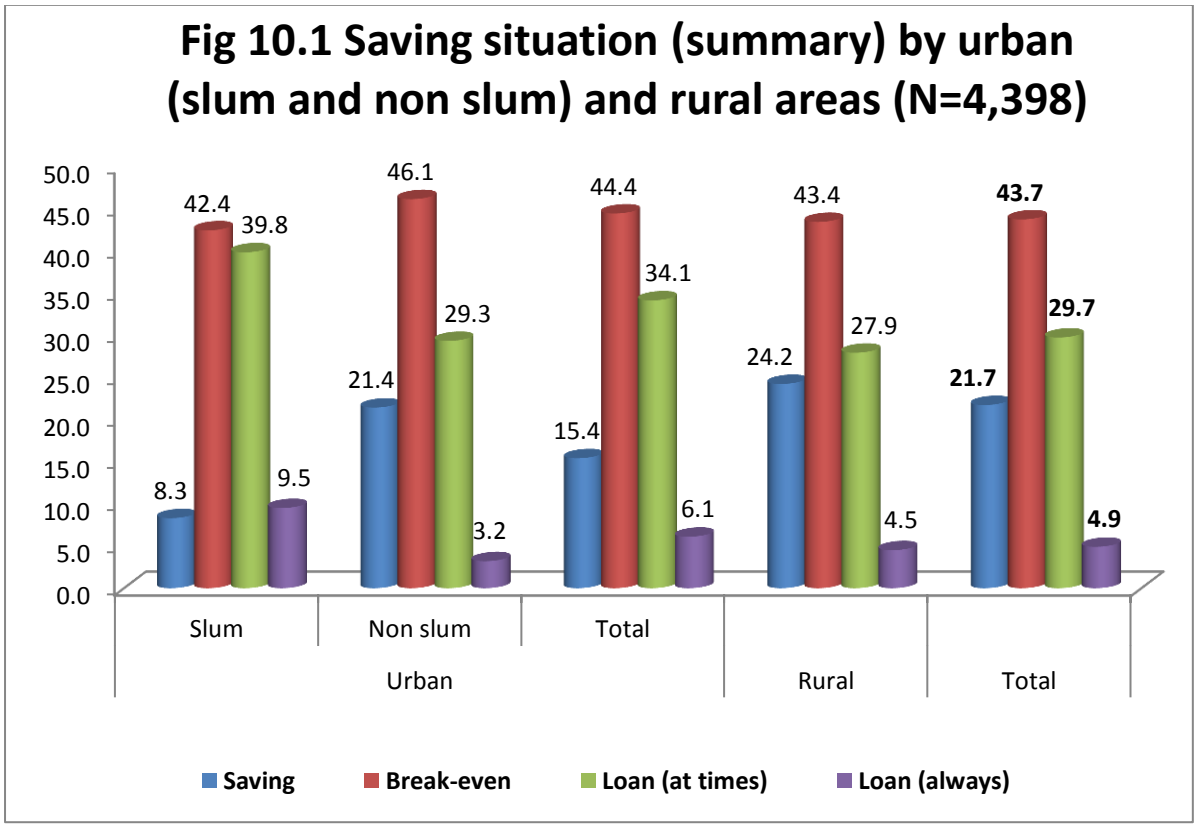
As may be seen, possession of motocar was more in rural areas than urban areas (3.0 percent to 2.4 percent respectively). Possession of air-conditioner was equal in urban and rural areas in this study. Possession of bycycle was also equal among urban and rural families. However, possession of electirc fan, motorbykes, refrigerator and television was more in urban areas. Except air-conditioner and motorcar all other possessions were more in urban slums than in rural areas. The possessiom of refrigerator was equal among these two locations.

No motorcar was possessed by the sampled families in Rajshahi urban areas. Families living in the slums of Barisal and Rangur did not possess any motorcar, while no sampled family in Rajshahi possessed motorcar. Highest number of Barisal urban and rural area families possessed motorcars (3.7 percent each). Chittagong slum families owned more motorcars than non-slums and rural areas (2.3 perccent, 0.7 percent and 2.0 percent respectively). Sylhet based slum families owned more motorcars (2.9 percent families), while in urban areas no sampled families owned motocars (in rural areas the possesion rate was 3.6 percent). In Khulna, Dhaka and Rangpur more families owned motocars and rural families owned more motorcar than urban slum families in these divisions. Families in urban areas of Barisal and Rajshahi did not possess any air-conditioner. Slum families in Sylhet, Rangur, Khulna and Chittagong also possessed air-condtioner, although less than the urban non slum areas (except in Chittagong and Rangpur, where less number of families had air-conditioners than in slums). Almost all rural areas had air-conditioners and more than urban slums except in Sylhet, where the estimates were equal. Slums in Barisal and Khulna had more refrigerator than rural areas. In Chittagong more rural families had refrigerator than urban areas. In Sylhet 68.6 percent urban non slum families had refrigerator. In Rangpur the poession of refrigerator was very low. But rural areas had more refrigerators than urban slums. In general urban non-slum families possessed more refrigerator.

Fig 9. Possession of assets (summary) in urban (slum and non-slum) and rural areas (N=4,398)



Saving situation



In total 21.7 perent, 43.7 percent, 29.7 percent, and 4.9 percent families had savings, were in break-even position, borrowed at times or had to borrow costantly respectively among the study families. In urban areas the correspnong figrues were: 15.4 percent (saving), 44.4 percent (break even), 34.1 percent (occasional borrowing) and 6.1 percent (constantly borrowing) respectively. The comparatively poor situation in urban areas was due to the poorer economic condition in urban slums. In urban slums 8.3 percent and in non-slum areas 21.4 percent families had savings, less thant in rural areas. Break even position was seen in 42.4 percent and 46.1 percent families in urban slums and non-slum areas, in comparison to 43.4 percent families in rural areas. In urban slums 39.8 percent and in non-slum areas 29.3 percent families had to borrow occasionally in comparison to 27.9 percent in rural areas. Constant borrowing was noted in 9.5 percent slum and 3.2 non-slum families in comparison to 4.5 families in rural areas (Fig 10.1).

Barisal, Rajshahi, Khulna and Dhaka in that order had the highes number of families who had to borro ocassionally. The occasionally borrowing families were the least in Rangpur and then in Chittagong, closely followed by Sylhet. Dhaka and Barisal urban areas had the highest number of families who needed to borrow constantly. Chittagong (urban and rural), and Sylhet and Khulna rural families also needed constant borrowing. Barisal, Dhaka and Rajshahi rural areas had the least number of families who needed constant borrowing (Fig 10.2 and 10.3).

Fig 10.2 Saving situation by division and urban (slum and non-slum) and rural areas (N=4,398)

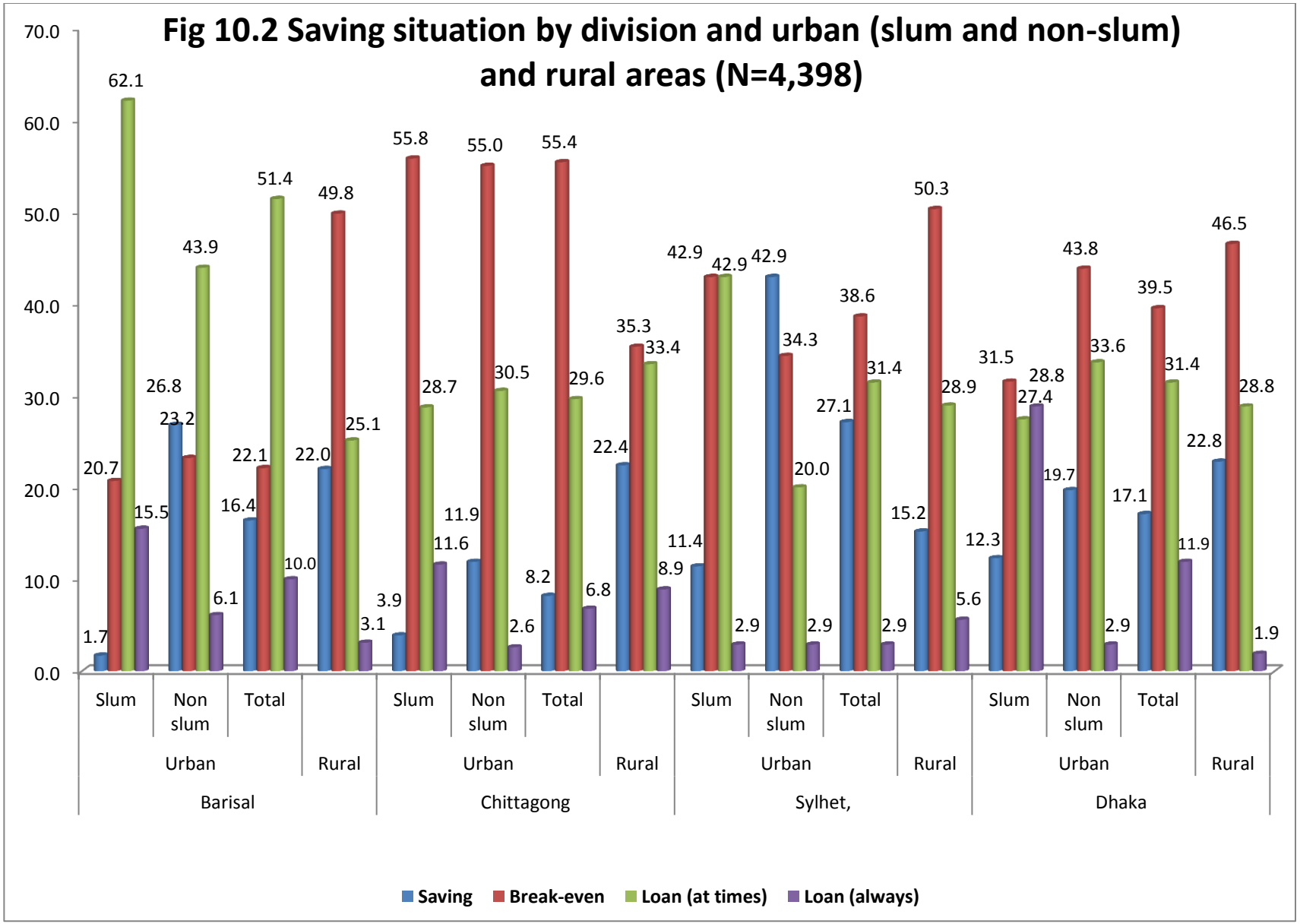
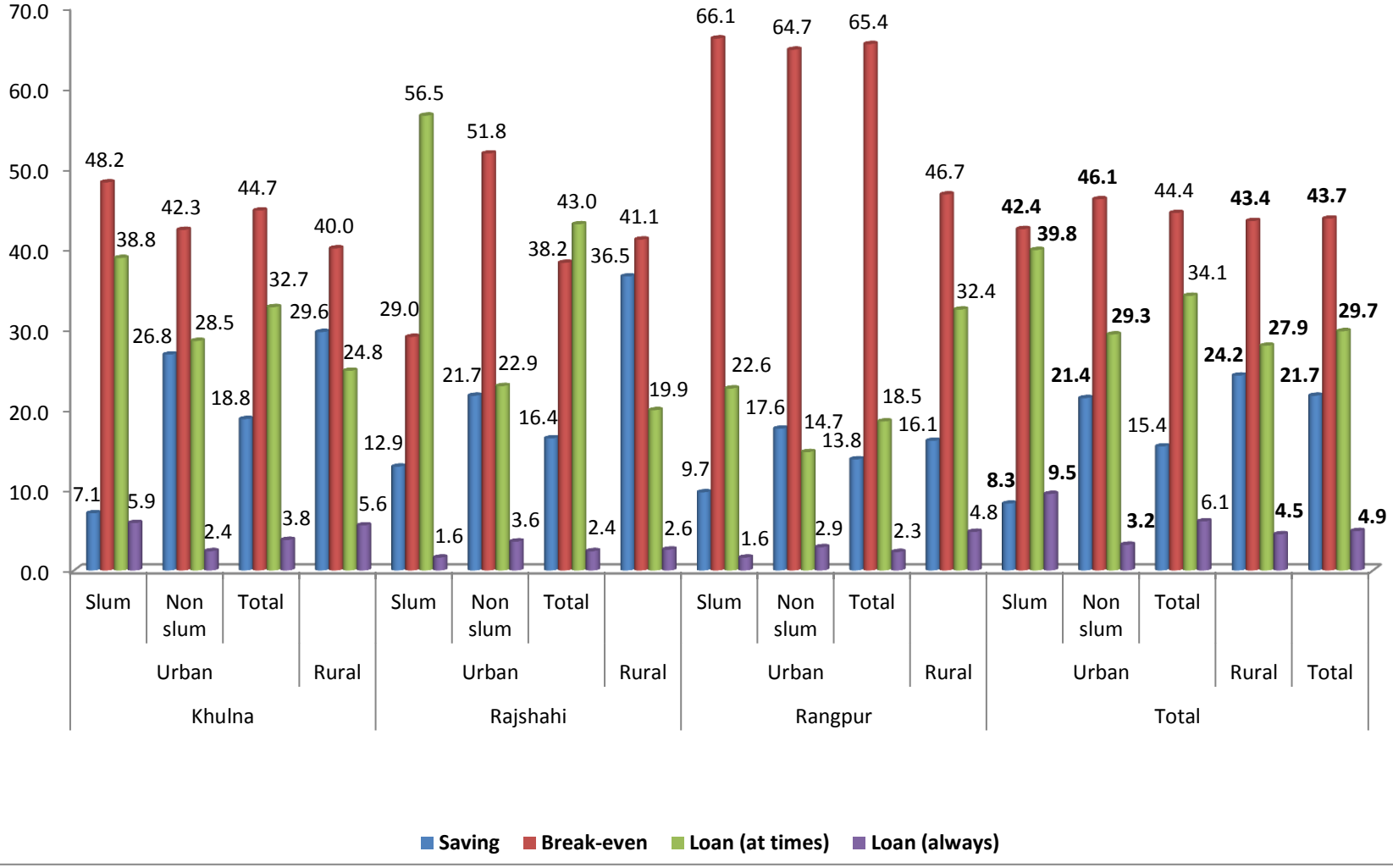


Fig 10.3 Saving situation by division and urban (slum and non-slum) and rural areas (N=4,398)



Nutritional practices

Family backyard gardening and horticulture

Among the studied families 41.0 percent, 35.6 percent, 31.1 percent, and 28.8 percent had backyard garden for leafy vegetables; solid vegetables, e.g., carrot, pumpkin; roots and tubers; and other vegetables, e.g., egg plant, tomato, ochre. The corresponding rural figures were: 44.8 percent, 38.8 percent, 33.6 percent and 30.4 percent and the urban figures were: 31.5 percent, 27.5 percent, 24.6 percent and 24.6 percent respectively for leafy vegetables; solid vegetables, e.g., carrot, pumpkin; roots and tubers; and other vegetables, e.g., egg plant, tomato, ochre- lower than the rural estimates. In urban non-slums the commensurate figures were 31.8 percent, 27.7 percent, 25.2 percent and 25.6 percent. Urban slums had equal number of families with backyard garden for leafy vegetables and solid vegetables, e.g., pumpkins. The number of families in urban slums were less in comparison to non-slums, in the areas of cultivation of tubers and other vegetables, e.g., egg plant, tomato, ochre (Fig 11.1 and 11.2).

The number of families who had courtyard/ backyard horticultural trees among the study population, were as follows (Table1).

Table 1. Fruit trees in family garden

Family fruit trees	Urban areas			Rural areas	Average
	Slum areas	Non-slum areas	Total urban areas		
Papaya	46.8	58.9	53.5	56.4	55.8
Banana	35.2	44.9	40.5	55.5	52 7
Kul/Baroi	21.9	36.8	30.1	41.5	39.4
Lemon	20.6	27.7	24.5	39.0	36.3
Mango	44.2	53.0	49.0	66.4	63.1
Pine apple	6.0	9.5	7.9	16.6	15.0
Water melon	7.3	16.8	12.5	19.7	18.3
Guava	35.2	49.8	43.2	58.8	55.9
Jackfruits	26.2	38.6	33.0	54.3	50.3
Blackberry	18.5	20.0	19.3	29.6	27.7

As would be expected, more rural households had all categories of fruit trees than urban families, in particular those of mangoes, guava, papaya, banana, jackfruits, jujube (kool) and lemon. In urban non-slum areas again, more families had fruit trees (for all kinds) than in urban slums, which obvsiously had space limitation.

Figure 11.1 Backyard kitchen garden by division and urban (slum and non-slum) and rural areas (N=4,398)

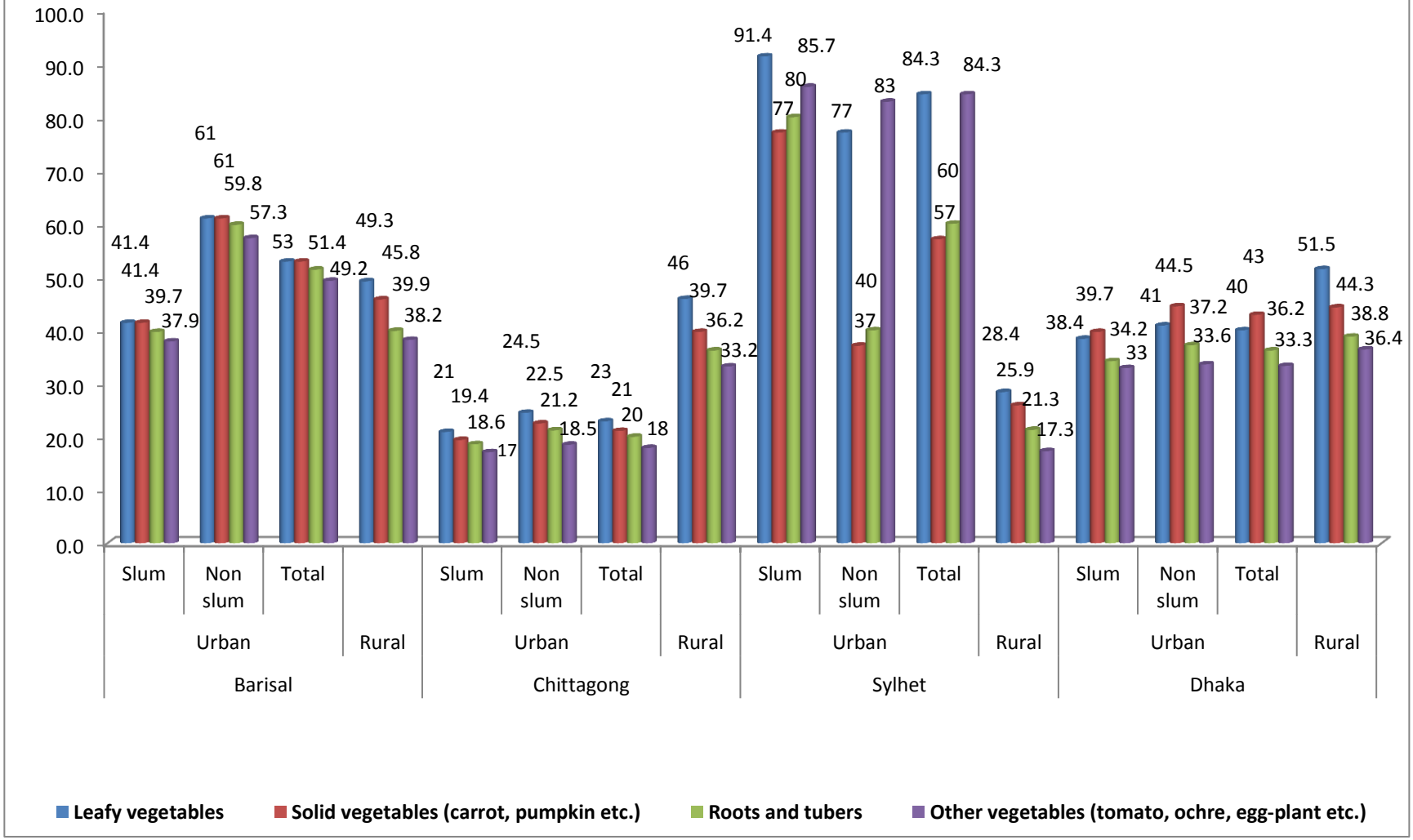
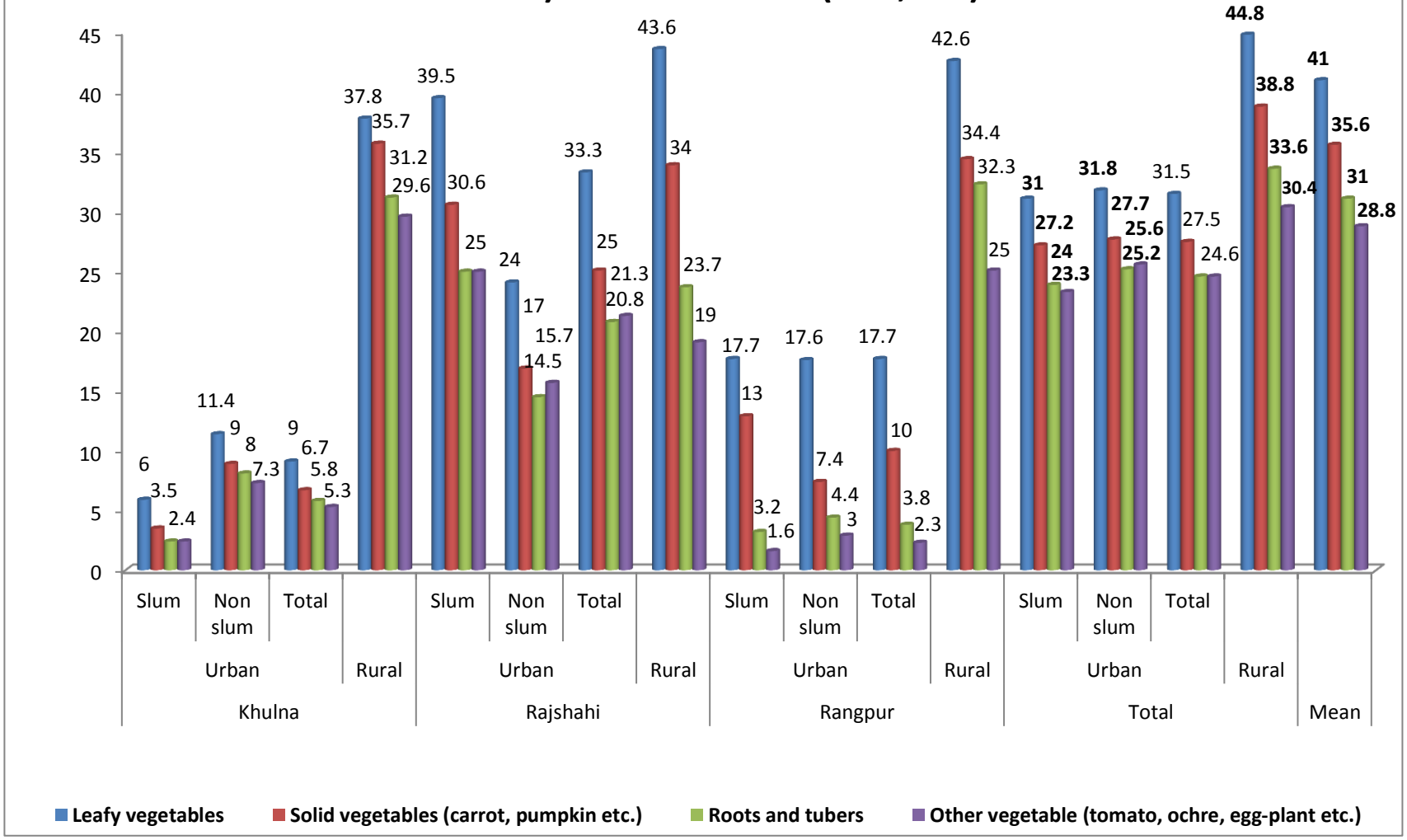
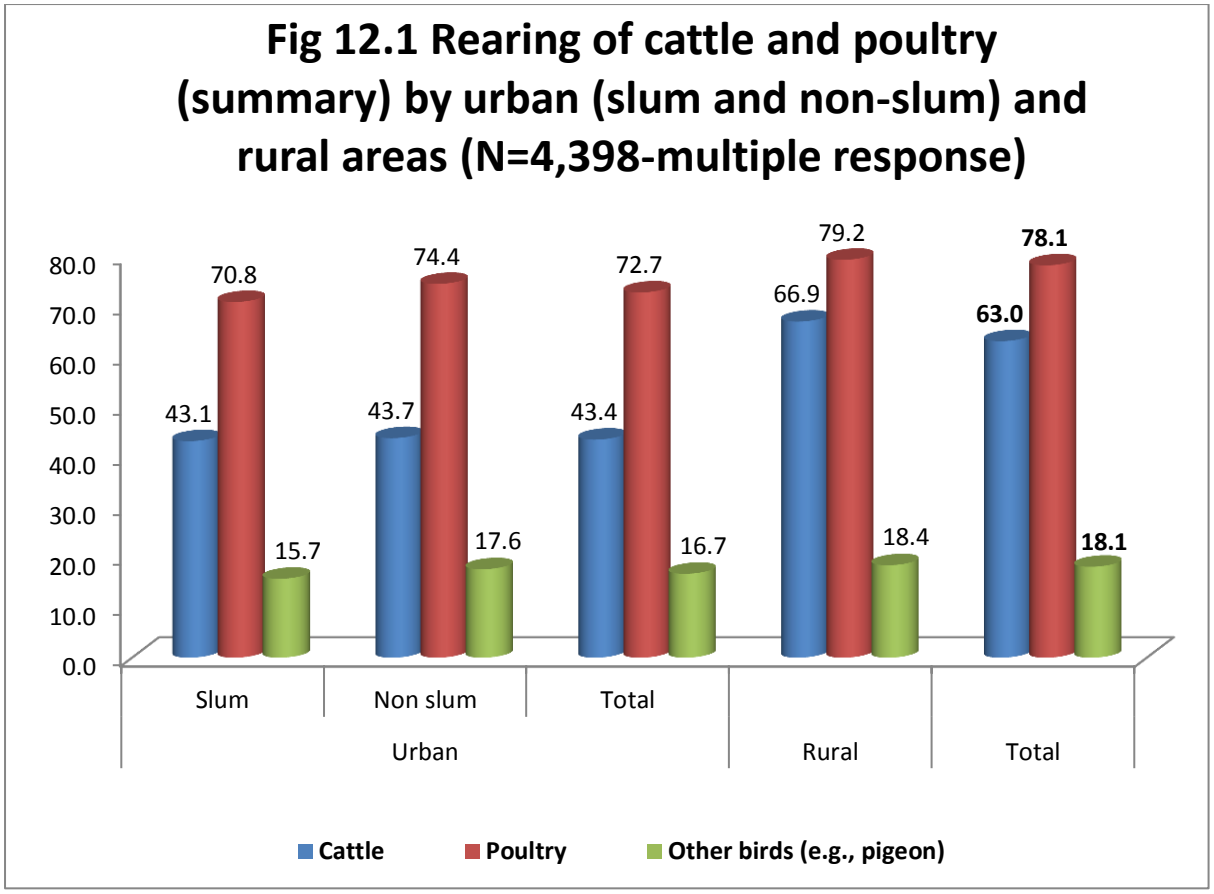


Fig 11.2 Backyard kitchen garden by division and urban (slum and non-slum) and rural areas (N=4,398)



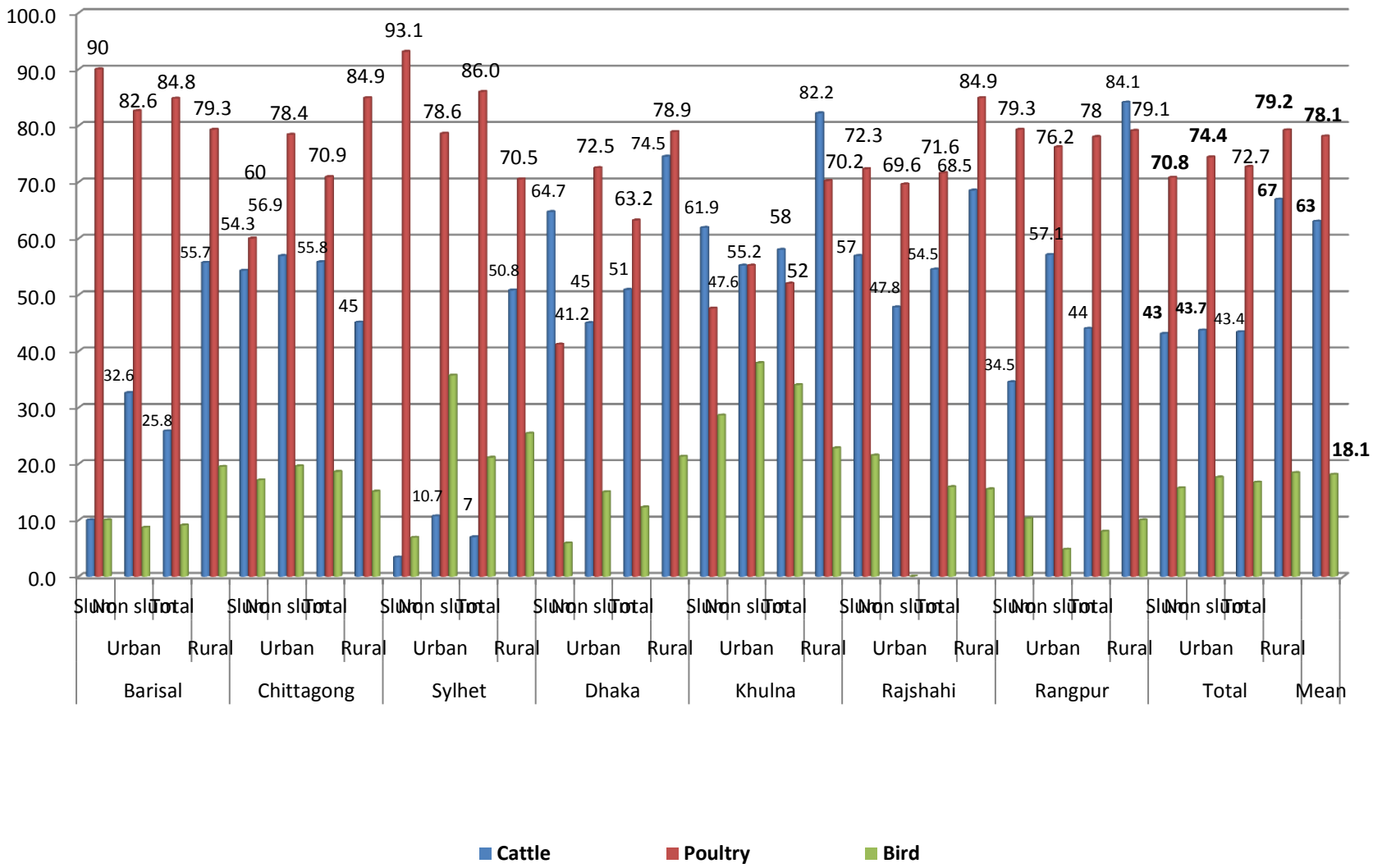


Rearing of animals and birds

Sixty three percent of the studied families were found rearing cattle, 78.1 percent poultry and 18.1 percent (multiple responses). In the rural areas the percentages were: 66.9; 79.2; and 18.4 respectively (Fig 12.1). In urban areas the corresponding percentages were: 43.4; 72.7 and 16.7 respectively. The urban area breakdown into slums and non-slums shows that the number of non-slum households which are rearing these animals and birds are slightly higher in number than the slum families, in particular for poultry and other birds.

Cattle rearing was more in Dhaka, Khulna and Rajshahi, especially in slums, however, the highest number of families were rearing the cattle in Rangpur, Khulna and Dhaka and then in Rajshahi rural areas in that order. Rearing of the cattle was lowest in Sylhet urban areas and little lower than other divisions in the rural areas of Chittagong. Chittagong and Rajshahi had the highest number of families rearing poultry. Rangpur, Barisal and Dhaka families were also rearing poultry more than the families in other divisions (Table 12.2).

Fig 12.2 Rearing of cattle and poultry by division, urban (slum and non-slum) and rural aread (N=4,398)



Feeding practices

Consumption of fish was higher in the second trimester than the first – 45.3 percent to 46.9 percent respectively. This trend was however, not universal. Although the highest consumption was seen in Dhaka, Chittagong and Barisal divisions, in Dhaka division the first trimester consumption was more in urban areas and in the rural areas of Chittagong. In Sylhet and Rangpur divisions first trimester consumption was more in both urban and rural areas. When amount of fish was inquired about, the first term consumption was way above the last trimester consumption in urban areas and slightly more in rural areas. In Rajshahi division as a whole and in the rural areas of Rangpur the consumption was better in rural areas in the first trimester. On average however, the amount was stated to be good only in 14.5 percent and 16.6 percent of the first trimester and the third trimester respectively (Fig 13.1).

Meat was consumed by 34.9 percent and 29.3 percent of the pregnant women in the first trimester and the third trimester respectively, which shows a fall in the third trimester, except in Dhaka and Khulna urban areas. Amount-wise only 19.1 percent and 18.9 percent of them consumed good amounts of meat. The situation was comparatively better in Dhaka, Khulna, Chittagong, Barisal and Sylhet. But except in Chittagong, Sylhet and Rangpur divisions as a whole and in Barisal rural and Khulna urban areas, in all other places first trimester consumption was more by amount (Fig 13.2).

Egg consumption was more in the first trimester on average 36.0 percent to 34.0 percent, highest being in Khulna and Rajshahi and the least in Rangpur and Barisal. Only in Chittagong, Sylhet, Dhaka, Khulna and Rajshahi urban areas the third trimester egg consumption was better. Amount-wise consumption in the third trimester in Barisal, Khulna, Chittagong and Rangpur was better and so also in the urban areas of Dhaka and Rajshahi. On average 17.9 percent and 22.8 percent of the pregnant women had good amount of eggs in the first and the third trimester of pregnancy respectively (Fig 13.3).

Milk consumption was reported by 27 percent and 25.2 percent of the pregnant women (Fig 13.4). Consumption was poor in Barisal, Sylhet and Rangpur. Except in Chittagong divisions as a whole and Dhaka and Rajshahi rural areas consumption was more in the first trimester. Amount-wise Rajshahi division showed the poorest condition, followed by Sylhet, Chittagong and Khulna urban areas. By and large the third trimester consumption was good in Rangpur, Barisal and Sylhet rural, and in Dhaka, Rajshahi and Chittagong urban areas, although Chittagong and Khulna urban and Rajshahi rural areas had very small number of pregnant women who had good amount of consumption.

Almost the same number of pregnant women consumed fruits in the first and the third trimester- 29.3 percent and 29.2 percent respectively (Fig 13.5). Consumption as a whole in Rangpur and Sylhet rural areas and then in Rajshahi urban areas in that order was the least. Consumption was higher in the third trimester in Barisal, Sylhet and Dhaka divisions, particularly in the urban areas, Chittagong rural areas, and Khulna and Rajshahi urban areas. Amount of consumption-wise only 19.4 percent and 19.9 percent pregnant women were good in the first and the third trimesters respectively. Only Barisal and Chittagong showed a higher amount in the third trimester, followed by Rajshahi and Rangpur urban areas. In rural areas of Rajshahi, and urban areas of Dhaka and Khulna, the least number of pregnant women reported to have good amount of fruits.

Consumption of vegetables (Fig 13.6) was good, although slightly less in the third trimester- 70.4 percent by 67.8 percent respectively. Least amount of vegetables was consumed in Sylhet division as a whole and the most in Barisal and Rajshahi. Third trimester consumption was better than the first trimester in urban areas of Rangpur and Chittagong and rural areas of Barisal, Rajshahi and Khulna.

Amount-wise the third trimester consumption was better than the first trimester in general (29.1 percent versus 34.1 percent respectively). Except in the Dhaka division as a whole and Rajshahi urban areas in all other areas the third trimester amount of consumption was more but in Sylhet the overall number of families was very few.

Among the families which took less than 2 liters of cooking oil per month 33.3 percent took this amount in the first trimester, while 32 percent took it in the third trimester (Fig 13.7). Highest number of families in this category were in Sylhet and Rangpur and the least number were in Rajshahi, Khulna and Chittagong. Only in Rangpur as a whole and Sylhet urban, and Khulna rural families showed a higher level of consumption in the third trimester. Among those families which took more than 2 liters of cooking oil per month per family 66.6 percent and 68.2 percent took this in the first and second trimester respectively. The number of Families in Rangpur and Sylhet were the least who took more than 2 liters of cooking oil per month per family. Families who took more oil in the third trimester belonged to Sylhet and Rajshahi (small increase) divisions as a whole, and in Barisal, Chittagong, Dhaka rural, and Khulna urban areas.

By and large, no substantial difference was seen among the pregnant women studied, with regard to their consumption of different types of food between the first and the third trimester and the amount of nutritious food taken during pregnancy can hardly be termed as adequate.

Fig 13.1.1 Consumption of fish by division and urban (slum and non-slum) and rural areas (N=4,398)

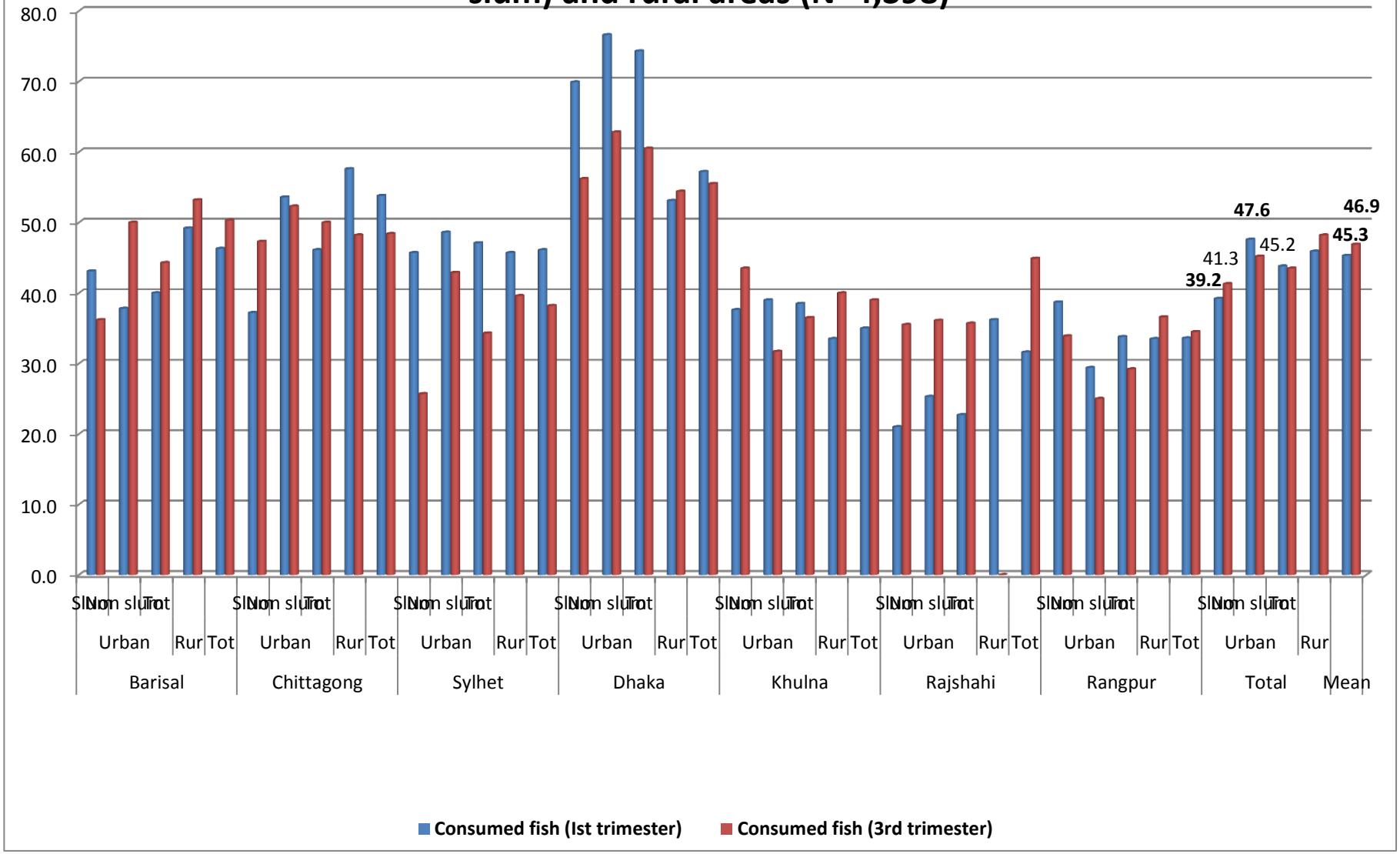


Fig 13.1.2 Amount of fish consumed by division and urban (slum and non-slum) and rural areas (N=4,398)

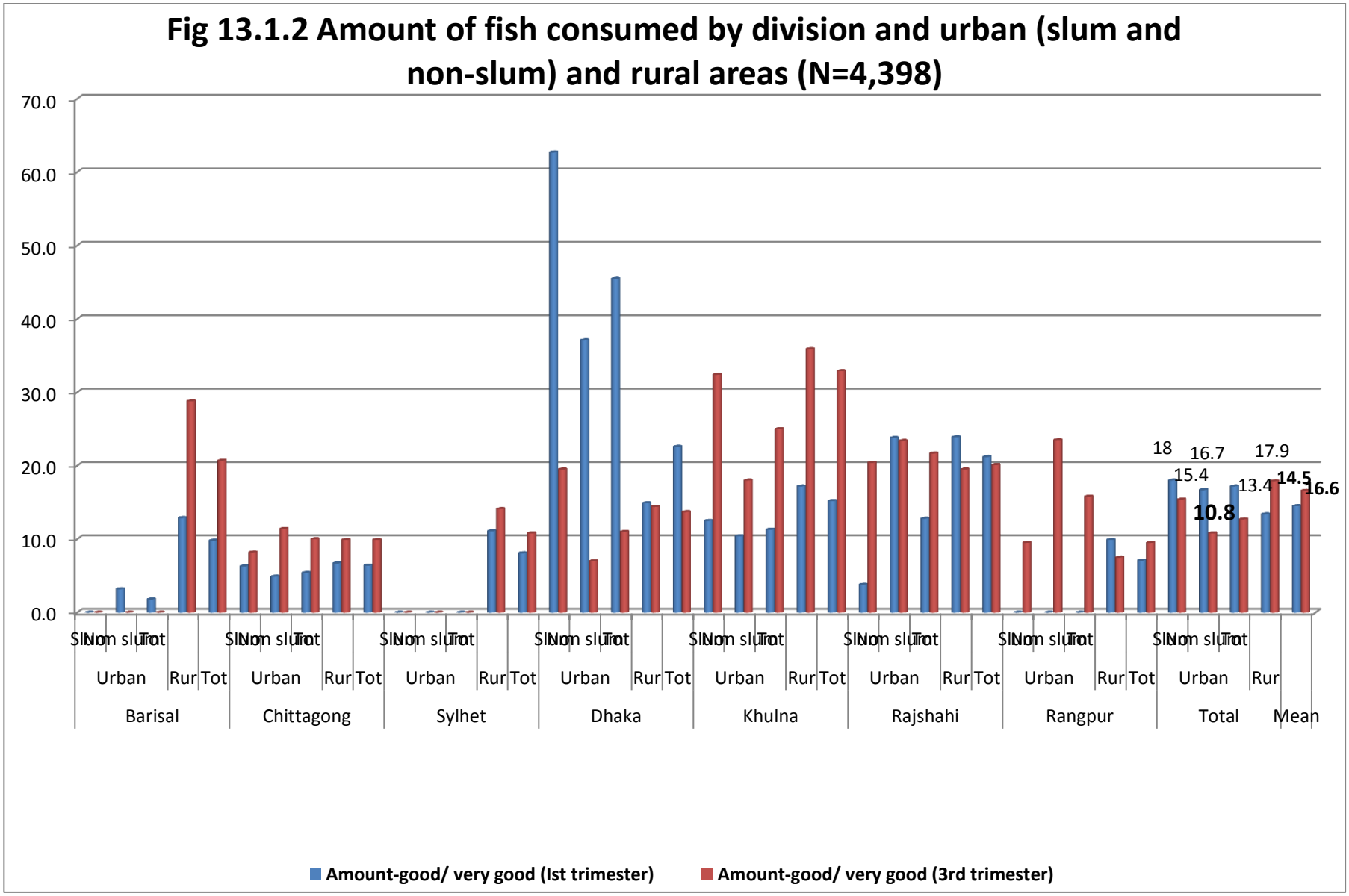


Fig 13.2.1 Consumption of meat by division and urban (slum and non-slum) and rural areas (N=4,398)

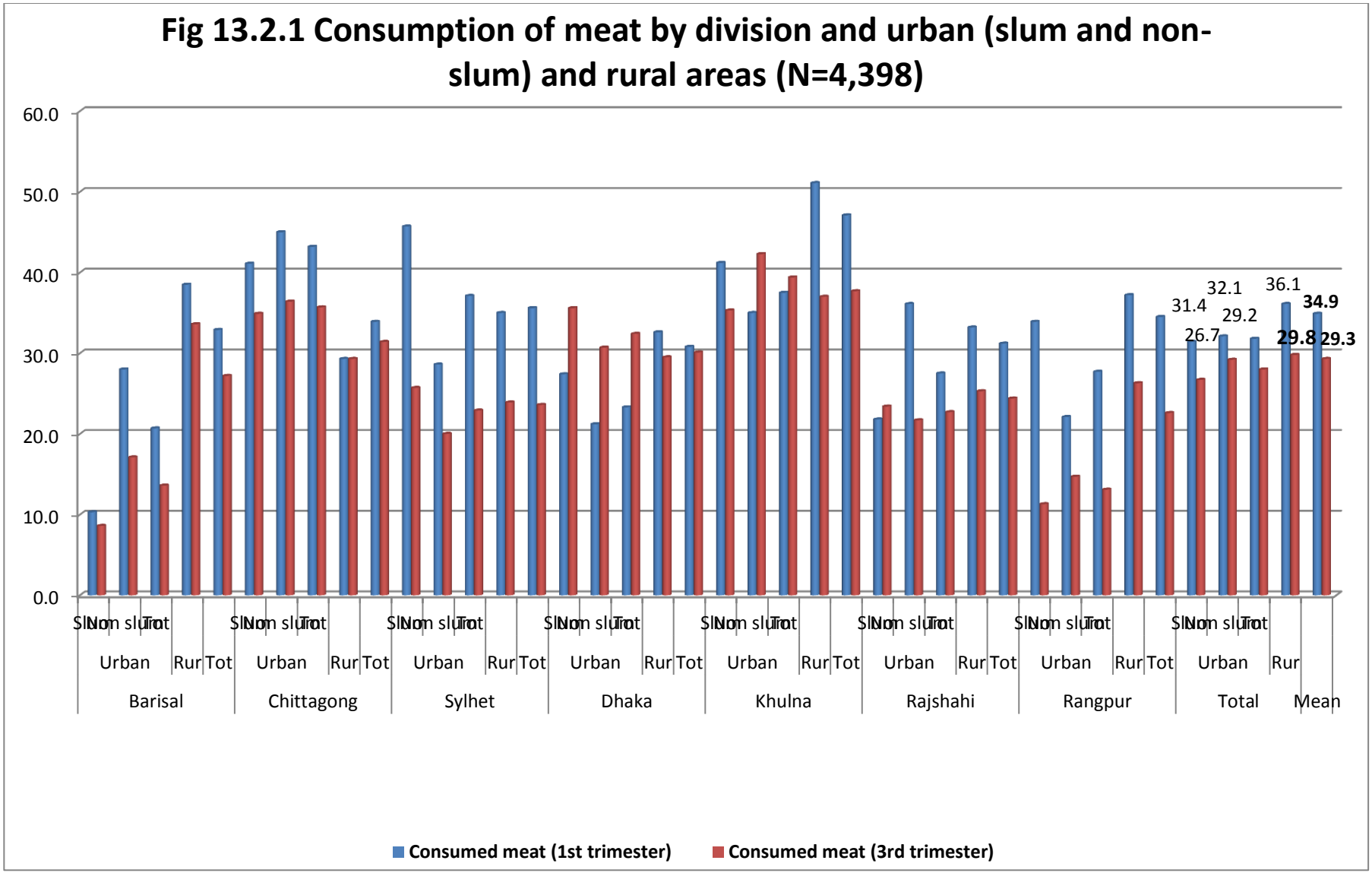


Fig 13.2.2 Amount of meat consumed by division and urban (slum and non-slum) and rural areas (N=4,398)

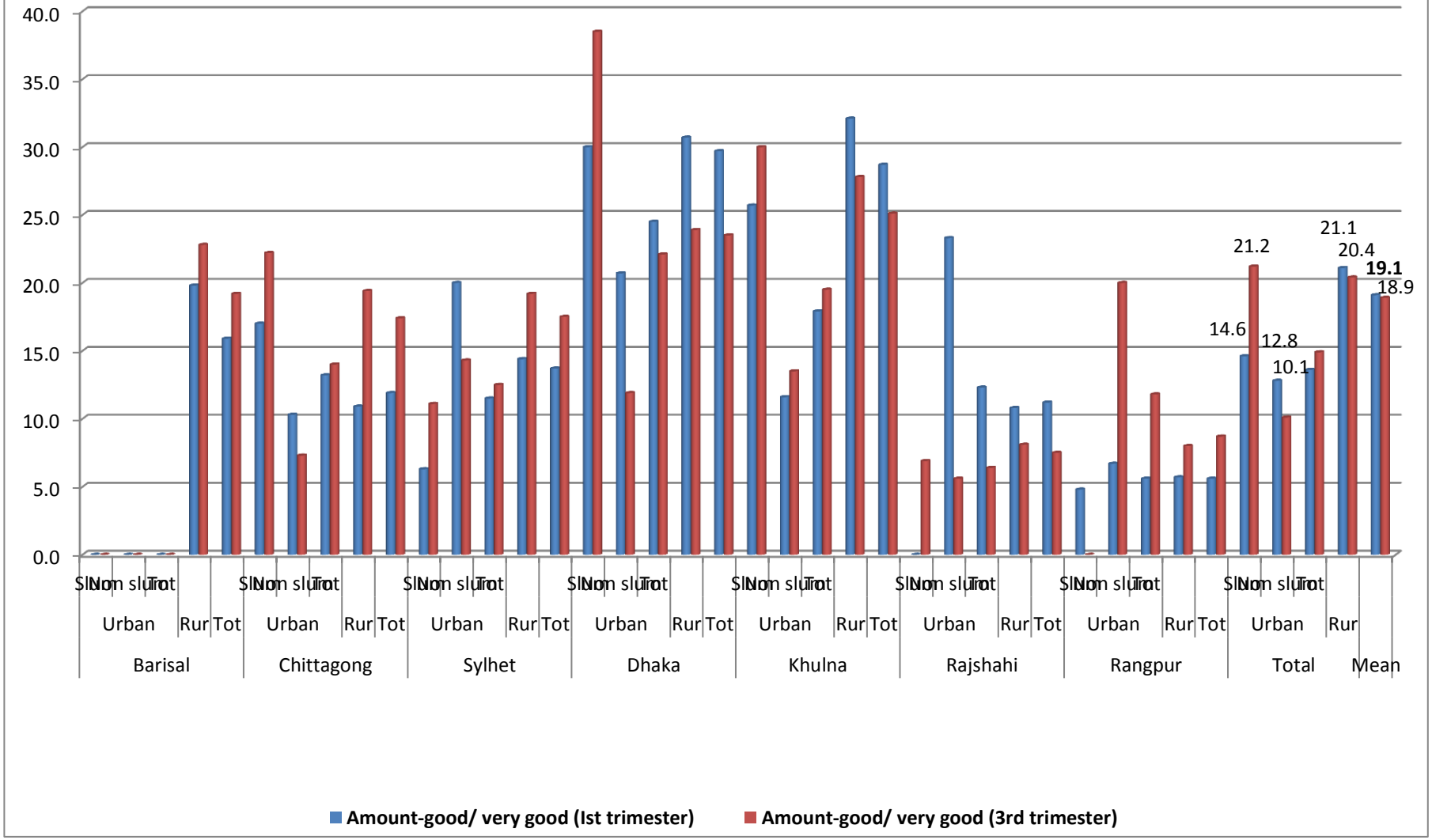


Fig 13.3.1 Consumption of egg by division and urban (slum and non-slum) and rural areas (N=4,398)

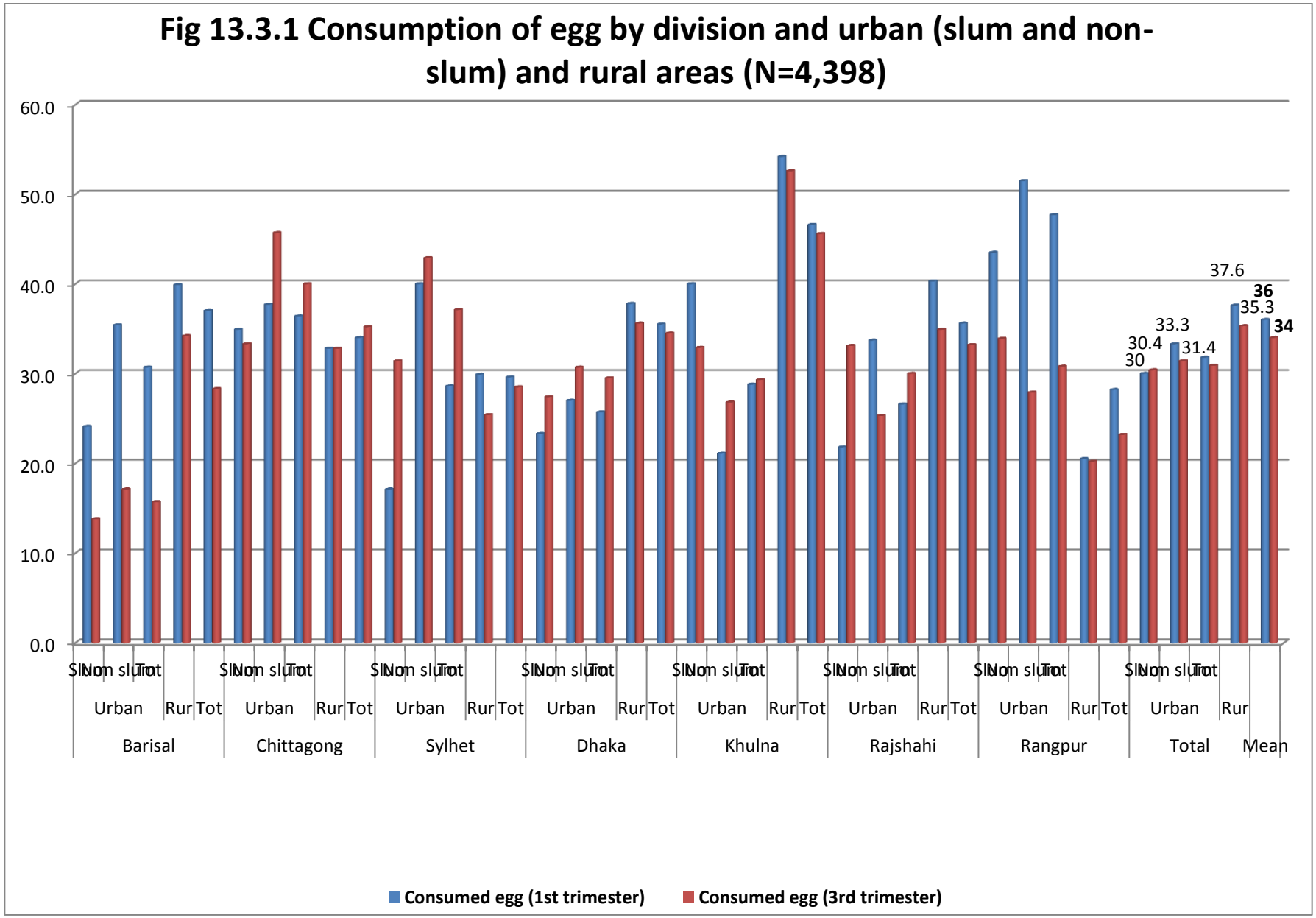


Fig 13.3.2 Amount of egg consumed by division and urban (slum and non-slum) and rural areas (N=4,398)

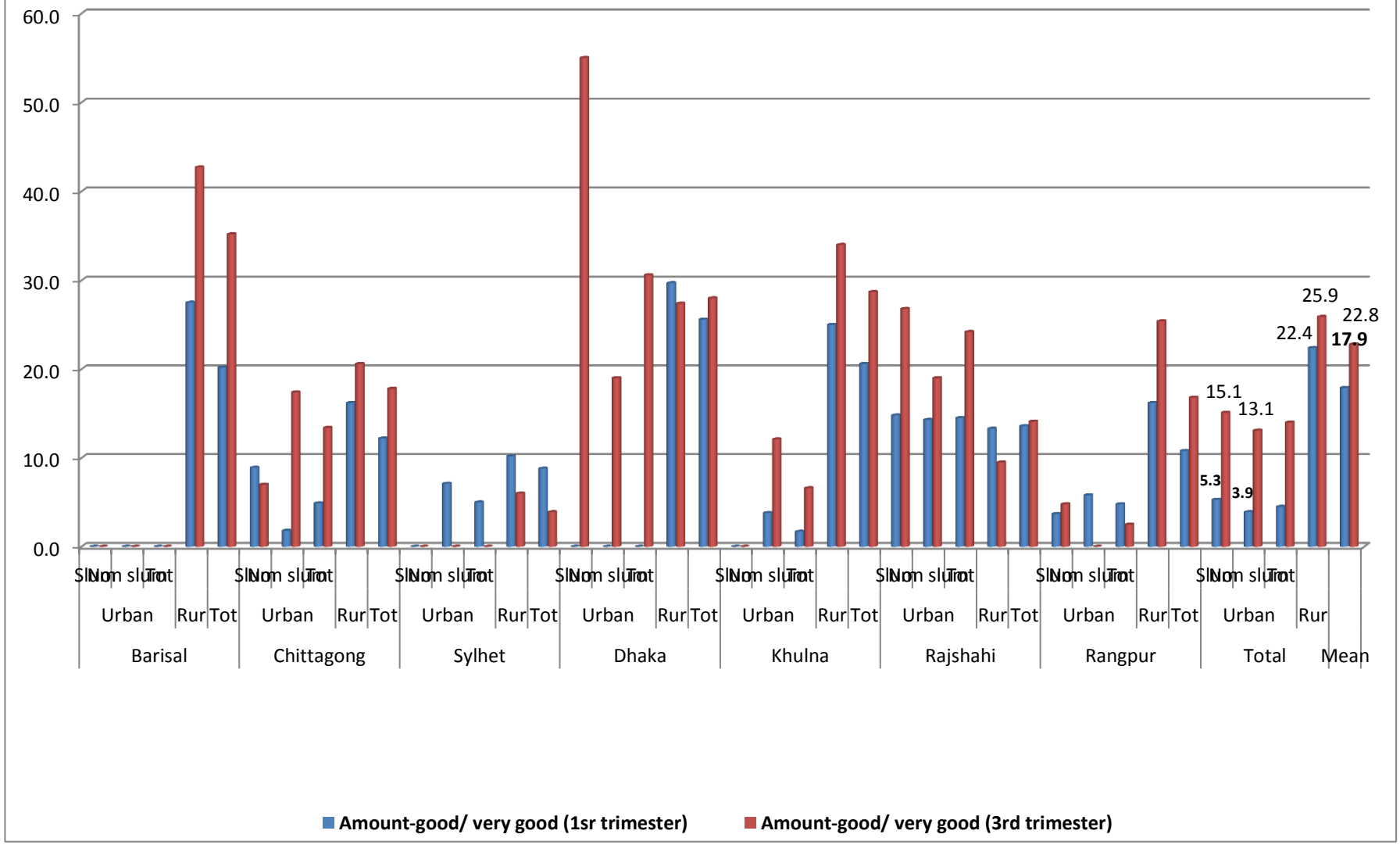


Fig 13.4.1 Consumption of milk by division and urban (slum and non-slum) and rural areas (N=4,398)

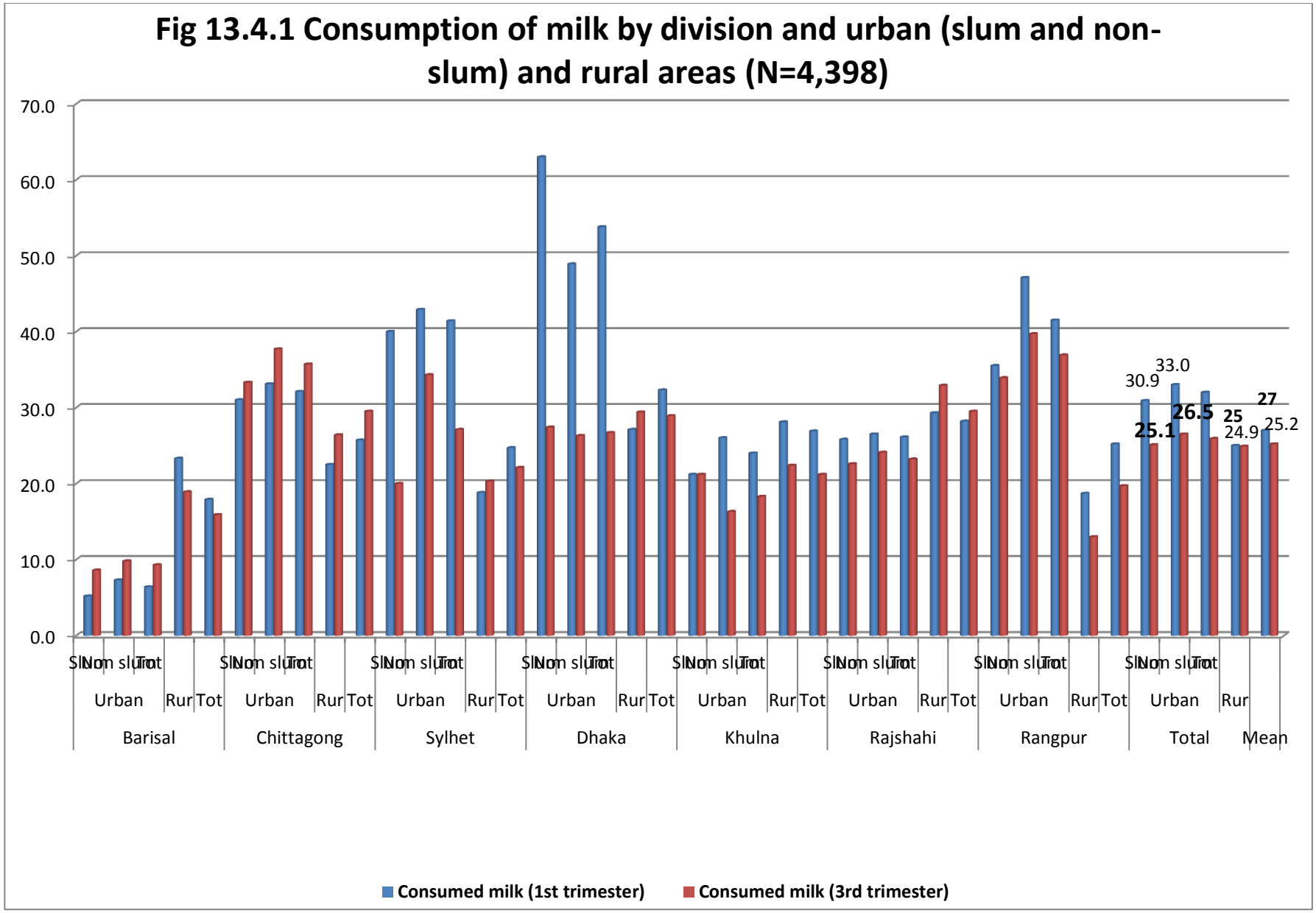


Fig 13.4.2 Amount of milk consumed by division and urban and rural areas (N=4,398)

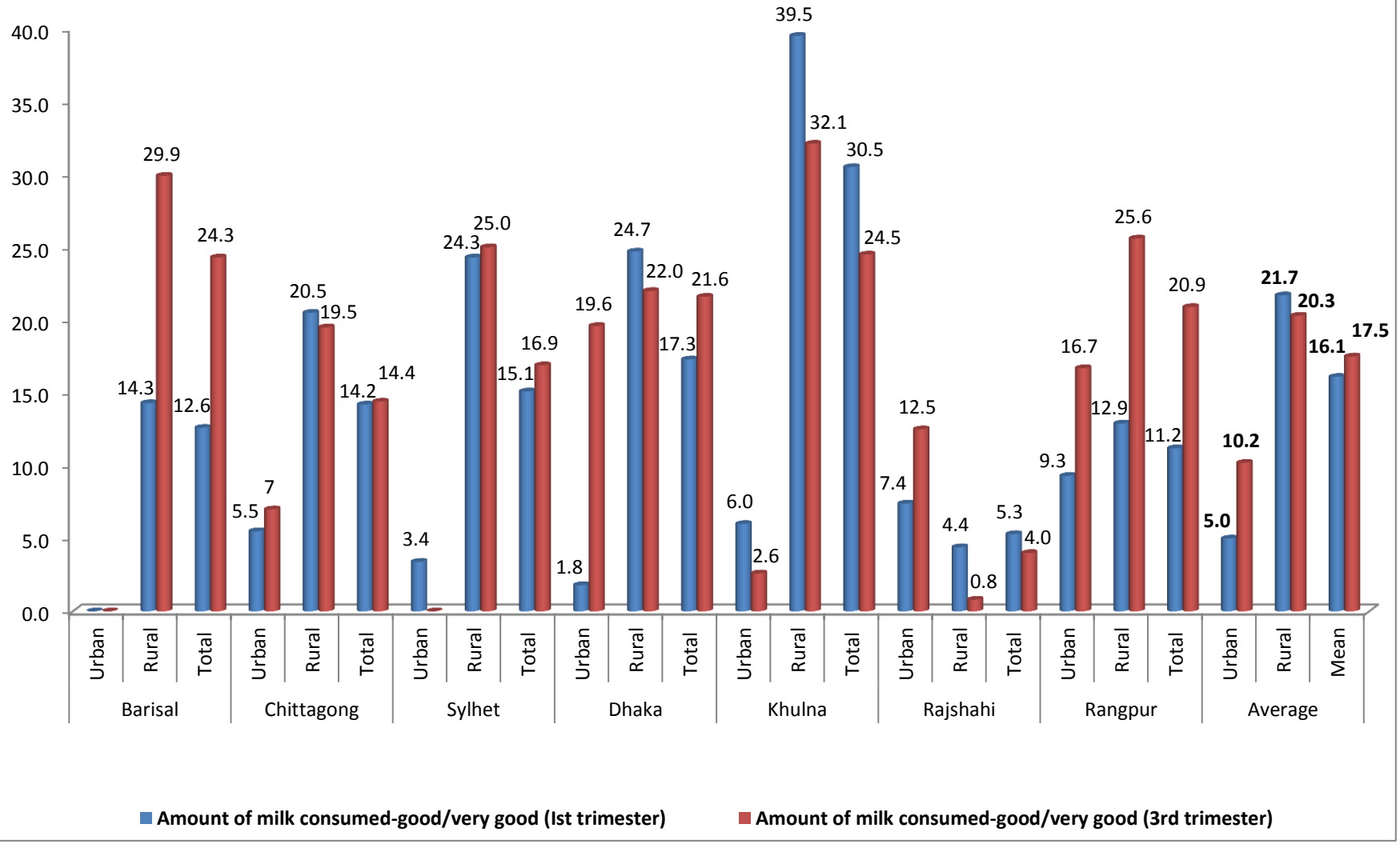


Fig 13.5.1 Consumption of fruits by division and urban and rural areas (N=4,398)

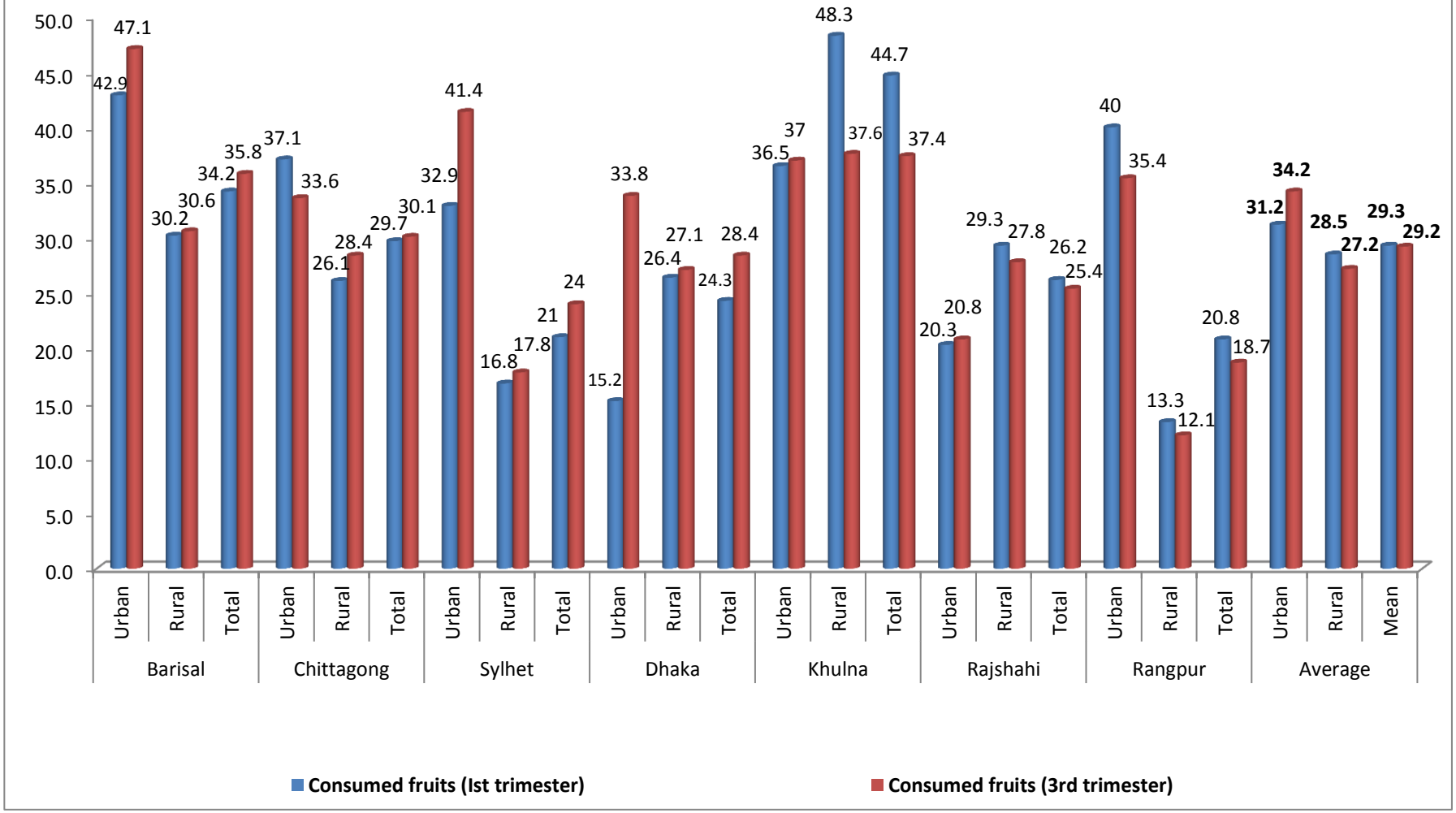


Fig 13.5.2 Amount of fruit consumed by division and urban and rural areas (N=4,398)

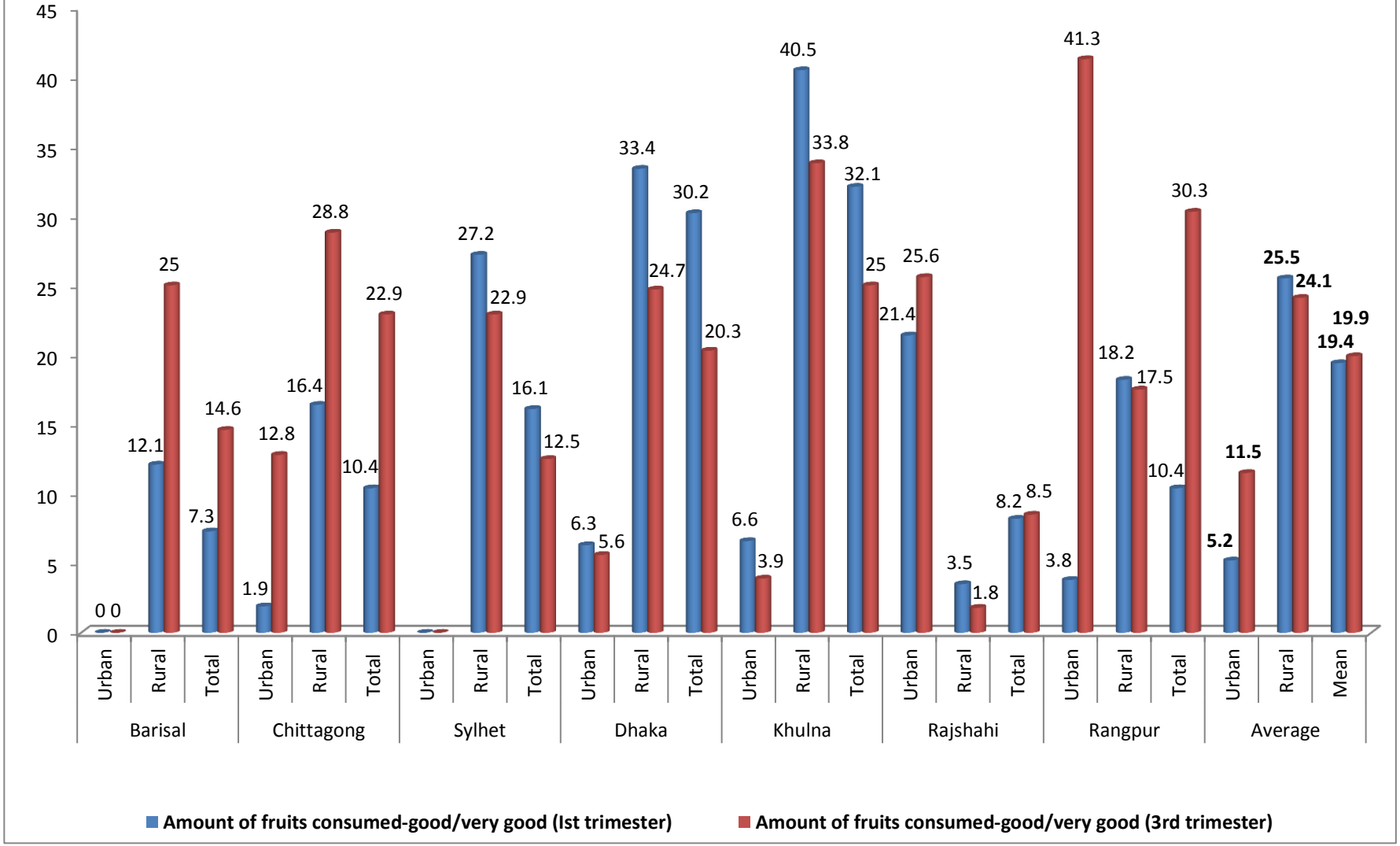


Fig 13.6.1 Consumption of vegetables by division and urban and rural areas (N=4,398)

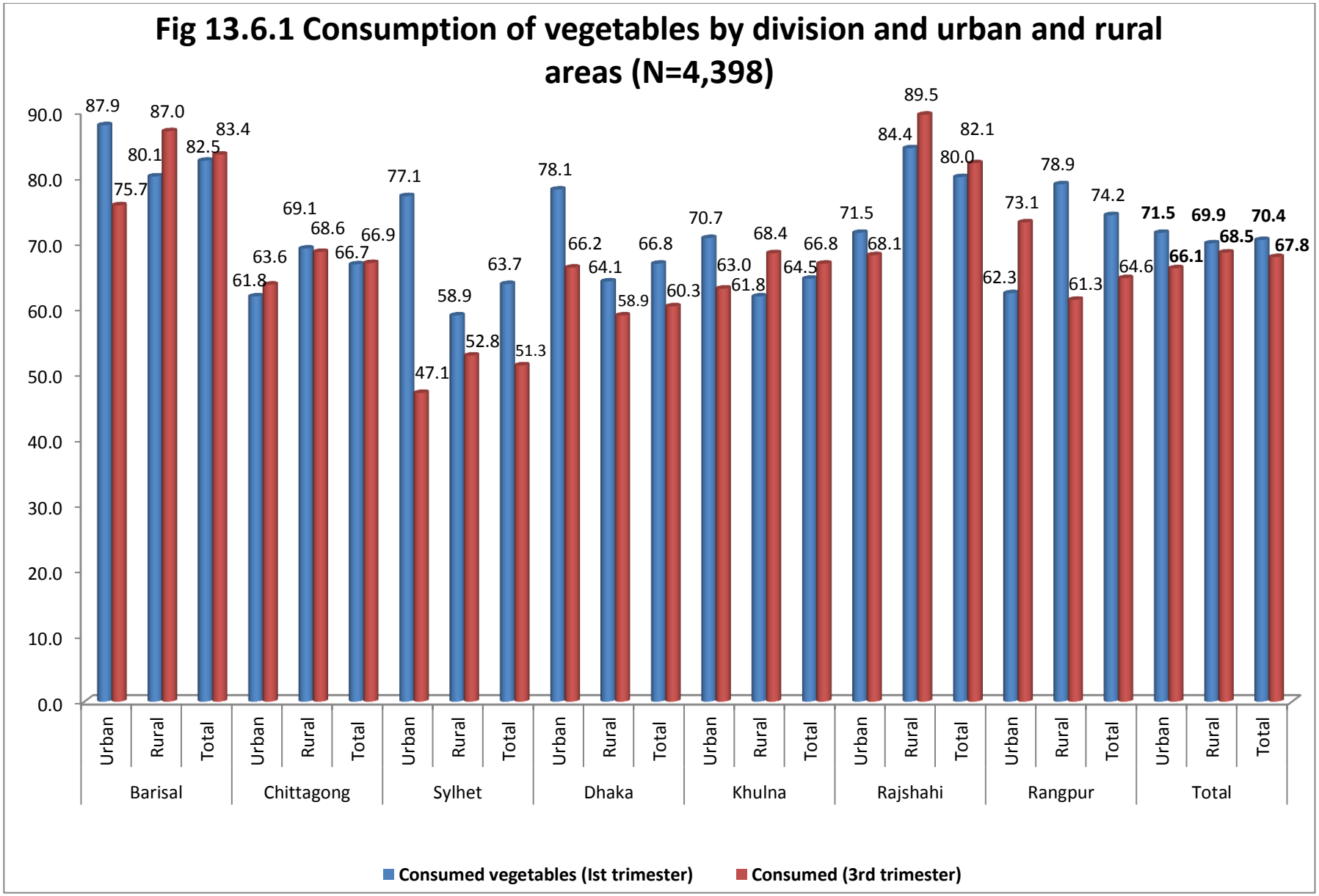


Fig 13.6.2 Amount of consumption of vegetables by division and urban and rural areas (n=4,398)

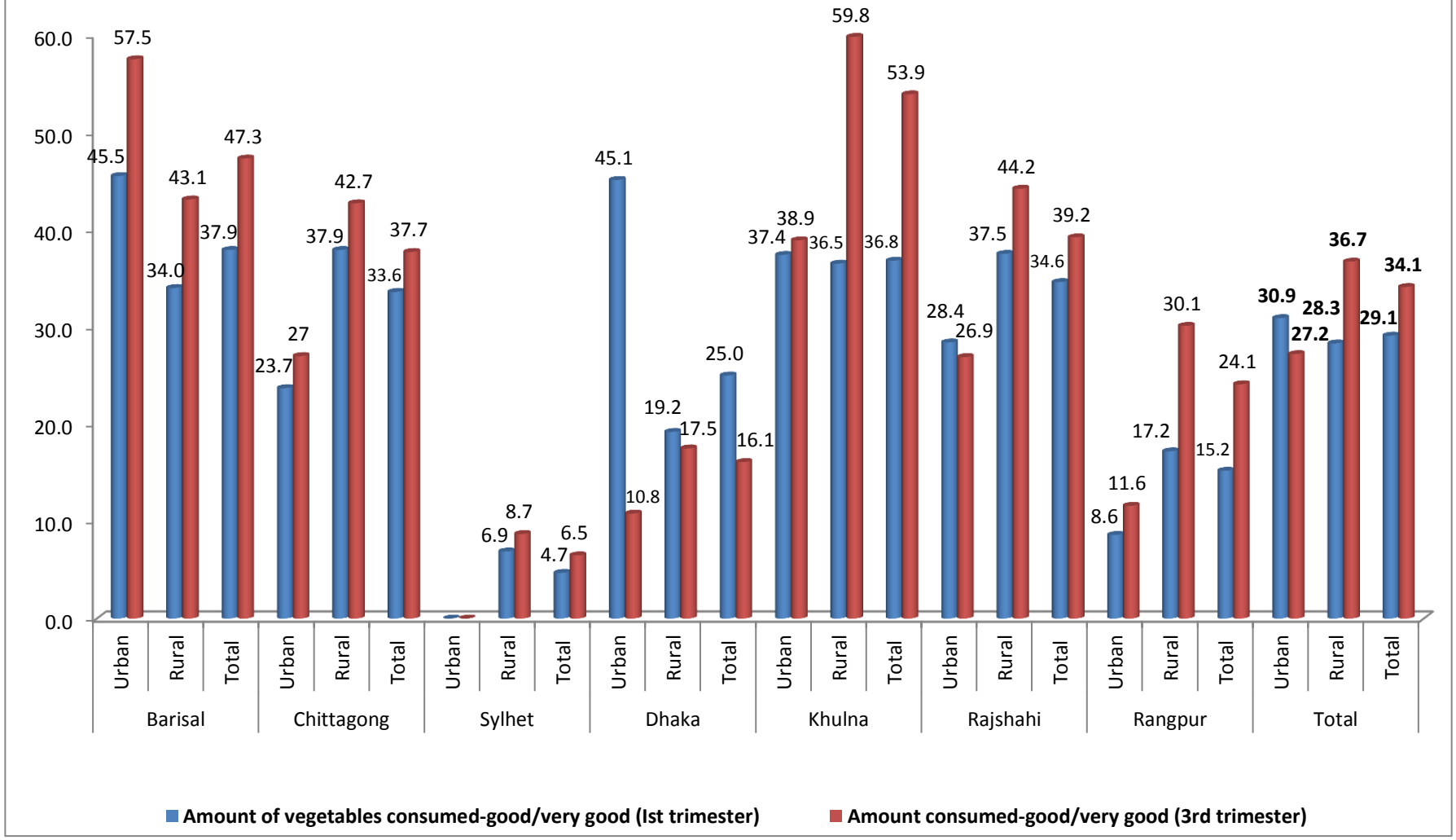


Fig 13.7.1 Consumption of cooking oil <2l/ month/ family by division and urban and rural areas (N=4,398)

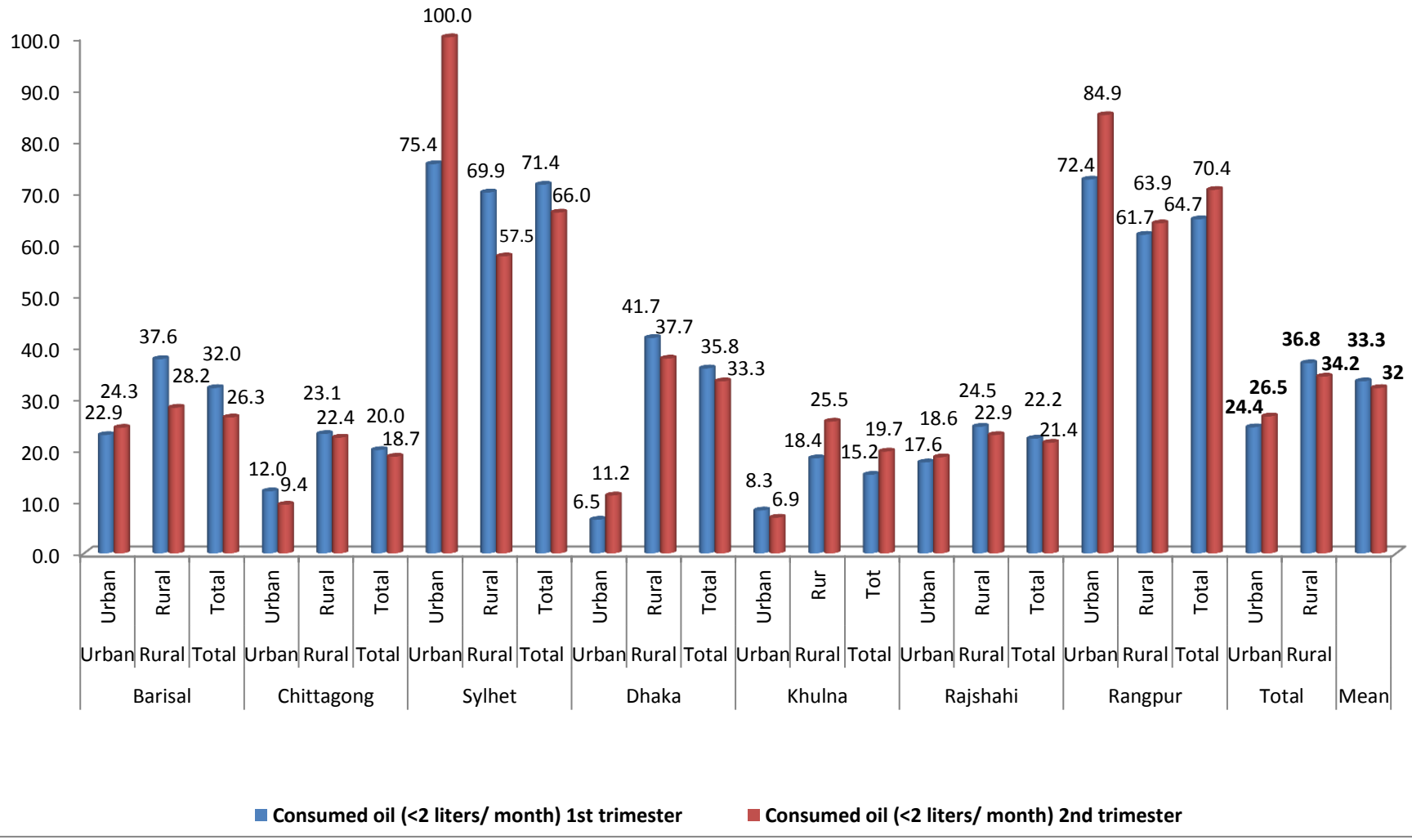


Fig 13.7.2 Consumption of cooking oil/ month/ family by division and urban and rural areas (N4,398)

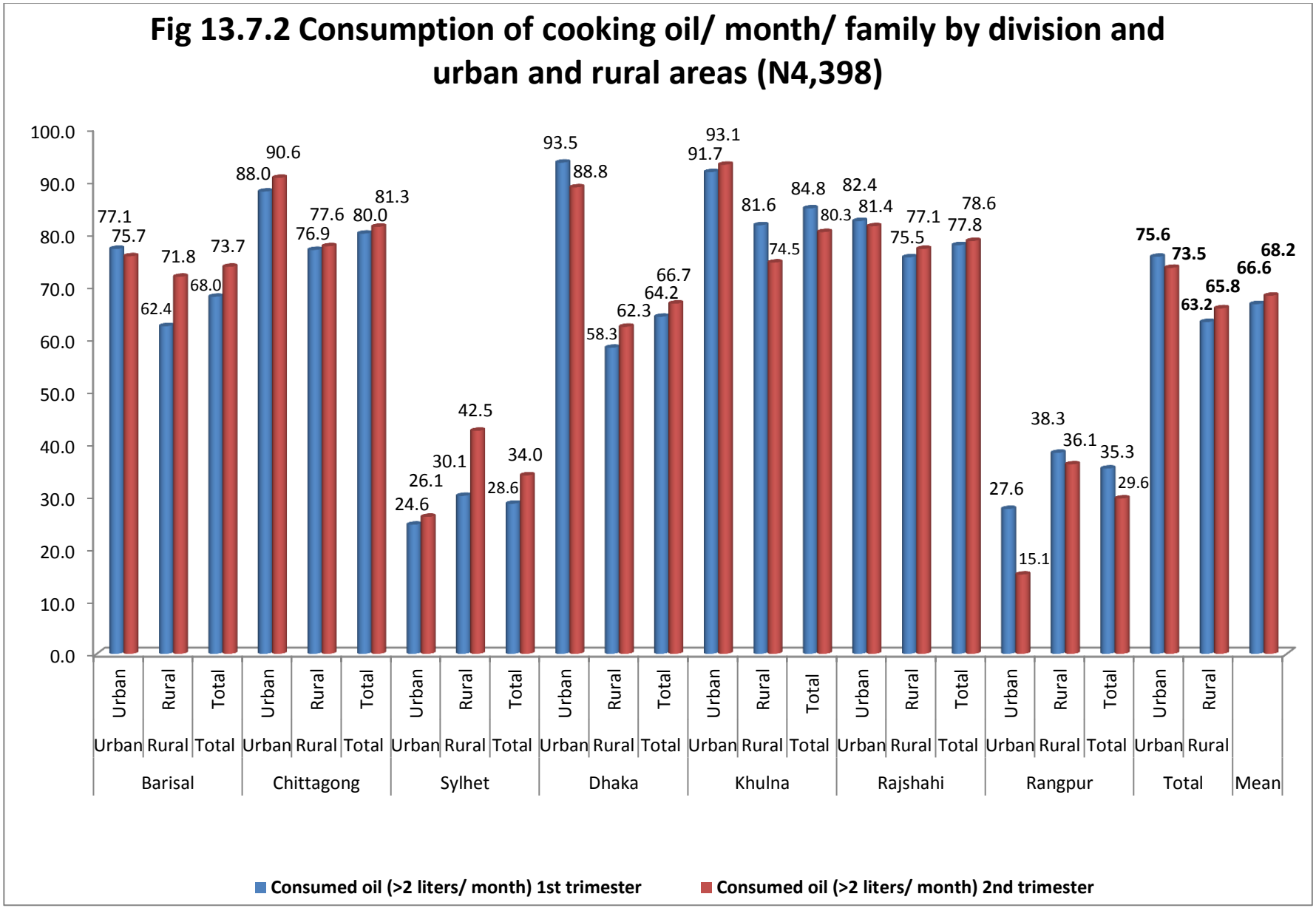


Fig 13.8.1 Consumption of good amounts of food (summary) by urban (slum and non-slum) and rural areas (N=4,398)

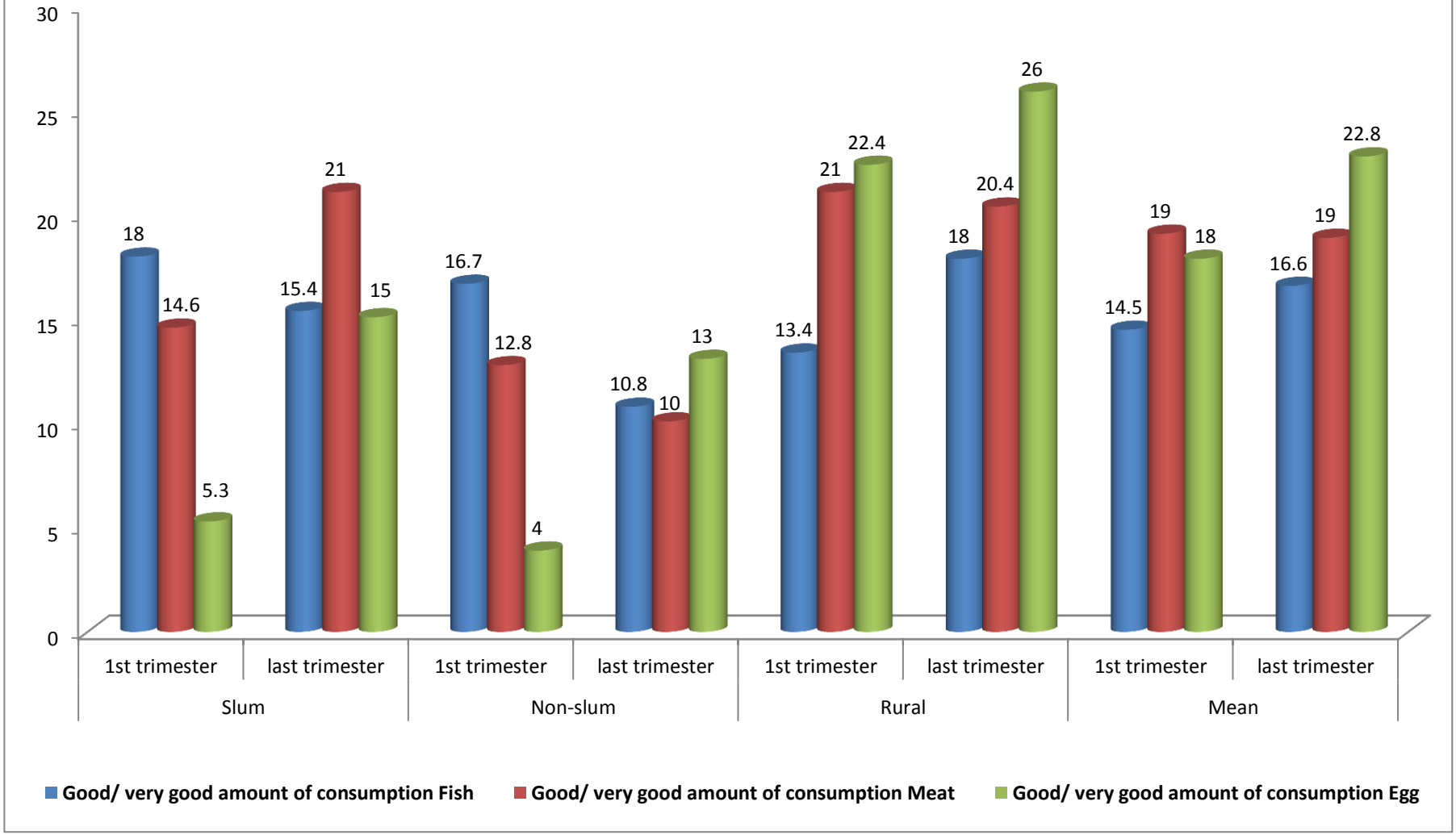
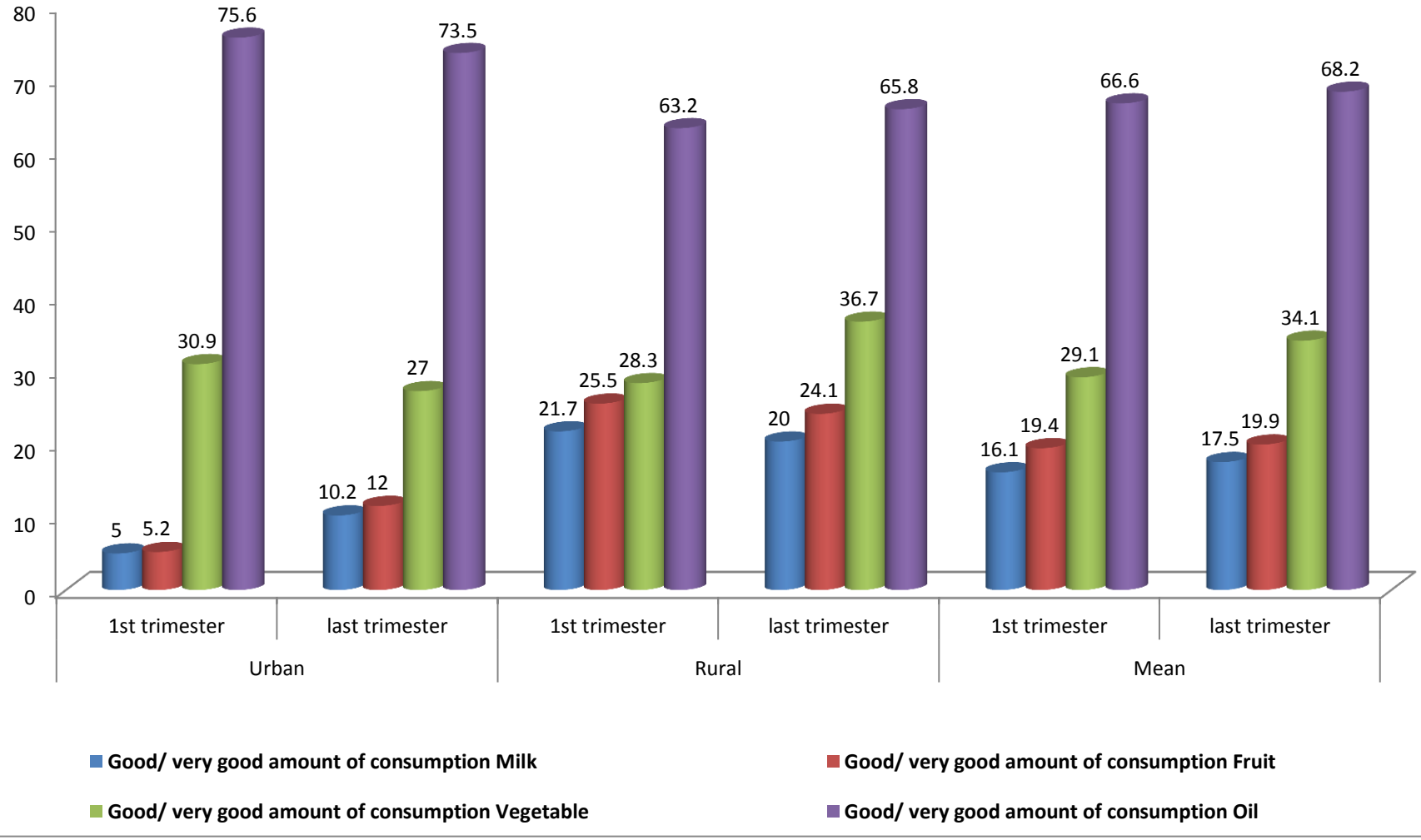


Fig 13.8.2 Consumption of good amount of food (summary) by urban and rural areas (N=4,398)



Health practices

Smoking habit

Among the pregnant women 3.6 percent were smokers, while among their husbands 39.8 percent were smokers. More husbands were smokers in urban areas than rural areas, particularly in the slums- 56.0 percent, 40.2 percent and 36.8 percent respectively are smokers in slums, non-slum urban and rural areas. Sylhet, Khulna and Rajshahi urban areas had the highest number of smokers, followed by Barisal and Rangpur urban areas (slums) (Fig 14.1 - 14.3).

Vaccination

Among the pregnant women 82.5 percent took TT-5 vaccine regularly the remaining were casual (Fig 15). In Rajshahi slums only 38.7 percent took TT-5 regularly. In Barisal slums 51.8 percent were regular takers of TT-5. In Barisal, Dhaka, Khulna and Rajshahi urban areas non-slum performance was better. Only in Rajshahi and Rangpur rural areas TT-5 coverage (regular) was better than in urban areas. But in general rural estimate was higher than both slum and non-slum areas (84.9 percent).

Intake of iron-folate and vitamins

Among the pregnant women 50.8 percent took iron folate tablets regularly. More in urban non-slums and rural areas than urban slums. The situation was worst in Sylhet division as a whole, where iron folate intake was irregular among all. Slightly better was in Barisal slum and Rajshahi rural areas. Situation in Khulna and Chittagong was the best, more than about 67 percent were regular taker of iron folate in Chittagong and more than 91 percent in Khula (more in non-slum and rural areas). Rangpur slum performance was slightly better in slums than non-slum areas, even better than rural areas. In all other areas non-slum rate was higher (Fig 16).

Regular intake of vitamins, especially calcium tablet was noted in 44.3 percent of the studied pregnant women. Highest amount was seen in Khulna and then in Chittagong (more in non-slum areas than slums. In Khulna slum intake was more than in rural areas, while in Chittagong it was equal. In Sylhet regular intake was almost zero, a little better situation was observed in Rajshahi and then in Dhaka. In both the places rural estimate, especially in Dhaka was more than urban areas in aggregate (Fig 17).

Rest, mental peace, cleanliness, heavy work during pregnancy

Majority of pregnant women could not take adequate rest- only 44.0 percent could. Among them 3.4 percent were worst off. Situation was better off in Chittagong slums and Rangpur rural areas – about 74 percent each. Chittagong's overall situation was better. Sylhet non-slum and then rural pregnant women, Rajshahi, Dhaka and Khulna rural and then non-slum pregnant women were better off than other areas. In general rural area pregnant women had more rest than urban ones. Among urban areas non-slum women took more rest than urban slum women (Fig 18).

Mental peace was noted in 40.8 percent pregnant women and 4.5 percent was worst off- best in non-slum areas and slightly better in rural areas than urban slums; 4.2 percent, 5 percent and 6 percent had no mental peace at all in urban slums, rural areas and urban non-slum areas (Fig 19). Situation was particularly bad in Barisal and Khulna slums (relatively better rural areas and then in urban non-slum areas).

Cleanliness was seen in 52.7 percent pregnant women but in 6.0 percent of them it was worse. Rural women were found to be cleaner than urban non-slum ones and worse was the slum women. Situation

was worst in Barisal slum and then in Sylhet slums. In Khulna urban areas 10.5 percent in non-slum areas and 11.8 percent in slums were found to be noticeably untidy (Fig 20).

Among the pregnant women heavy work was noted in 6.0 percent and no heavy work in 29.7 percent. Urban non-slum women were noted to be in a better situation. But more rural pregnant women had to do heavy work than urban slum ones. Worst was in Barisal slums, where none was found who could say that they did not have any heavy work. In non-slum and rural areas the situation was only slightly better. In Sylhet rural areas also the situation was bad. In Khulna and Rangpur slums the situation was worse than in other study areas (Fig 21).

Fig 14.1 Smoking habit of pregnant women and their husbands by division and urban (slum and non-slum) and rural areas (N=4,398)

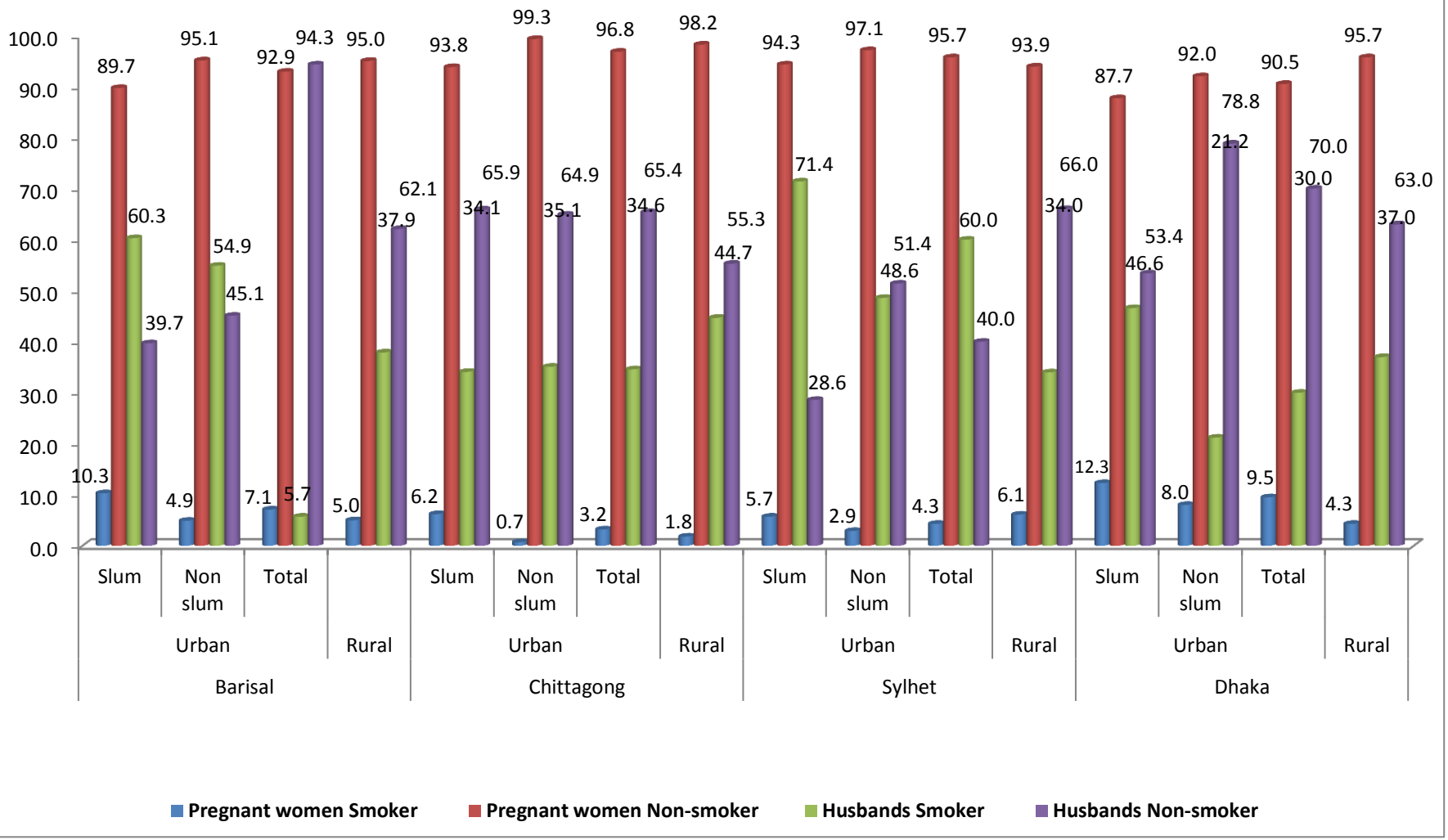


Fig 14.2 Smoking habit of pregnant women and their husbands by division and urban (slum and non-slum) and rural areas (n=4,398)

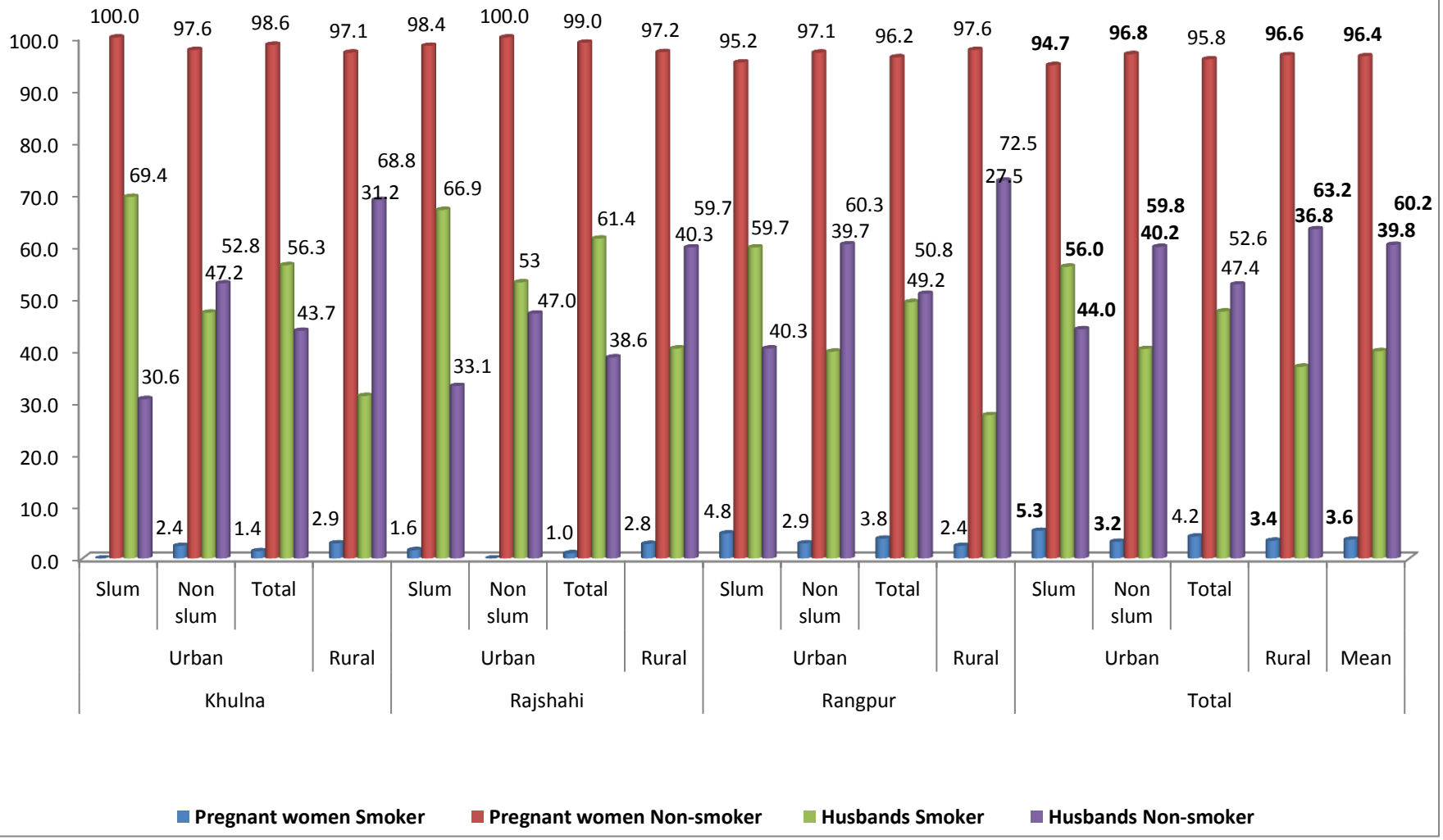


Fig 14.3 Smoking habit of pregnant women and their husbands (summary) by urban (slum and non-slum) and rural areas (N=4,398)

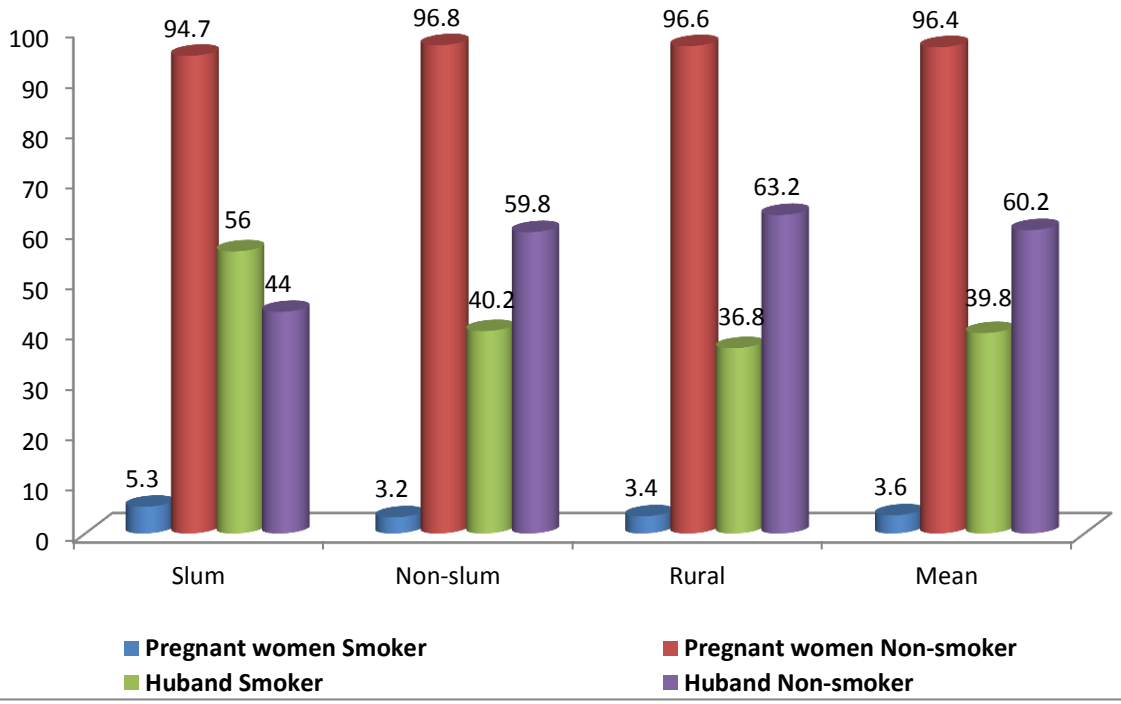


Fig 15. The rate of TT5 vaccination by division and urban (slum and non-slum) and rural areas (N=4,398)

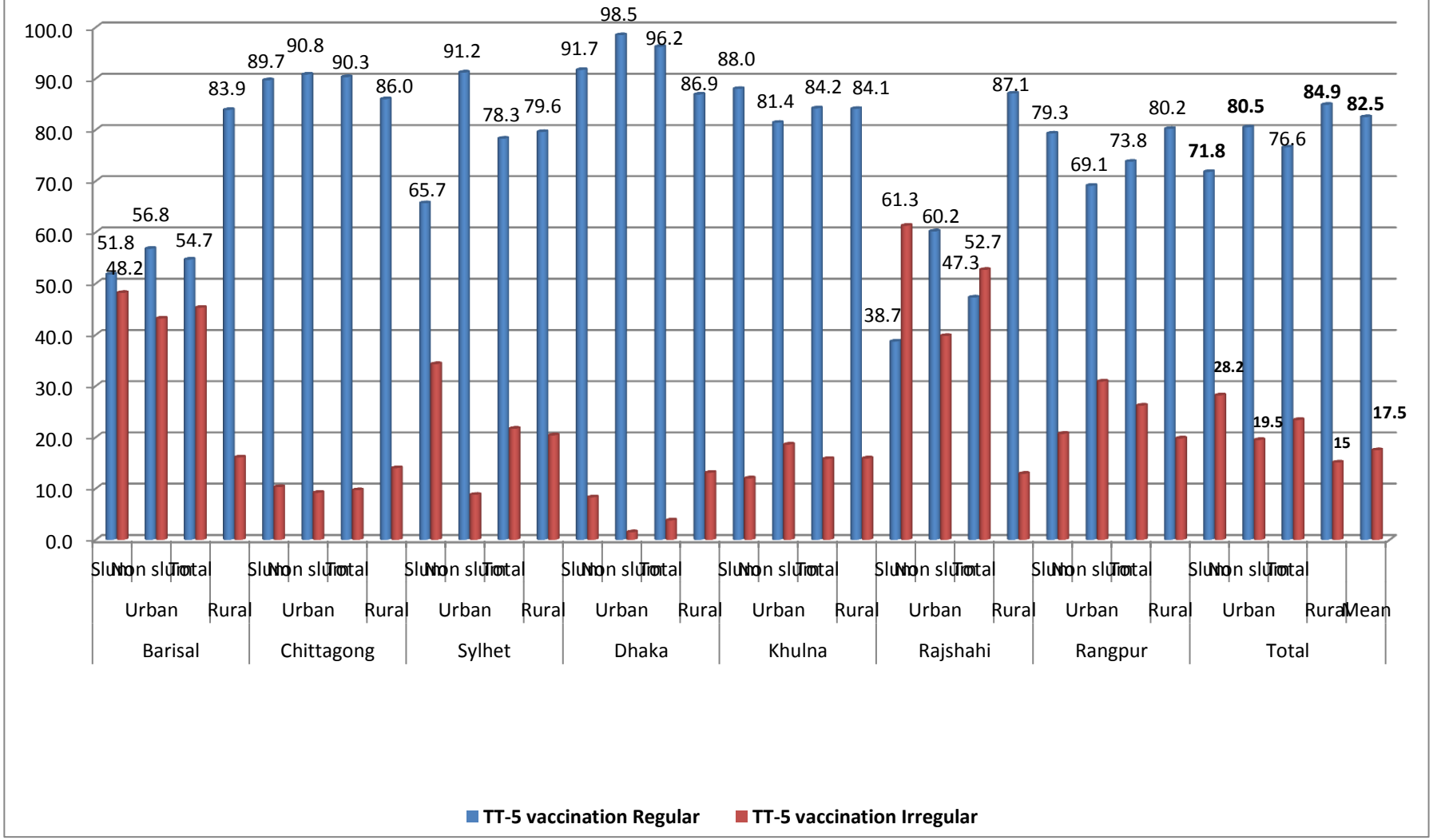


Fig 16. Intake of iron folate by division and urban (slum and non-slum) and rural areas (N=4,398)

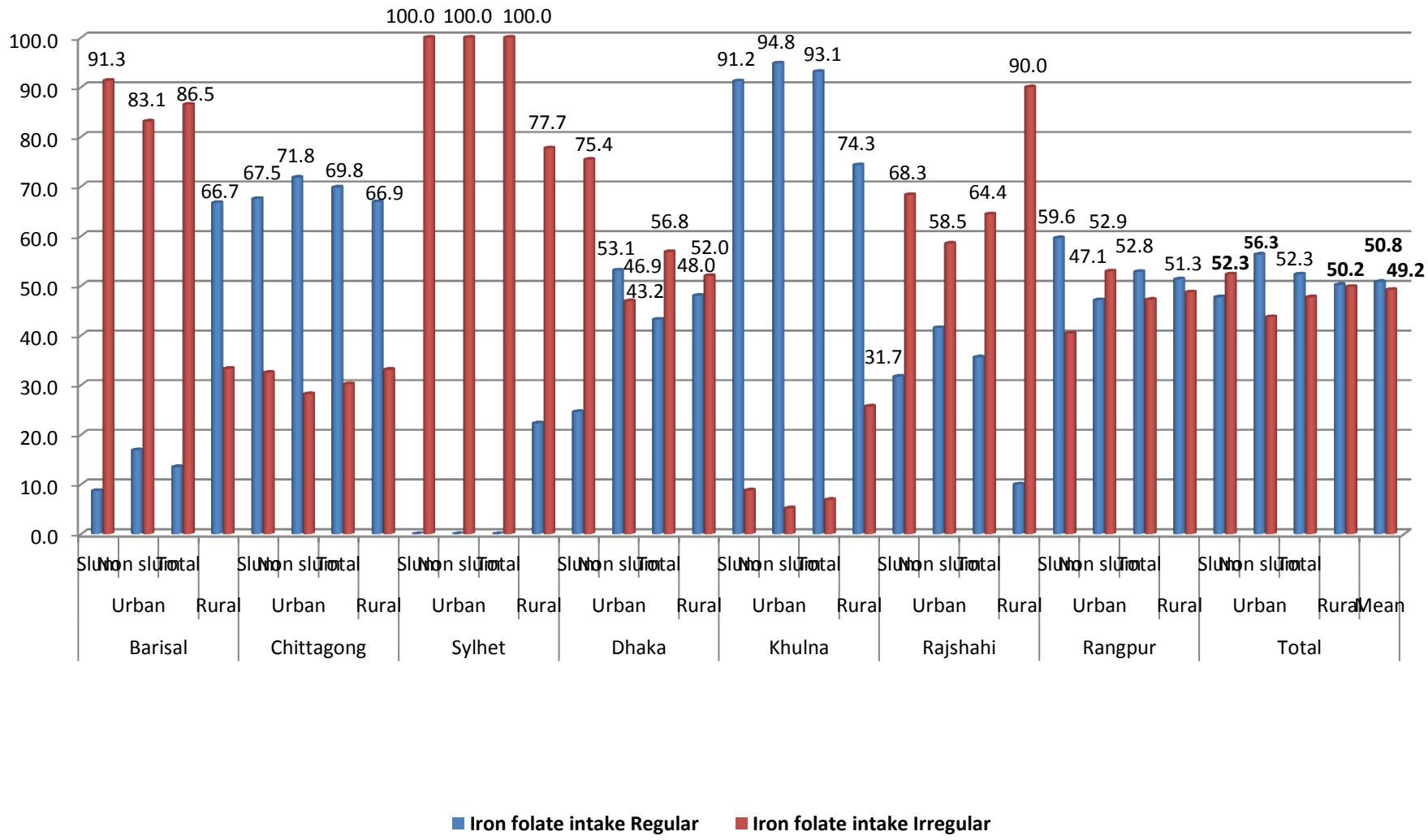


Fig 17. Consumption of vitamin/ calcium tablets by division and urban (slum and non-slum) and rural areas (N=4,398)

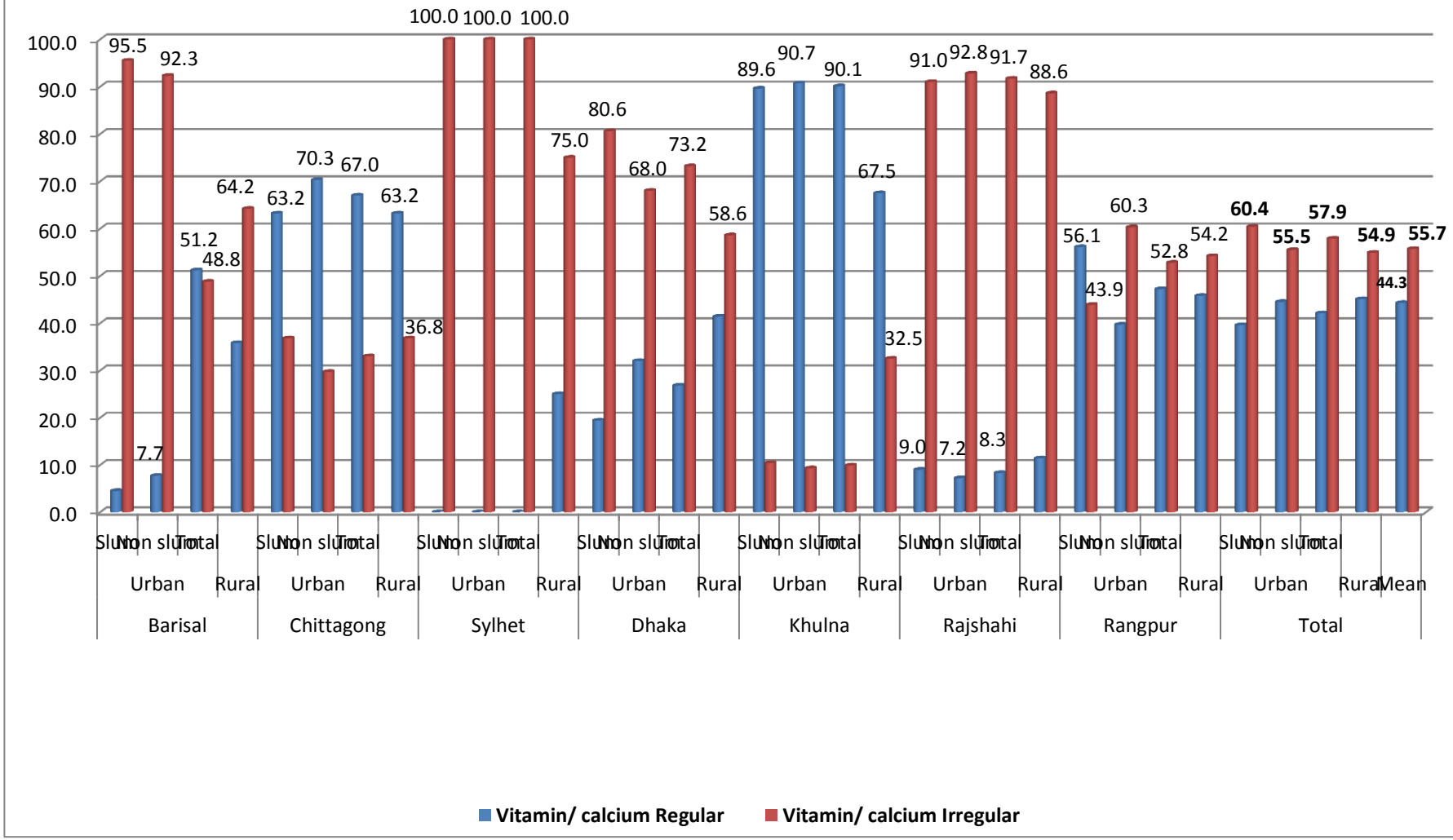


Fig 18. Rest taken during pregnancy by division and urban (slum and non-slum) and rural areas (N=4,398)

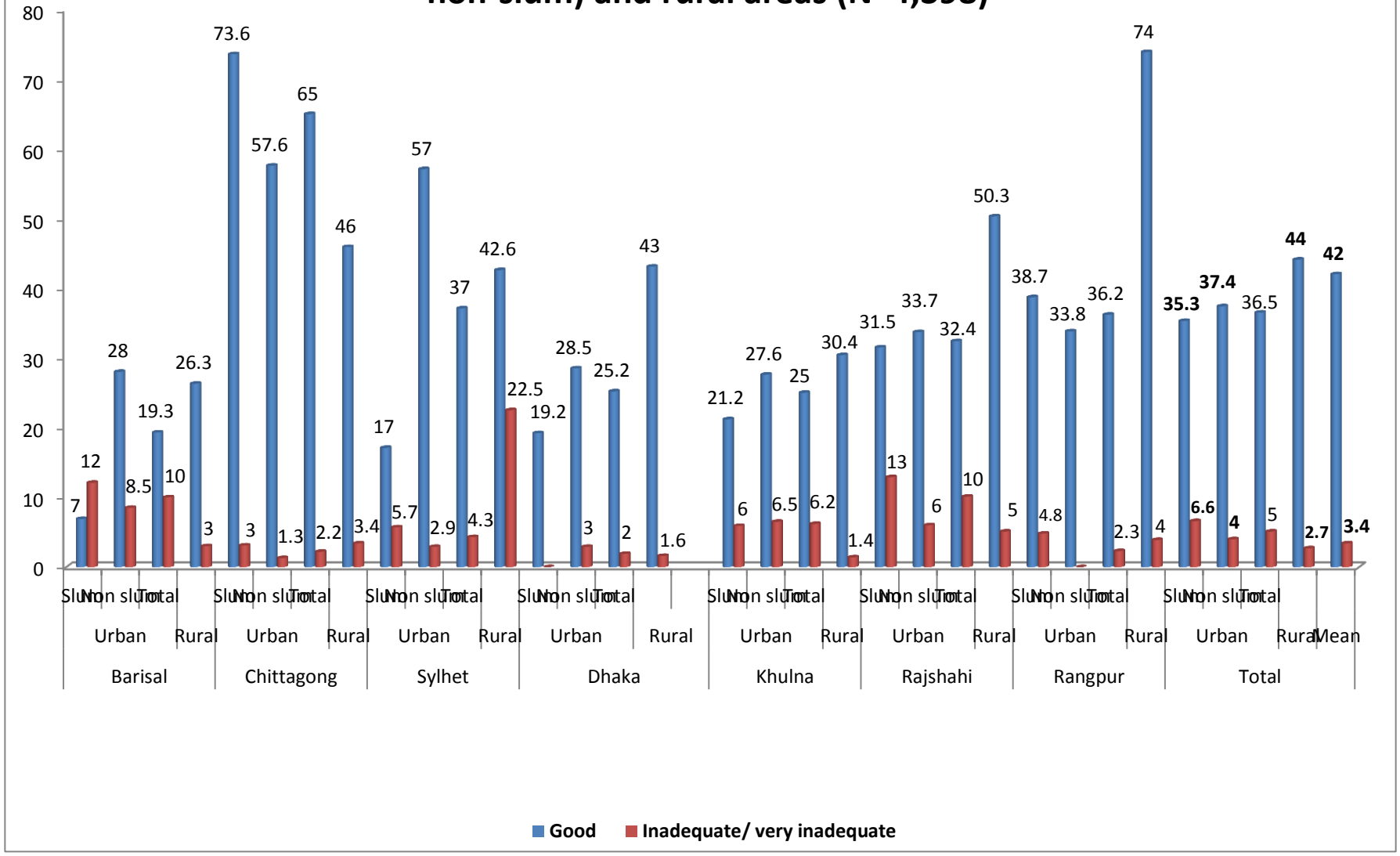


Fig 19. Degree of mental peace in pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

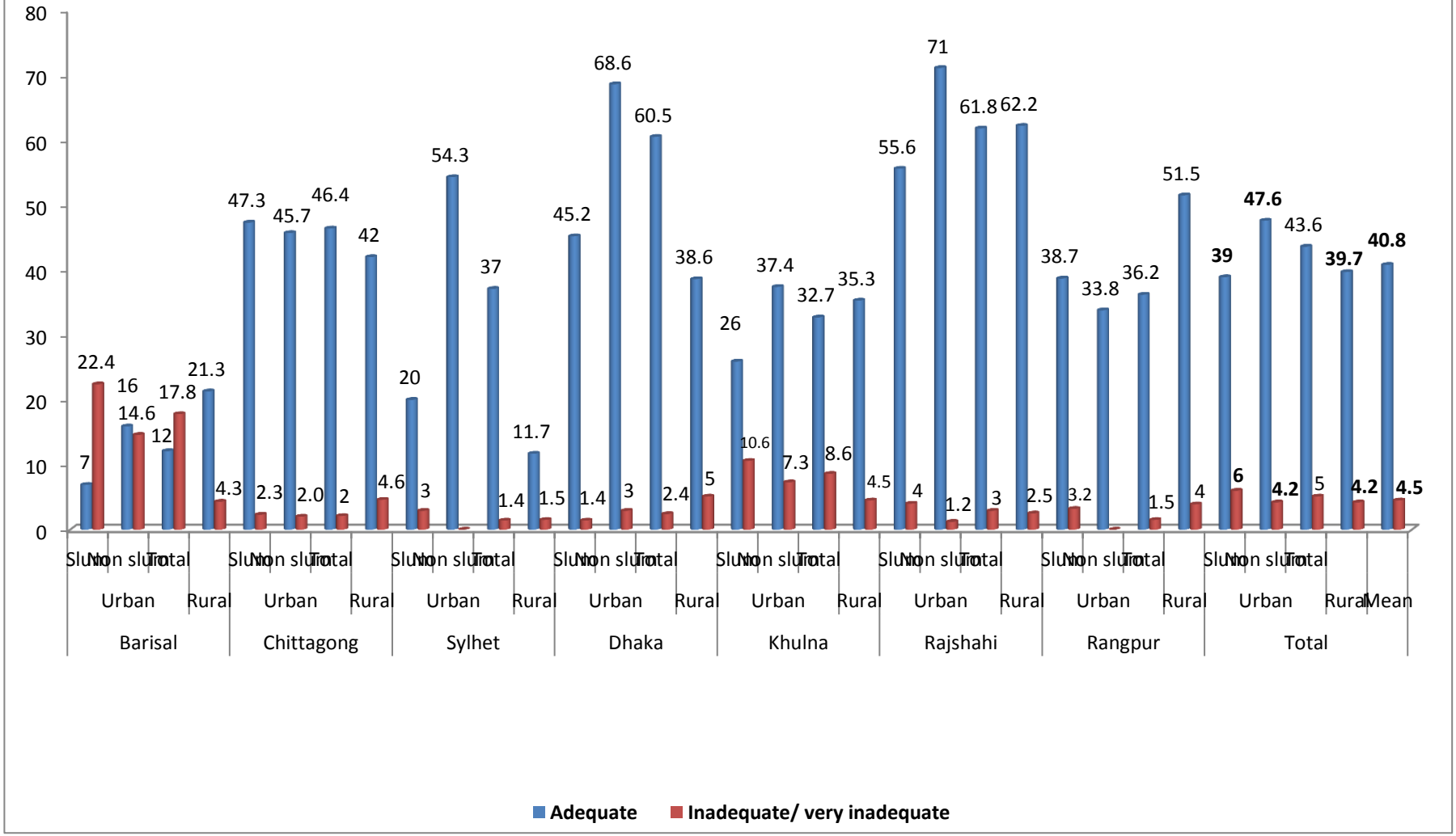


Fig 20. Cleanliness of pregnant women by division and urban (slum and non slum) and rural areas (N=4,398)

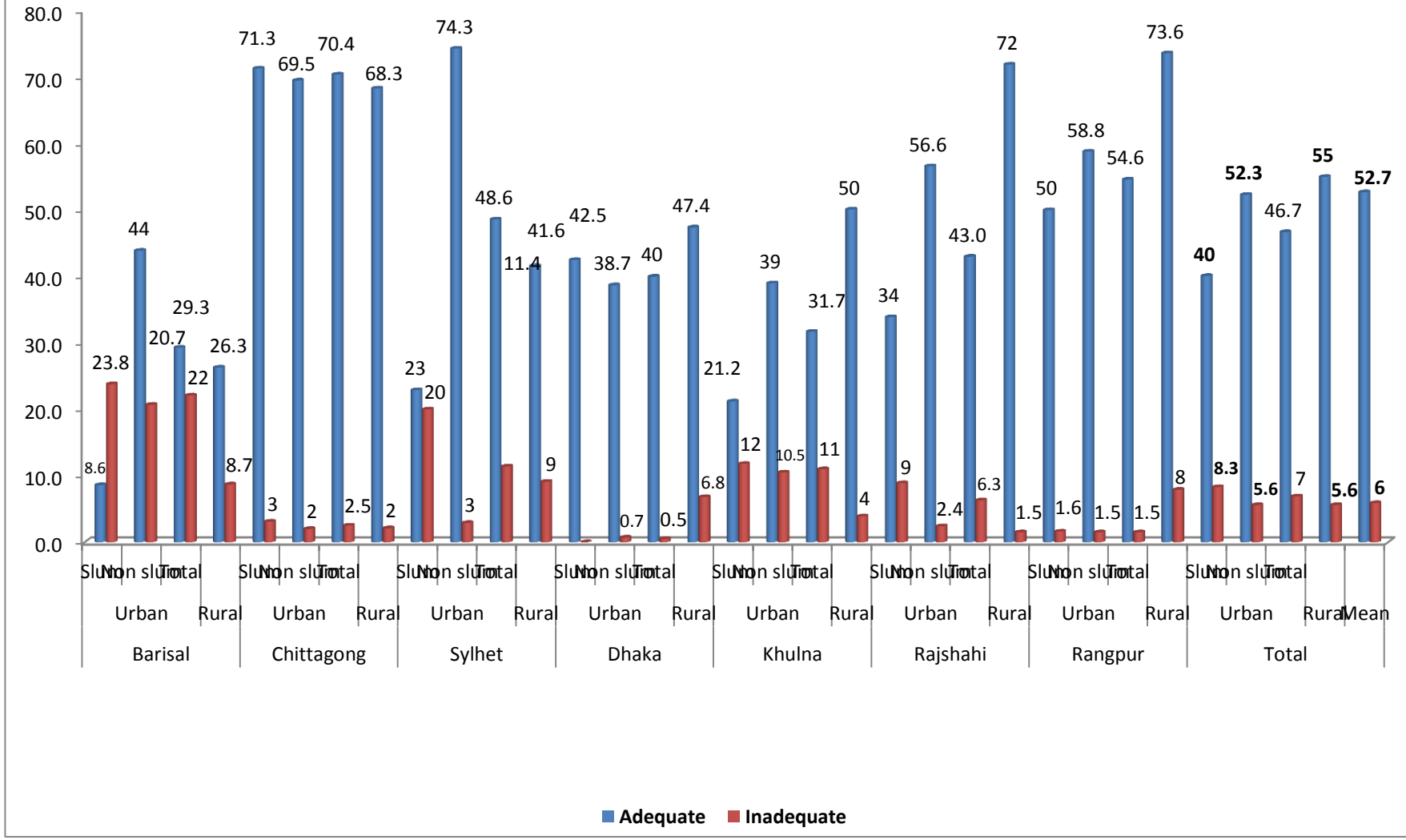


Fig 21. Heavy work done by pregnant women by division and by urban (slum and non-slum) and rural areas (N=4.398)

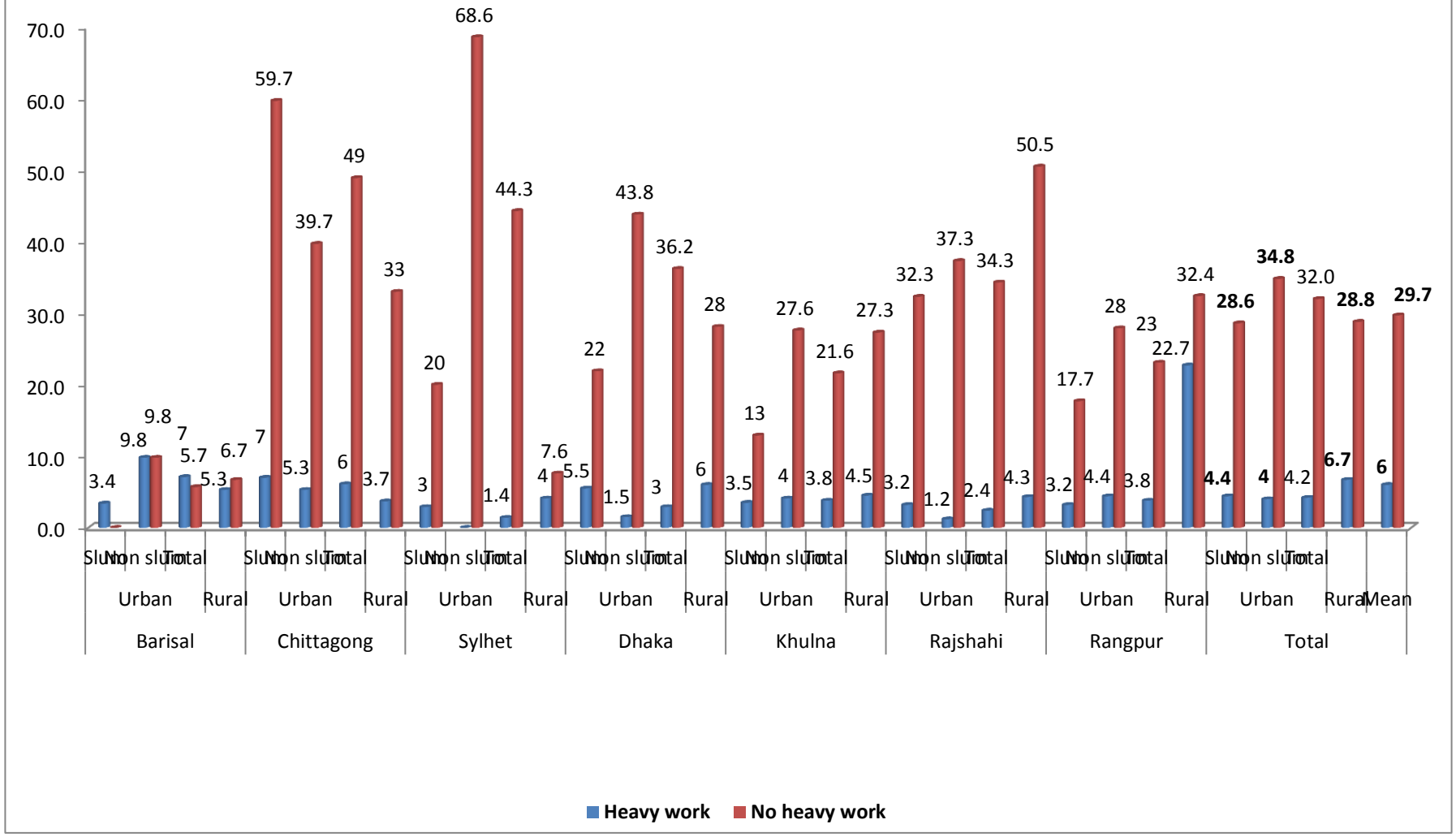


Table 2 gives a summary of the figures of 16-21 on the health habits (health practices during pregnancy) – intake of iron-folate, vitamins/ calcium tablets, rest taken. amount of the state of mental peace and the degree of heavy work undertaken during pregnancy.

Table 2. Care during pregnancy by urban (slum and non-slum) and rural area(summary) (N=4,398)

Residential location	Iron-folate	Vit/calcium	Rest taken	Mental peace	Heavy work
Slum	47.7	39.6	35.3	39.0	4.4
Non-slum	56.3	44.5	37.4	47.6	4.0
Rural	50.2	45.1	44.0	39.7	6.7
Mean	50.8	44.3	42.0	40.8	6.0

Anthropometric measurements

The average height of the husbands of the studied pregnant women was 161.5 cm, which is 5 feet and 4 inches. While in other divisions their heights are close to the average, in Rajshahi urban areas this is much above- slightly higher in non-slum areas. The husbands in the Dhaka urban areas are next tallest- in slums and non-slums this being equal. In Chittagong while non-slum husbands are slightly taller this is close among all the husbands irrespective of whether they were living in slum, non-slum or rural areas. The average height for husbands in non-slum areas was 164.3 cm, in slums this was 163.5 cm and in rural areas it was 160 cm (Fig 22.1 and 22.2). The average height of the pregnant women was 150.3 cm, i.e., slight more than 5 feet–151.6 cm; 150.7 cm and 150 cm in urban non-slum, urban slum and rural areas respectively. Height of pregnant women was the least in Rangpur, Dhaka and Chittagong divisions as a whole (Fig 23.1 and 23.2).

Among the pregnant women, 84 percent were above 145 cm in height. Pregnant women in Dhaka division urban and rural areas were the shortest, equally divided among those who are less or more than 145 cm. Women in Rangpur and Khulna were also smaller than in other divisions (Fig 24.1). The tallest women were noted in Sylhet division, where none among the study women was less than 145 cm (Fig 24.2).

The average weight at the beginning of the study, of the pregnant women, was 49.1 Kg. In rural areas it was 48.6 Kg and in urban areas 50.1 and 50.2 Kg in slums and non-slum areas (Fig 251. and 25.2). The weight was least in comparison in Sylhet and then in Rangpur (especially in slums). Dhaka division also had relatively lighter women but more in rural and non-slum urban areas in that order (Fig 25.3).

Weight of the husbands had an average of 60.2 Kg; again, less in rural areas- 59.9 Kg. In urban non-slum it was 61.4 Kg and in slums 60.5 Kg. Heavier husbands were measured in Rajshahi division-slightly more in slums and least in rural areas. Rangpur had the lighest husbands but location-wise just in the reverse order. In Barisal the rural husbands were bulkier, while urban husbands measured equal and slums and non-slum areas. Sylhet also had relatively lighter husbands but the rural husbands were lighter than the urban ones (Fig 26.1 and 26.2).

Fig 22.1 Height of the husbands by division and urban (slum and non-slum) and rural areas (N=4,398)

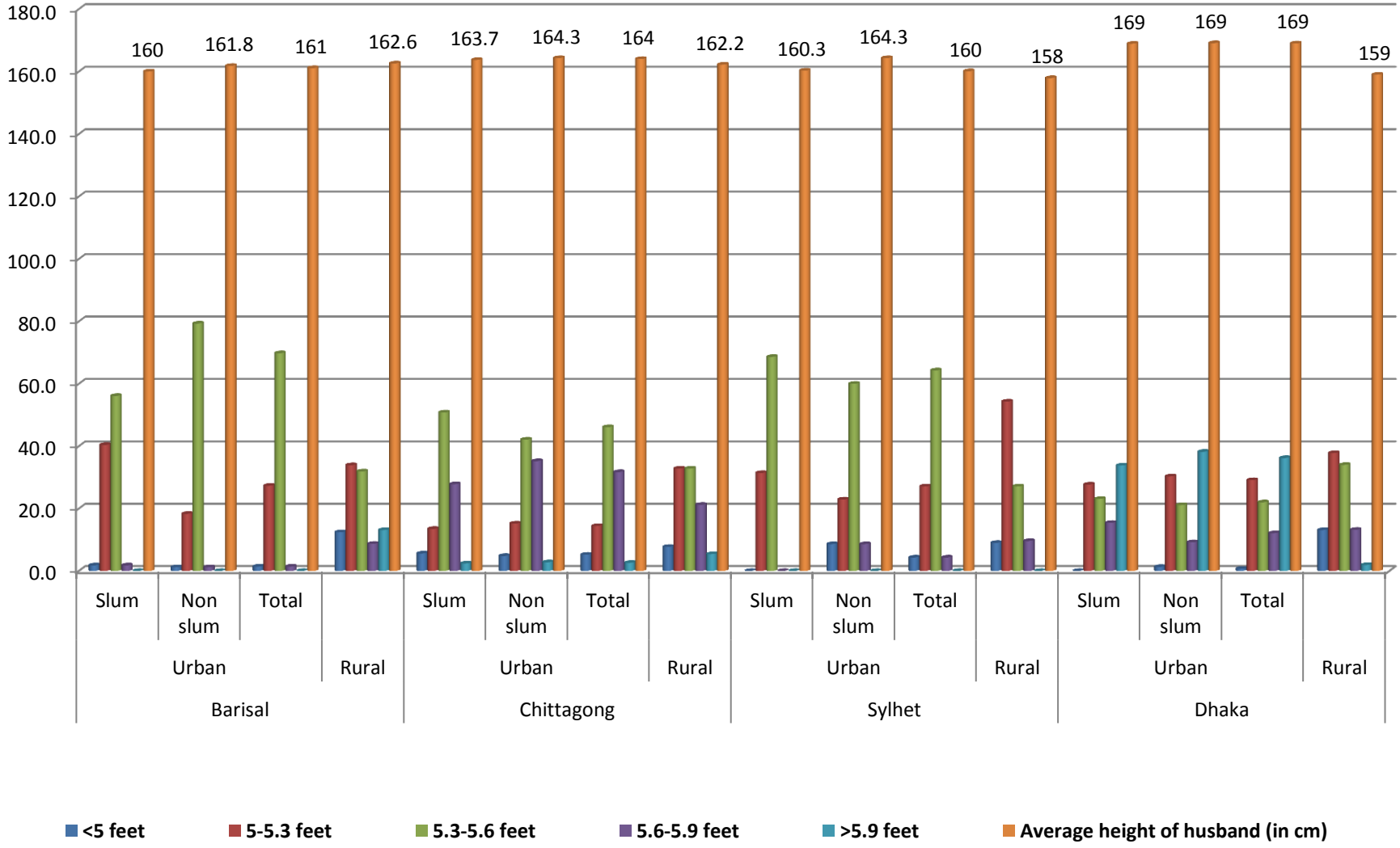


Fig 22.2 Height of the husbands by division and urban (slum and non-slum) and rural areas

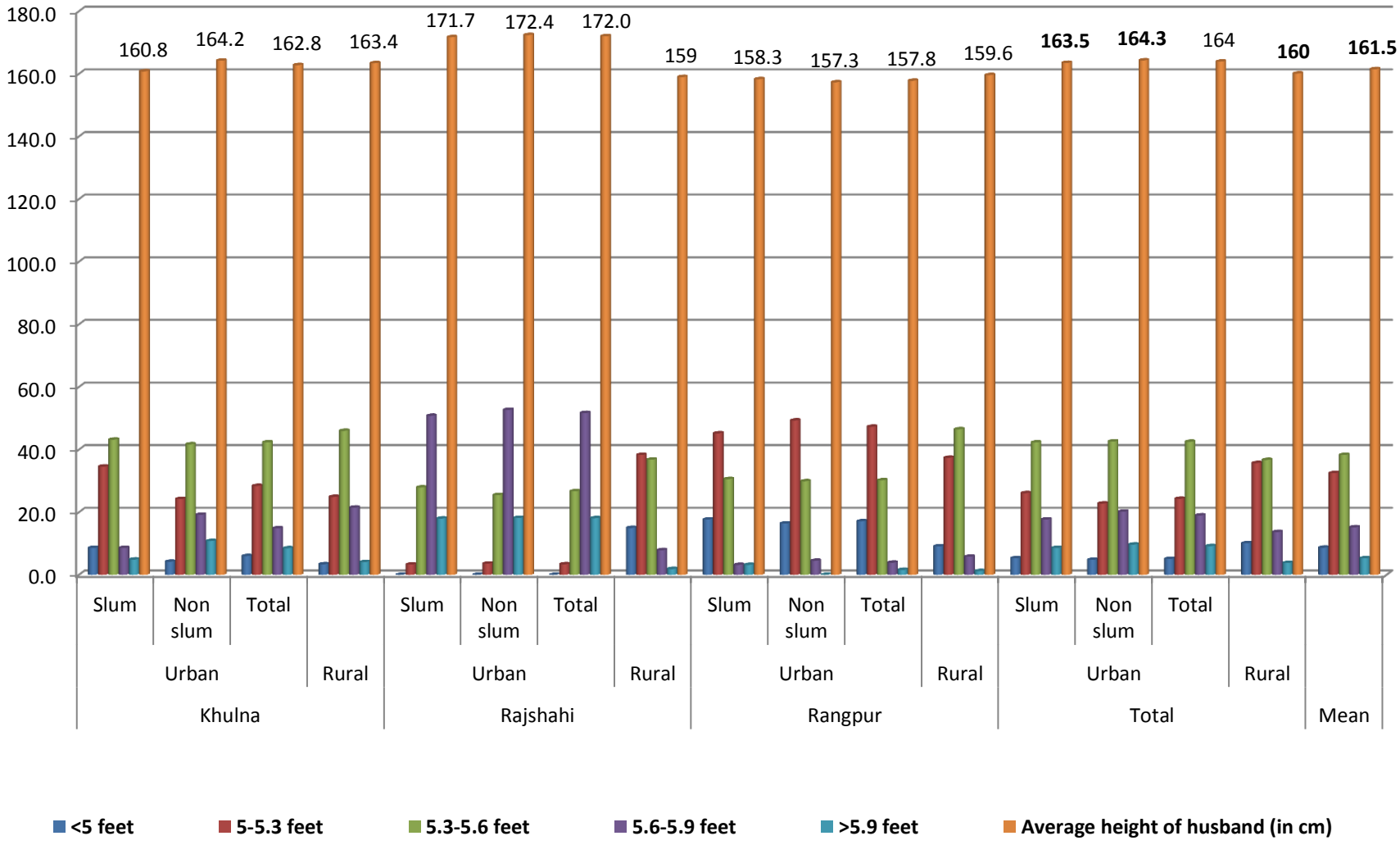


Fig 23.1 Height of the pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

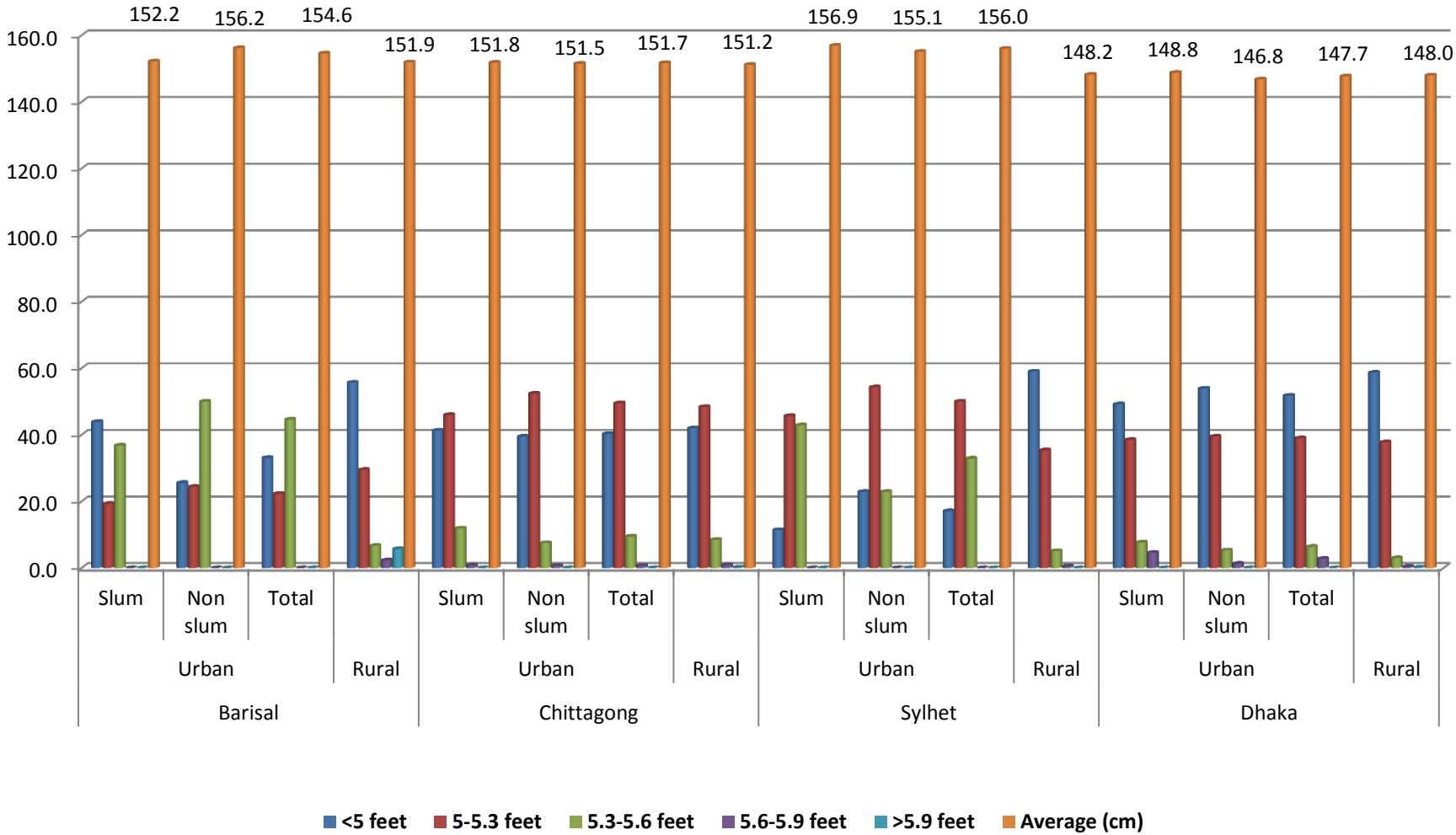


Fig 23.2 Height of the pregnant women by divisions and urban (slum and non-slum) and rural areas (N=4,398)

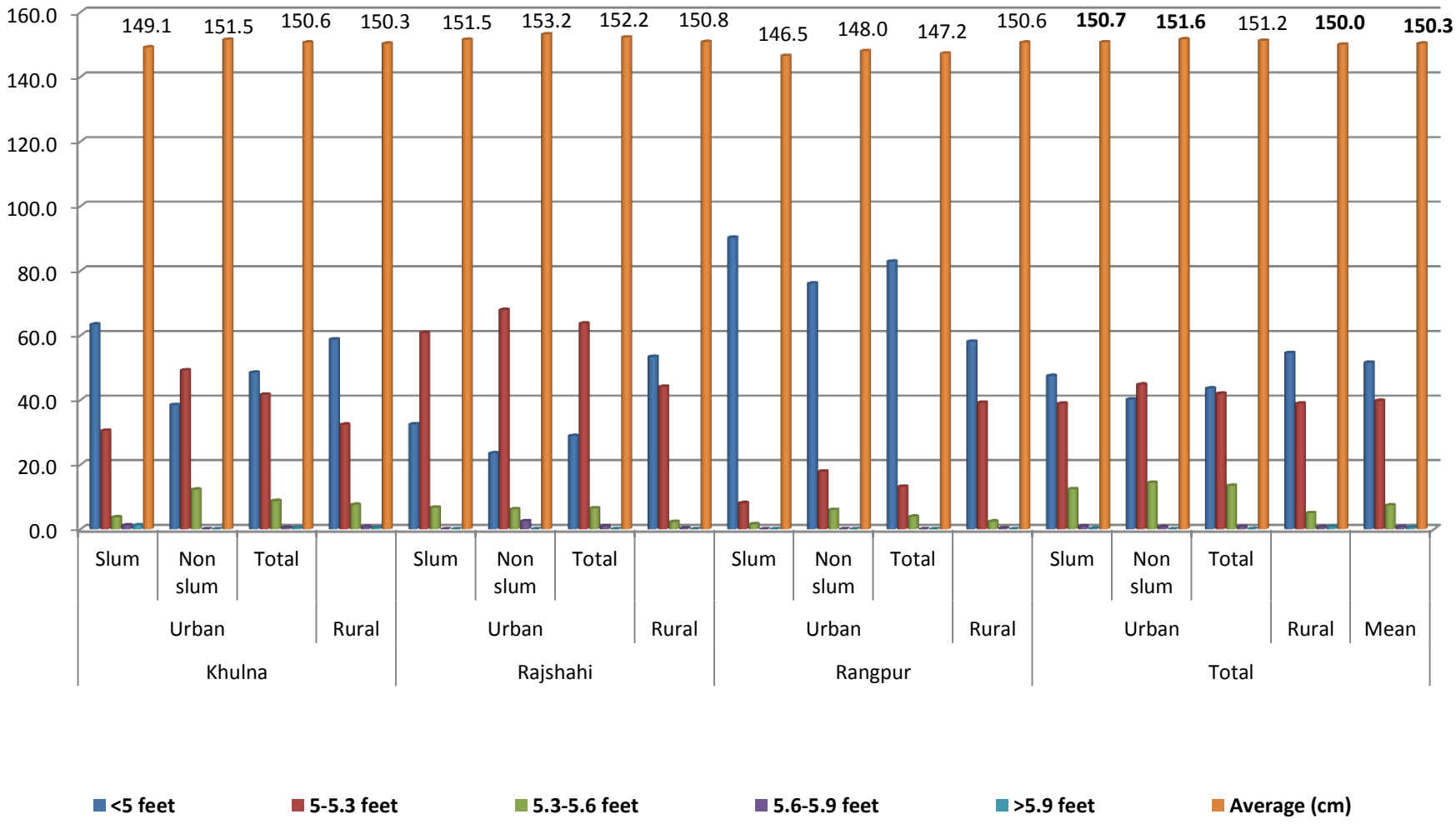


Fig 24.1 Height of pregnant women below and above 145 cm by division and urban (slum and non-slum) and rural areas (N=4,398)

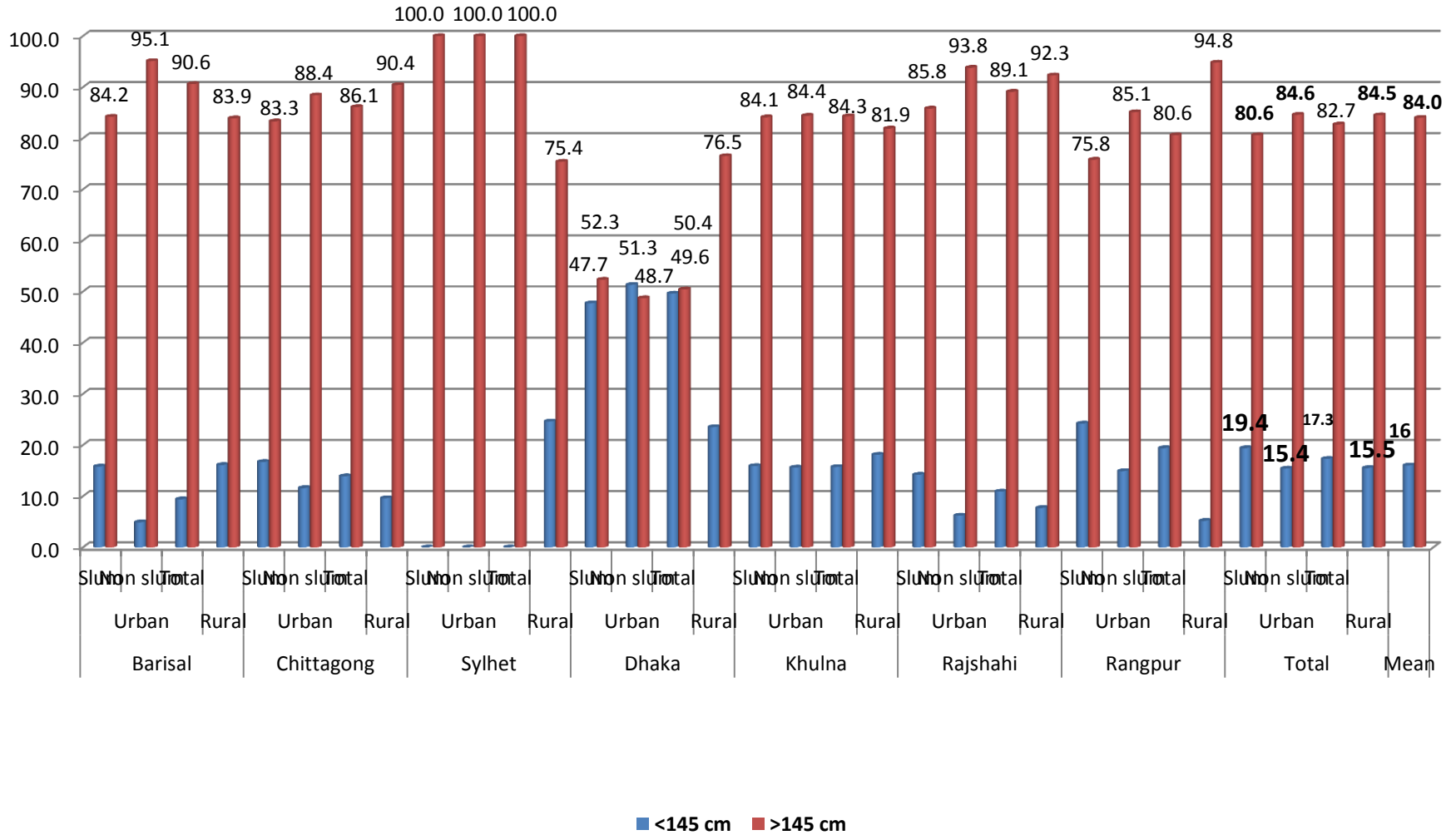


Fig 24.2 Height of pregnant women <> 145 cm (summary) by urban (slum and non-slum) and rural areas (N=4,398)

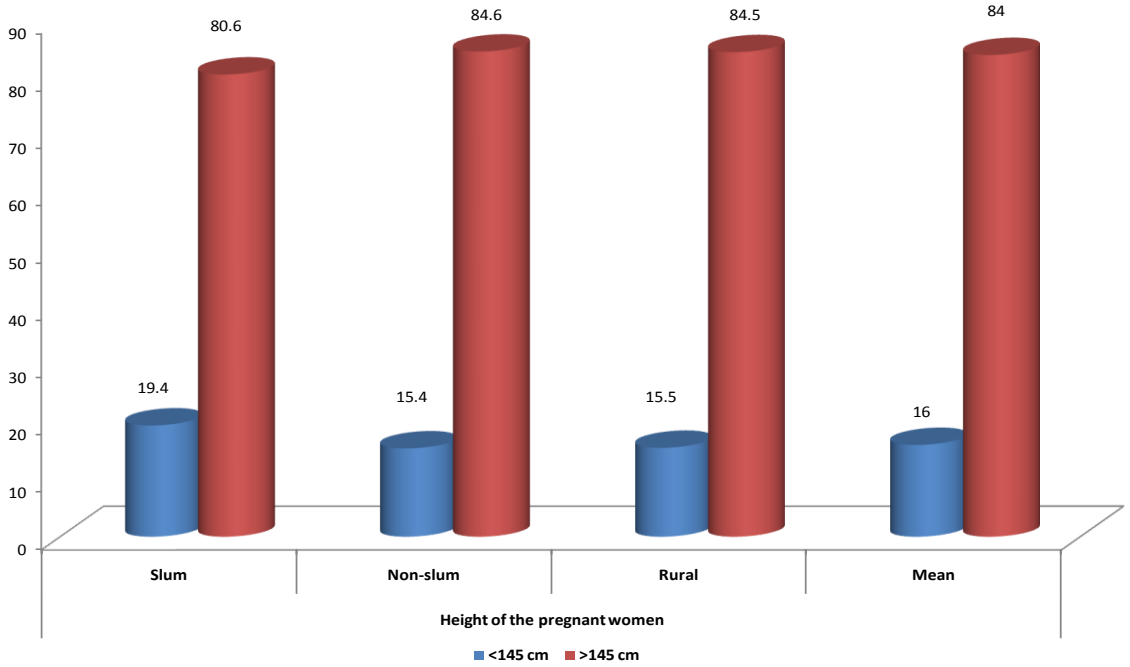


Fig 25.1 Initial weight (in Kg) of the pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

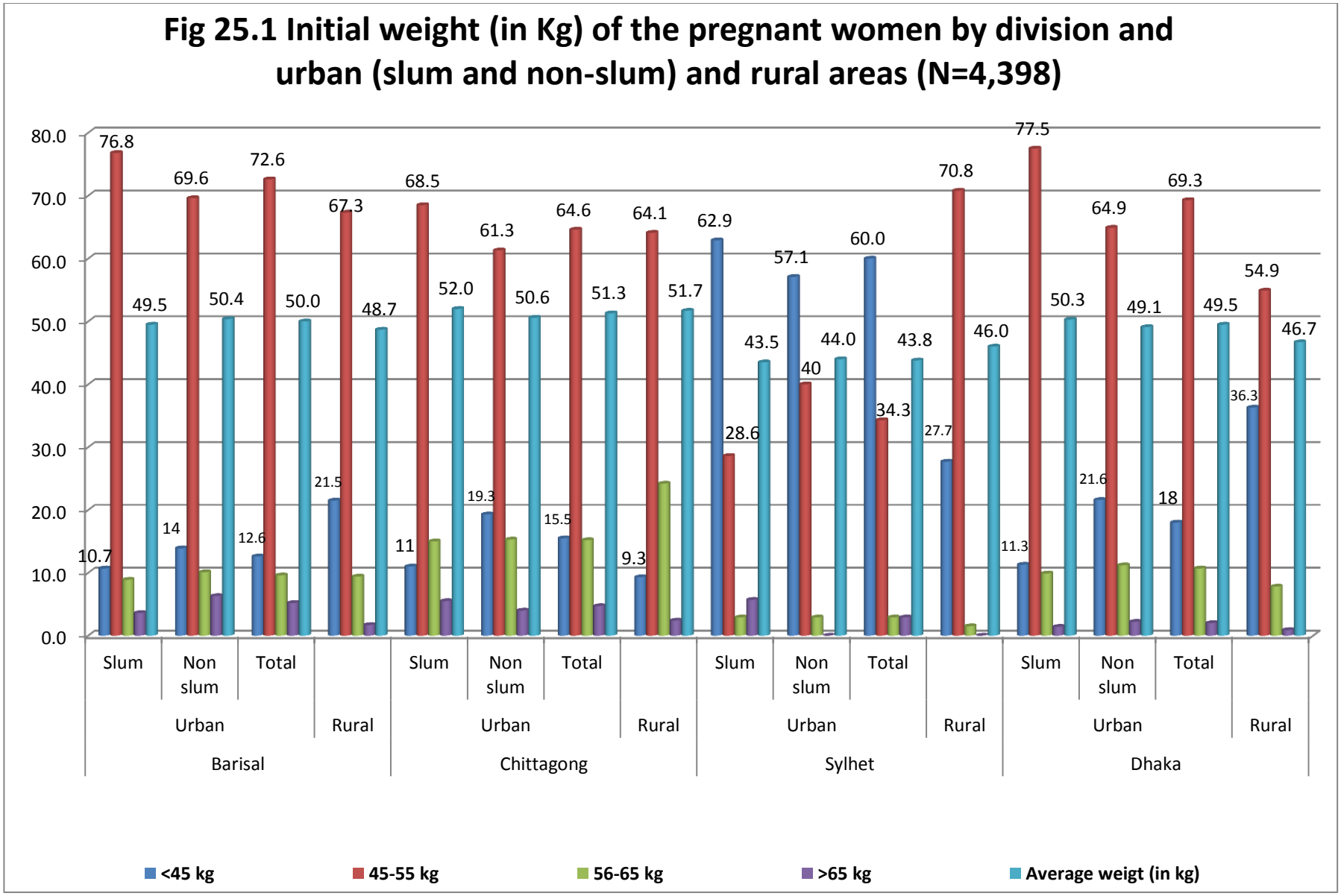


Fig 25.2 Initial weight (in Kg.) of the pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

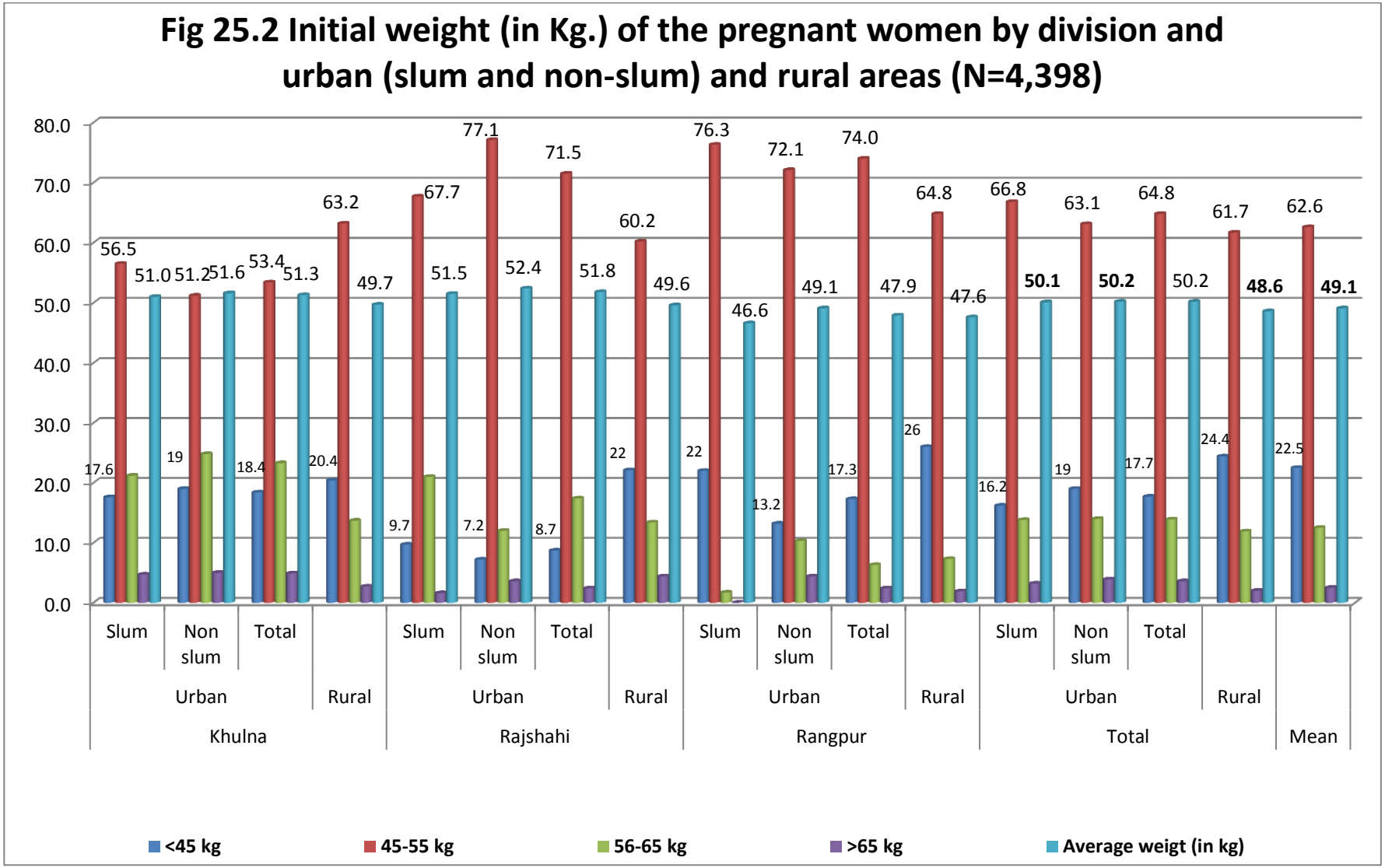


Fig 25.3 Initial weight (in Kg) of pregant women (summary) by urban (slum and non-slum) and rural areas (N-4,398)

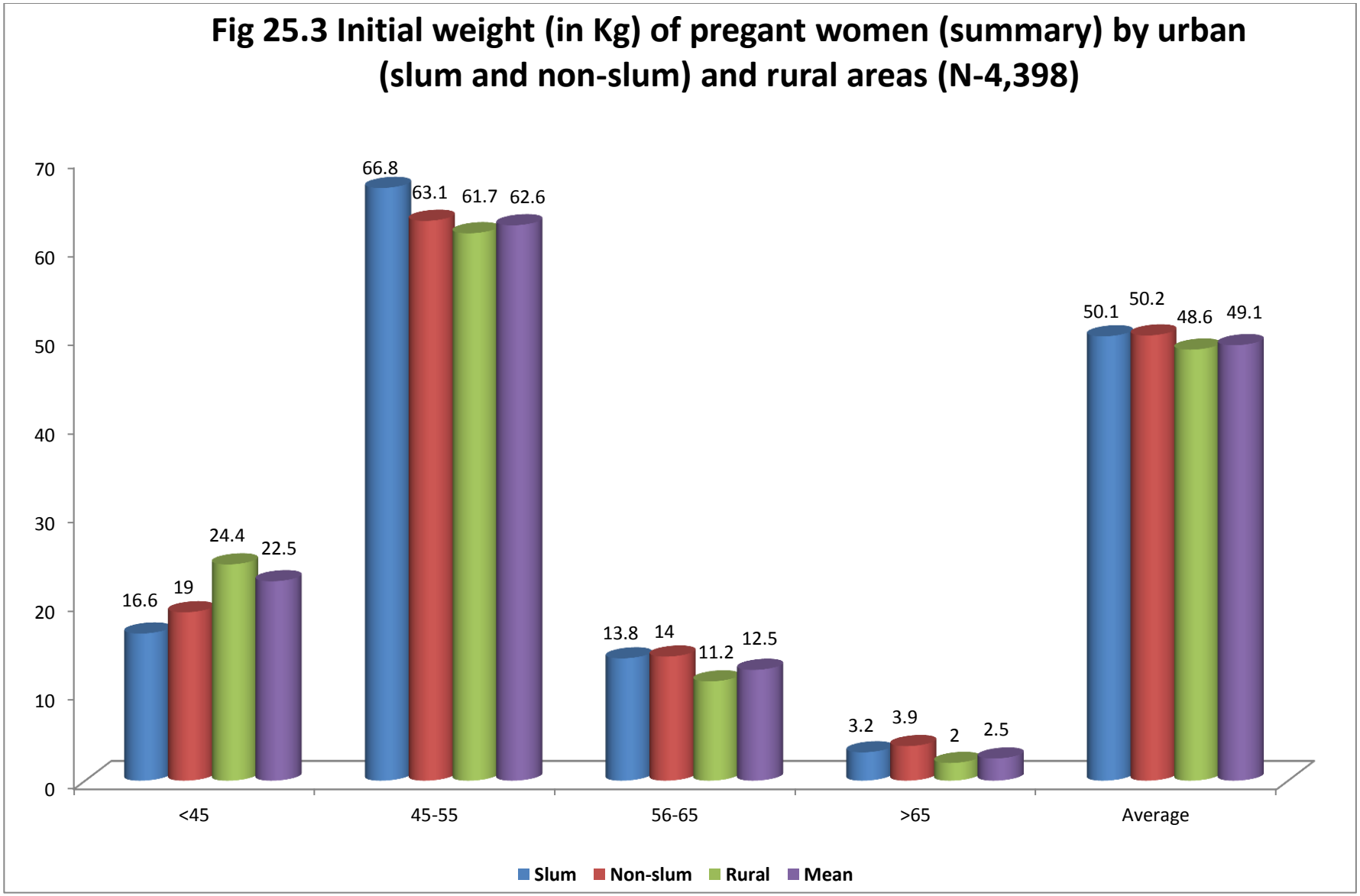


Fig 26.1 Weight of the husbands (in Kg) of pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

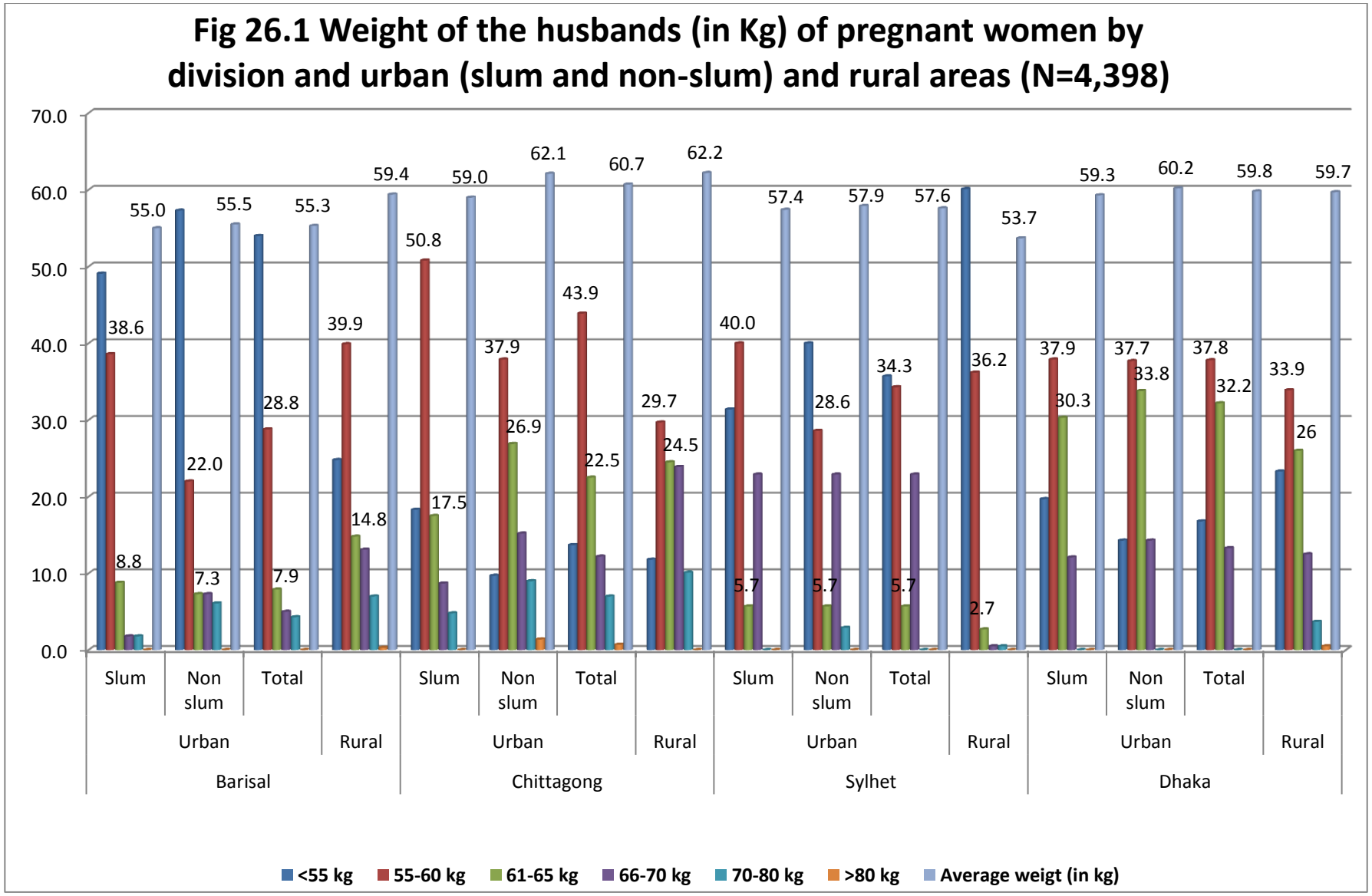
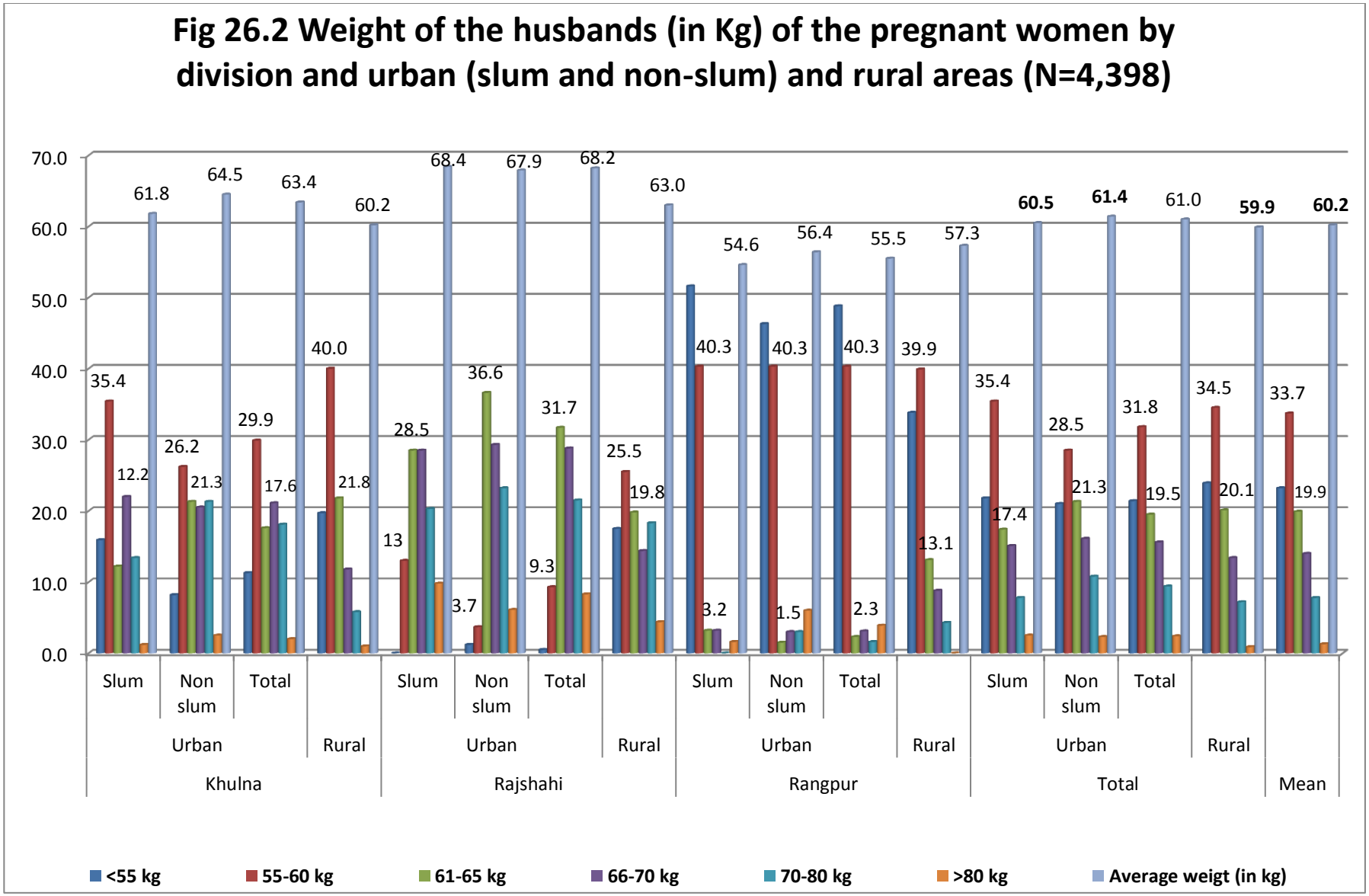


Fig 26.2 Weight of the husbands (in Kg) of the pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)



Biochemical/ Clinical conditions and physical appearance during pregnancy

Among the pregnant women 2.3 percent were suffering from diabetes, 54.8 percent from anemia, 10.2 percent from albuminuria, and 3.1 percent from hypertension. Incidence/ prevalence of diabetes was high in Khulna (more in slums), Barisal (more in slums), Chittagong (more in rural areas and then in slums). Dhaka and Sylhet non-slum pregnant women showed a higher rate in their respective areas. By and large more in non-slum suffered than rural areas from diabetes and it was the least in aggregate in urban slums.

Remarkably more anemia was seen in slums (67.2 percent) and the least was noted in urban non-slum areas (48.4 percent). Rural estimate was little higher than the urban non-slums. While in Chittagong rural areas anemia was noticeable, rural areas of Barisal, Dhaka and Rangpur showed a relatively fewer women with anemia.

Albuminuria was seen mostly in Rajshahi, in particular in the slums and then in rural areas, and in rural areas of Dhaka and to some extent in that of Rangpur. The estimates on average were: 14.9 percent in slums, 12.5 in rural areas and 1.1 percent in urban non-slum areas.

The rate of hypertension among the pregnant women was more in urban slums and the least in rural areas. Rajshahi and Khulna slums, Rajshahi rural areas and Rajshahi non-slums, Sylhet non-slums and then slums and a little less in rural areas, Chittagong slums and Barisal non-slum and slum areas showed relatively higher rates of hypertension (Fig 27.1 - 27.3)..

Pregnant women were assessed for their physical appearance. More in non-slum urban areas were identified to be in good condition (30.8 percent). In rural areas this was 29.0 percent, while in slums the rate was 23.5 percent. Overall 28.6 percent appeared in good shape. On the other hand, while 7.0 percent in aggregate were found to appear in bad or very bad physical status, in urban slums it was 9.4 percent, 6.8 percent in rural areas and 6.0 percent in urban non-slum areas. The condition was the best in Rangpur rural areas and then Chittagong rural areas. Non slum pregnant women in Rajshahi, Chittagong, and Rangpur were better off. Slum women in Dhaka on the other are the ones who felt better in the division as a whole. Barisal and Khulna (except in rural areas) and to some extent Dhaka non-slum and rural area women were suffering from the worst physical appearance (Fig 28).

Fig 27.1 Biochemical/ clinical conditions of pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)

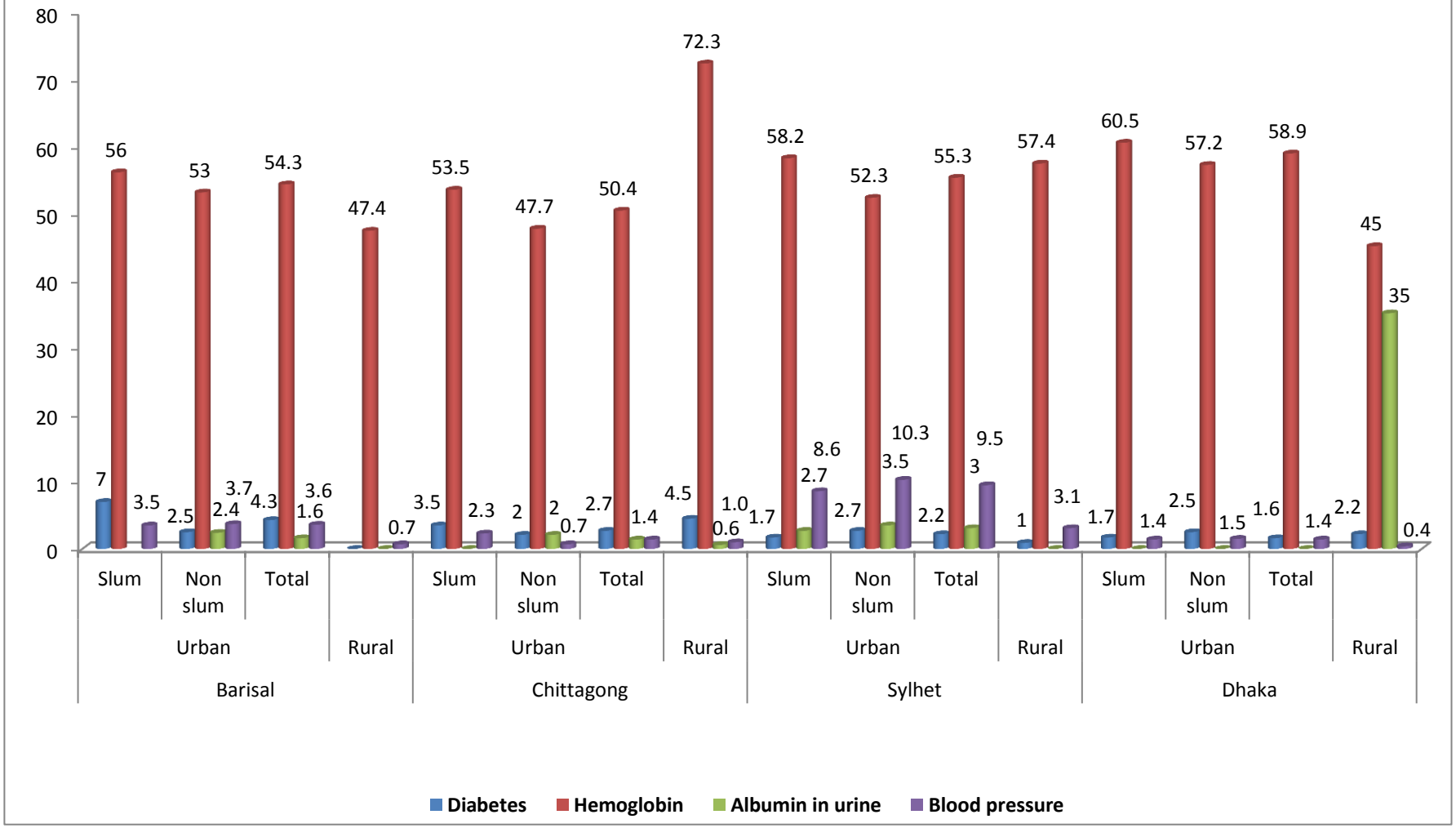
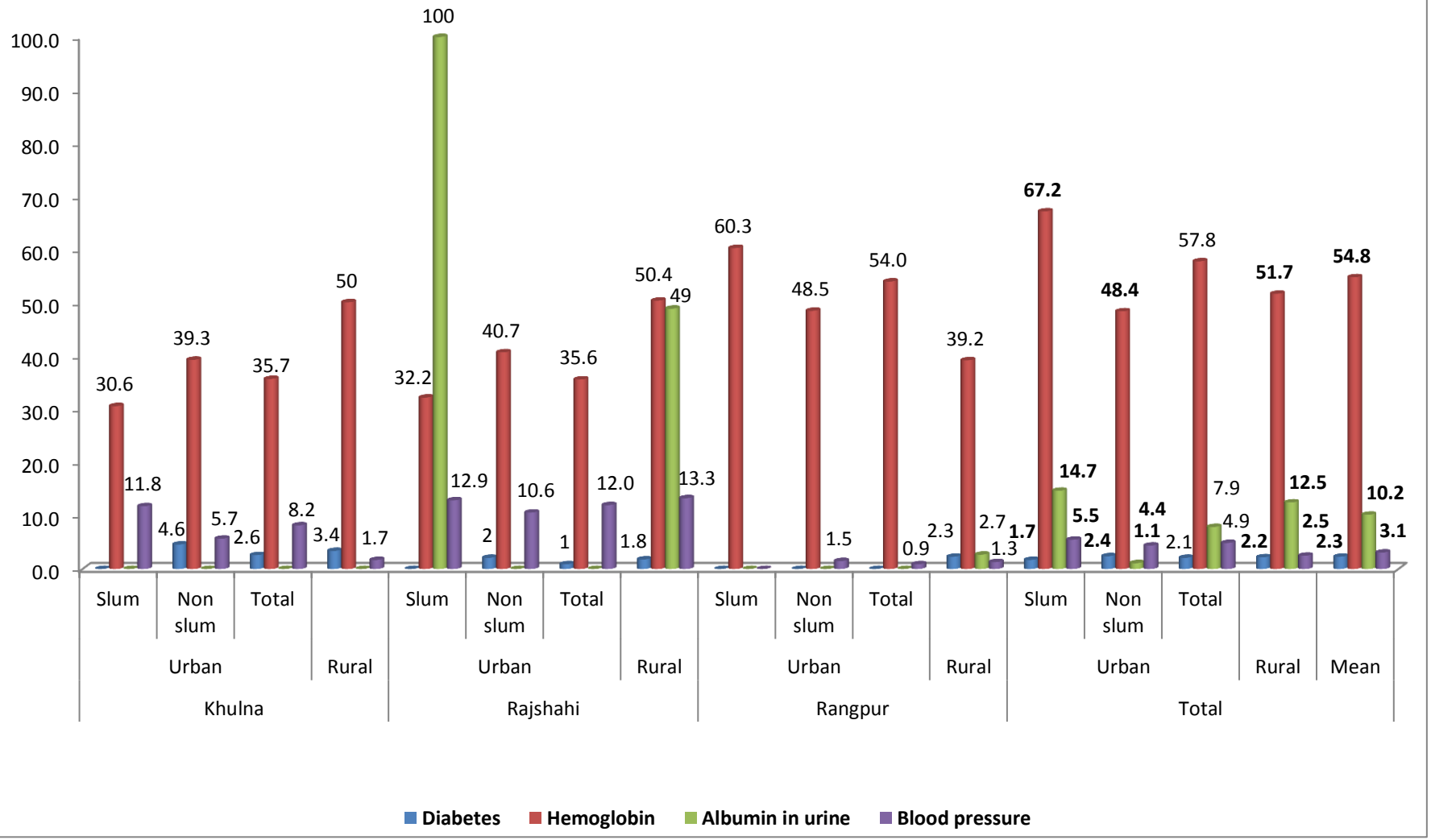
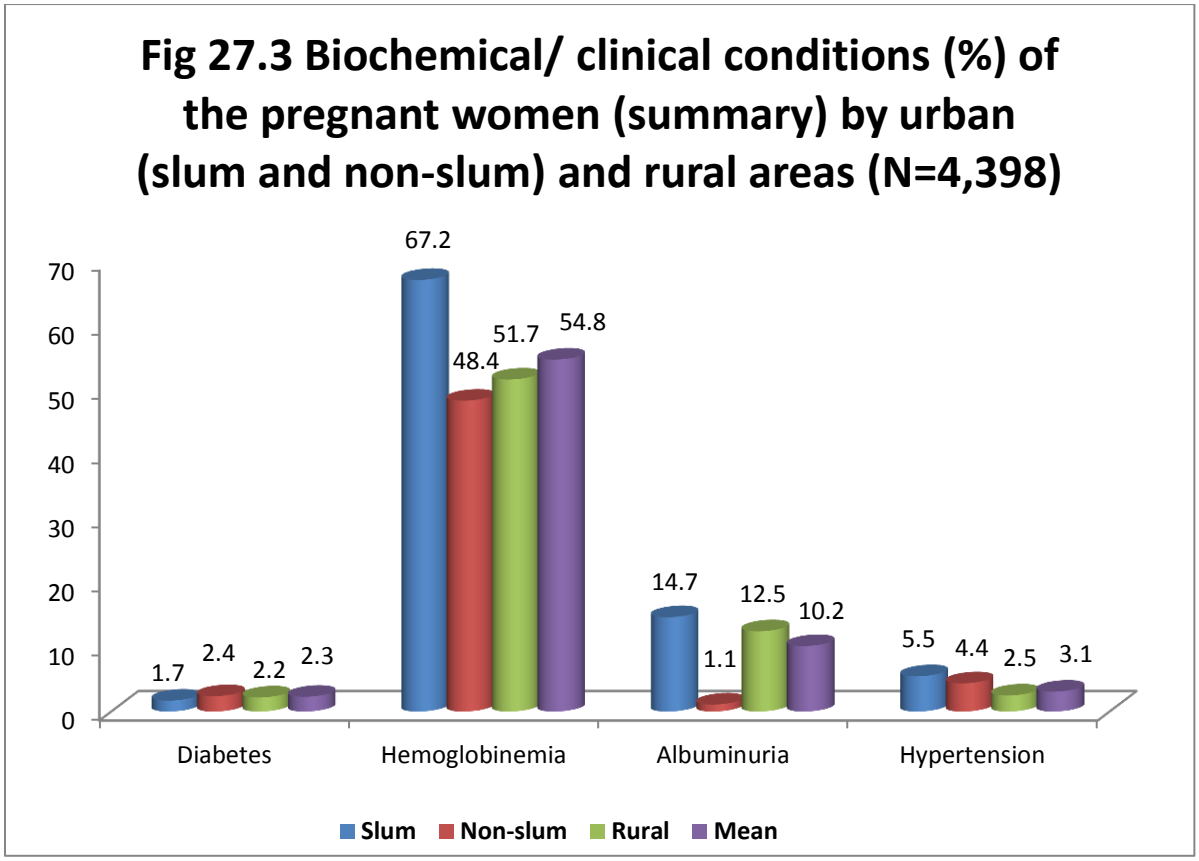
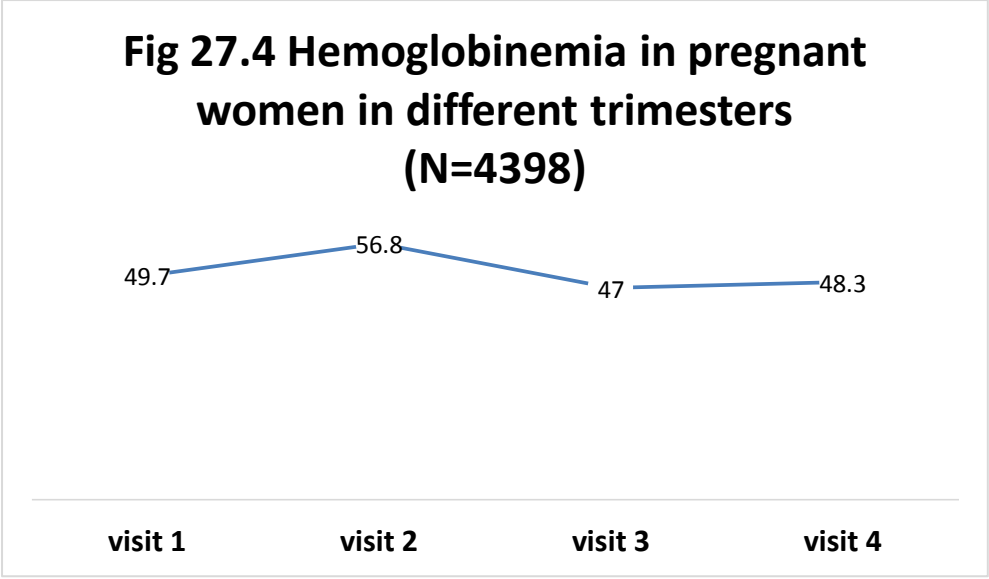


Fig 27.2 Biochemical/ clinical conditions of pregnant women by division and urban (slum and non-slum) and rural areass (N=4,398)



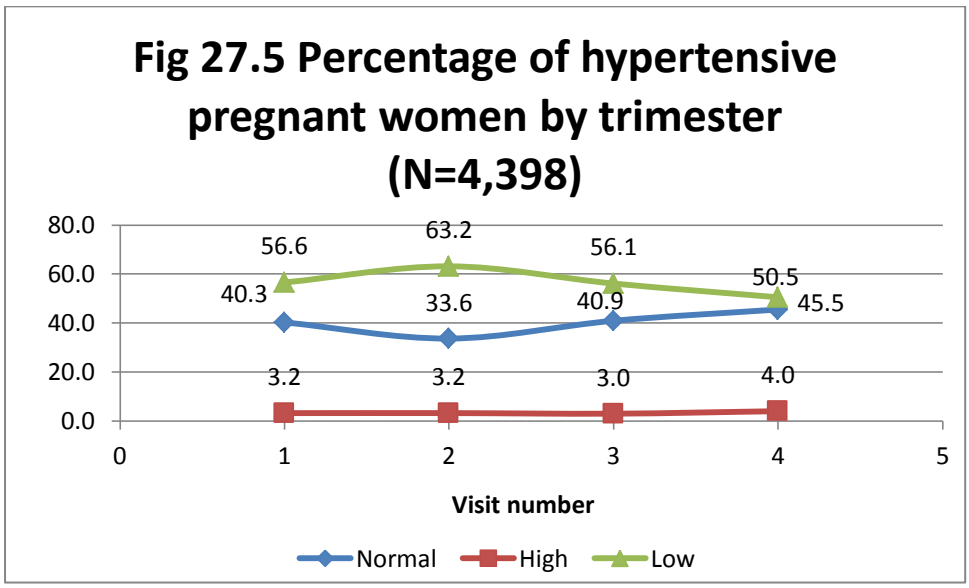


An assessment was made on the levels/ degree of diabetes, hemoglobinemia, and hypertension between the four mandatory visits, every trimester (two in the last trimester), made to the pregnant women by the data collectors. The results are as below:

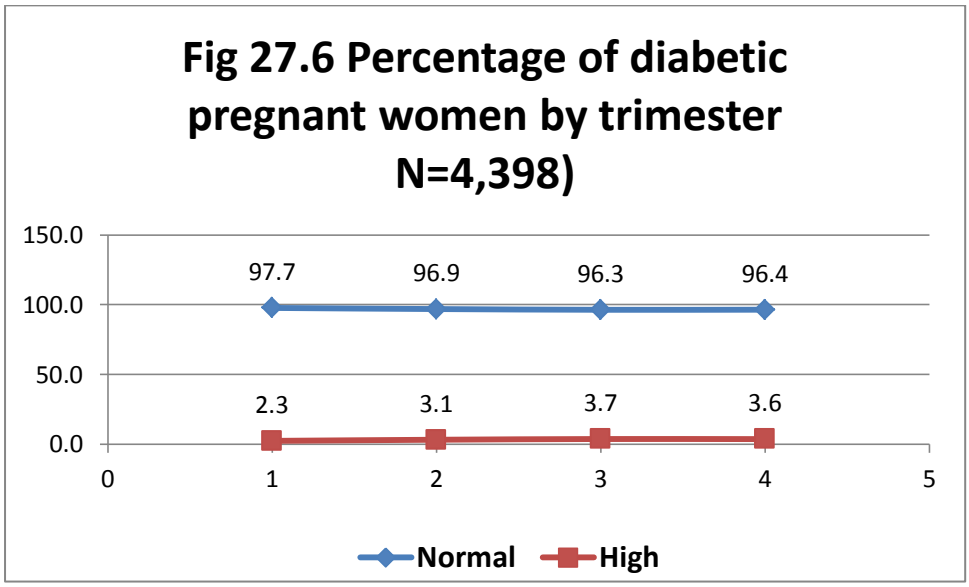


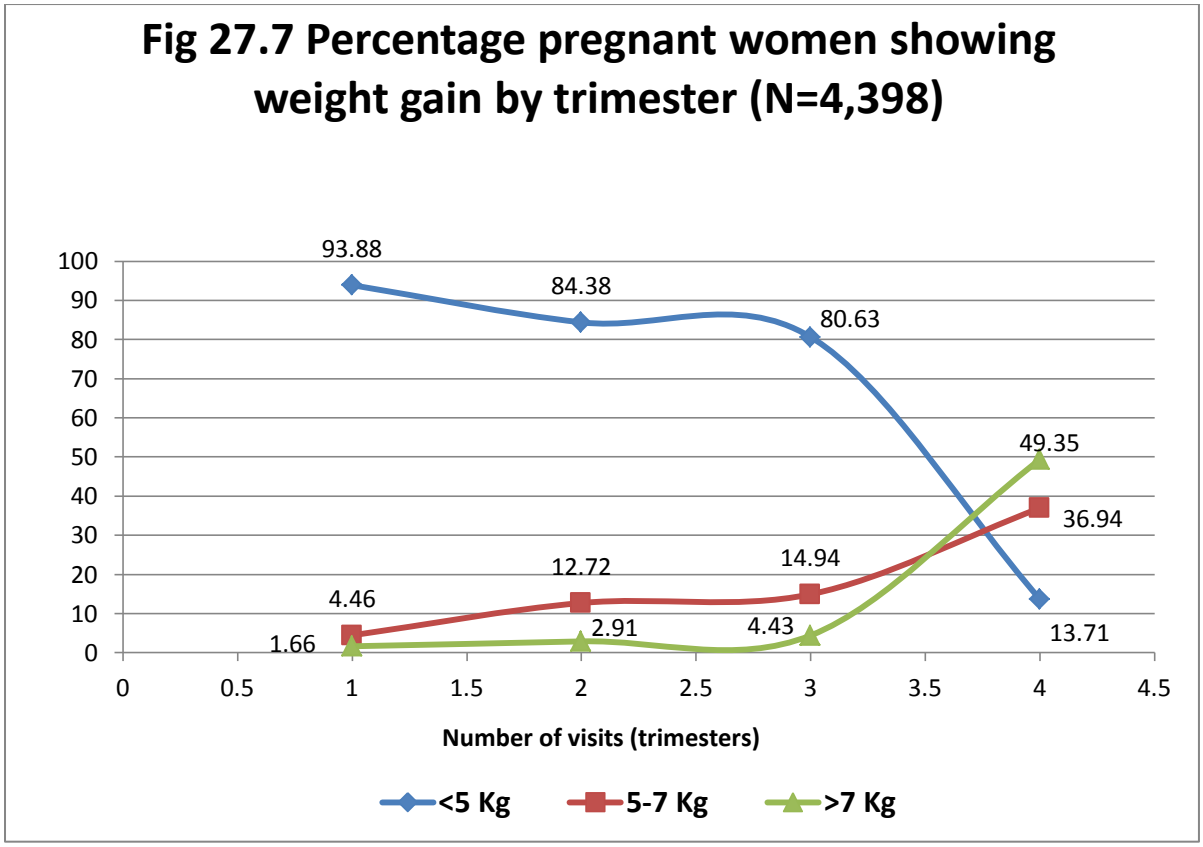
By McNemar's test the differences in the degree of hemoglobinemia between the four visits were significant (except the difference between the first and the last visits). Hemoglobinemia was highest in the second trimester. It was slightly more near the date of delivery, although not more than what was observed in the beginning of pregnancy. This lowering of hemoglobinemia might be due to the effect of iron folate intake the pregnant women, more religiously at the end (Fig 27.4).

The rate of hypertension increased near to the date of delivery (Fig 27.5), while the number with low blood pressure decreased and hence the number of pregnant women with normal blood pressure increased gradually commensurate to decrease in the number of low pressure individuals after the second trimester. These differences in the number of pregnant women with normal blood pressure are significant by McNemar's test between the different visits (trimesters), except between the fist and the second trimester readings. The difference in the number of pregnant women with hypertension also increased significantly close to the data of delivery, which is a significant finding in this survey.



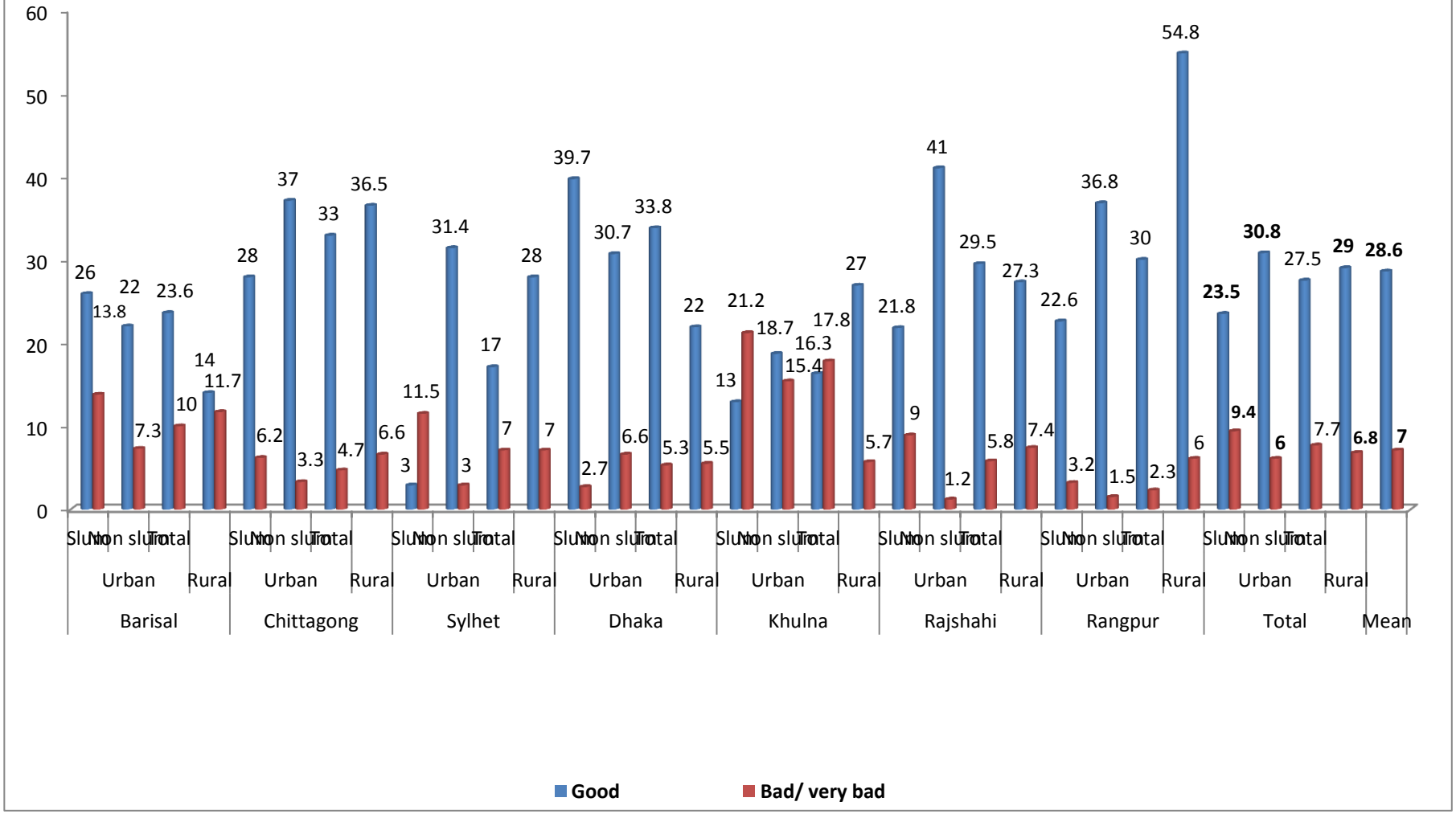
The sugar level increased close to the delivery data (Fig 27.6). While the difference in the rate of diabetes was not significant between the first three visits, the rate increased significantly in the last recording (p=0.000, McNemar's test)





Significant number of pregnant women gained weight between the first and the last trimester (P=0.000 by paired 't' test). More and more of the pregnant women came out of the less than 5 Kg weight gain category as the pregnancy period advanced (Fig 27.7). While initially only 1.66 percent of them showed more than 7 Kg of weight gain (from the initial weight taken at the beginning, before any follow up), this ended in 49.35 percent. Similarly, those who showed increase of gestational weight in the range of 5-7 Kg was also was significant. During the last recording those who had less than 5 Kg of weight gain in the beginning also showed improvement (falling from 93.88 percent to 13.71 percent (more described below).

Fig 28. Physical appearance of the pregnant women by division and urban (slum and non-slum) and rural areas (N=4,398)



Child birth related information

The range of age among the nulliparous pregnant women in this survey was observed to spread from 13 years to 45 years, with an average of 20.4 years. Among the multiparous the range of age of the pregnant women studied was between 15 years and 40 years, with average of 20.0 years. The standard deviation of 3.14 and 3.38 respectively, show that the dispersion of individual measures was not wide and the central tendency towards the mean was quite strong An almost similar average of age among the nulliparous and multiparous, may mean that comparatively more women are marrying/ bearing children at a later age now. .

Weight gain was measured during the quarterly (trimester-wise) visits to the pregnant women. The data depicts three common categorical (ranges) measurements, average estimates for slum, non-slum and rural measurements and divisional averages separately.

The overall increase of gestational weight between the first and third trimester was 8.2 Kg. Rural area weight gain was more while urban non-slum weight gain was slightly more than slum areas. Sylhet, Khulna and Rangpur divisional averages were more than the overall average in that order. Average weight gain was the least in Barisal (especially in slum areas) and then in Chittagong (especially in rural areas). In Rajshahi also slum and rural area pregnant women showed less wait gain than the overall mean weight gain (Fig 29.1 – 29.3).

The pregnancy outcome was as follows: 93.5 percent live births, 4.7 percent abortions and 1.8 percent still births. The percentage of live births was almost equal in all the study areas- 93.7 percent, 93.6 percent and 93.4 percent in non-slum, slum and rural areas respectively. Chittagong, Dhaka, Khulna and Rajshahi had the highest live births (in slums of Chittagong and Rajshahi) and Dhaka, Chittagong Rajshahi non-slum areas. Barisal, Sylhet and Khulna had the lowest live birth rates. Abortions were more Khulna (particularly in urban areas) and Barisal (as a whole with slightly higher rates in urban areas). Rajshahi had the lowest abortion rate. Dhaka and Rajshahi also had lower rates of abortion (Fig 30.1 and 30.2).

Among the single live births 53.5 percent were boys; and among multiple births, 59.4 percent were boys on average. On the other hand, among those who died right after they were born alive, 59.1 percent were boys on average. In rural areas single birth among boys was 54.0 percent, among multiple births boys were 62.5 percent, while among those who died right after they were born alive 71.4 percent were boys in rural areas. In urban non-slum areas the corresponding figures for boys were 53.6 percent, 33.3 percent and there was no death among boys right after birth. In slums, these were (among boys): 51.6 percent, 60.0 percent and 43.0 percent respectively. In Barisal urban areas, all deaths after live births happened among girls. In rural areas more boys died after they were born alive. In Sylhet all the deaths among live births were girls and in non-slum areas. In urban areas of Rajshahi all who died were girls (in slums only).In rural areas of Rajshahi these deaths were equal among boys and girls. In Khulna slums also the deaths were equal among boys and girls and in rural areas more boys died than girls. In Barisal rural areas also more boys died than girls, right after their birth alive. In Chittagong and Dhaka rural areas and in Sylhet slums all those who died were boys. In general to sum up, while more deaths occurred among live birth girls in urban areas (slums) it was opposite in rural areas (Fig 31.1 and 31.2) and no death among boys in none slums.

Fig 29.1 Gestational weight gain (in Kg) by division and urban (slum and non-slum) and rural areas (N=4,398)

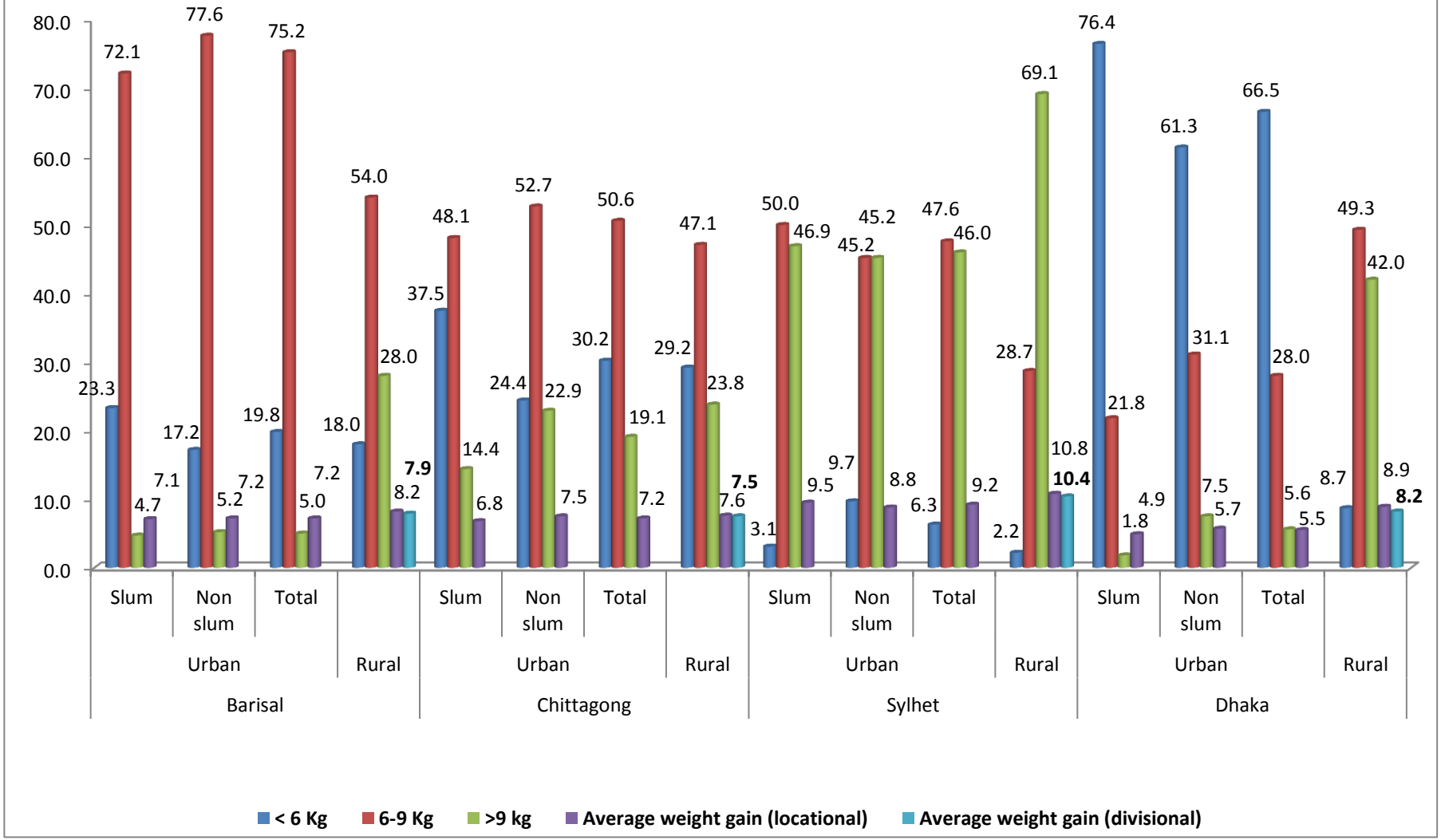


Fig 29.2 Gestational weight gain (in Kg) by division and urban (slum and non-slum) and rural areas (N=4,398)

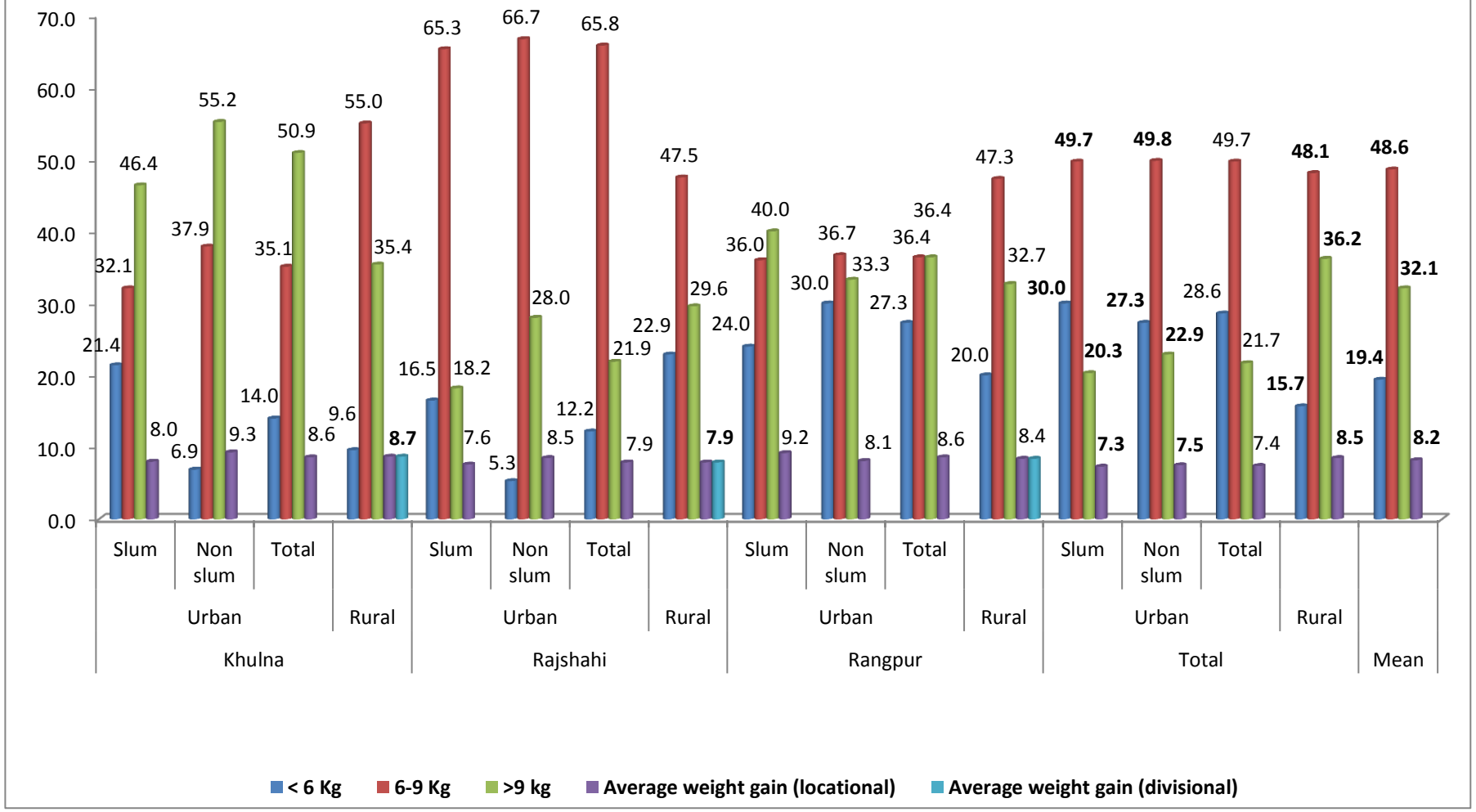


Fig 29.3 Weight gain (in Kg) during pregnancy (summary) by urban (slum and non-slum) and rural areas (N=4,398)

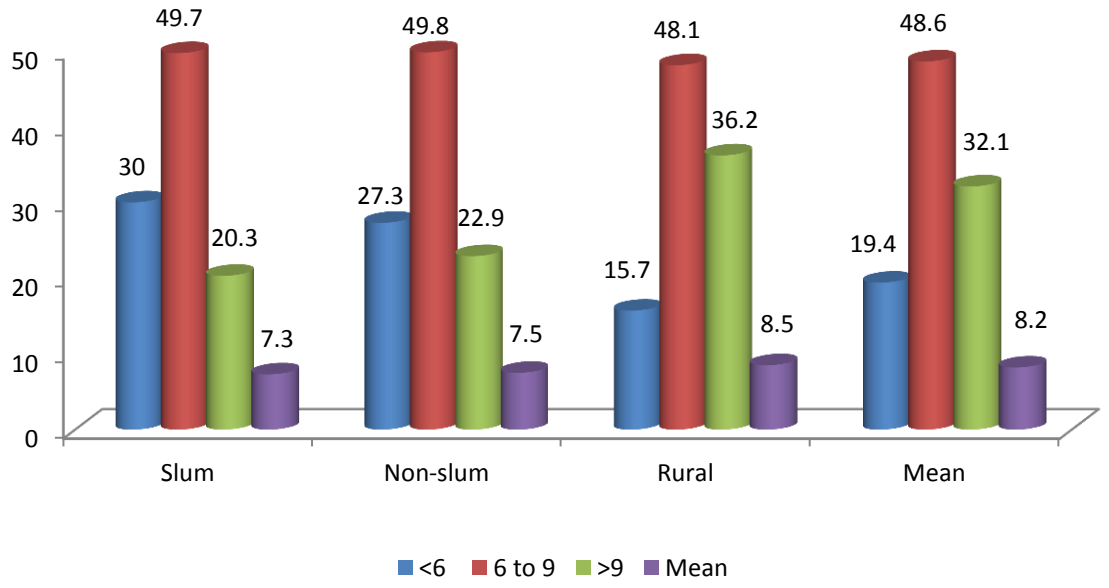


Fig 30.1 Pregnancy outcome by division and urban (slum and non-slum) and rural areas (N=4,398)

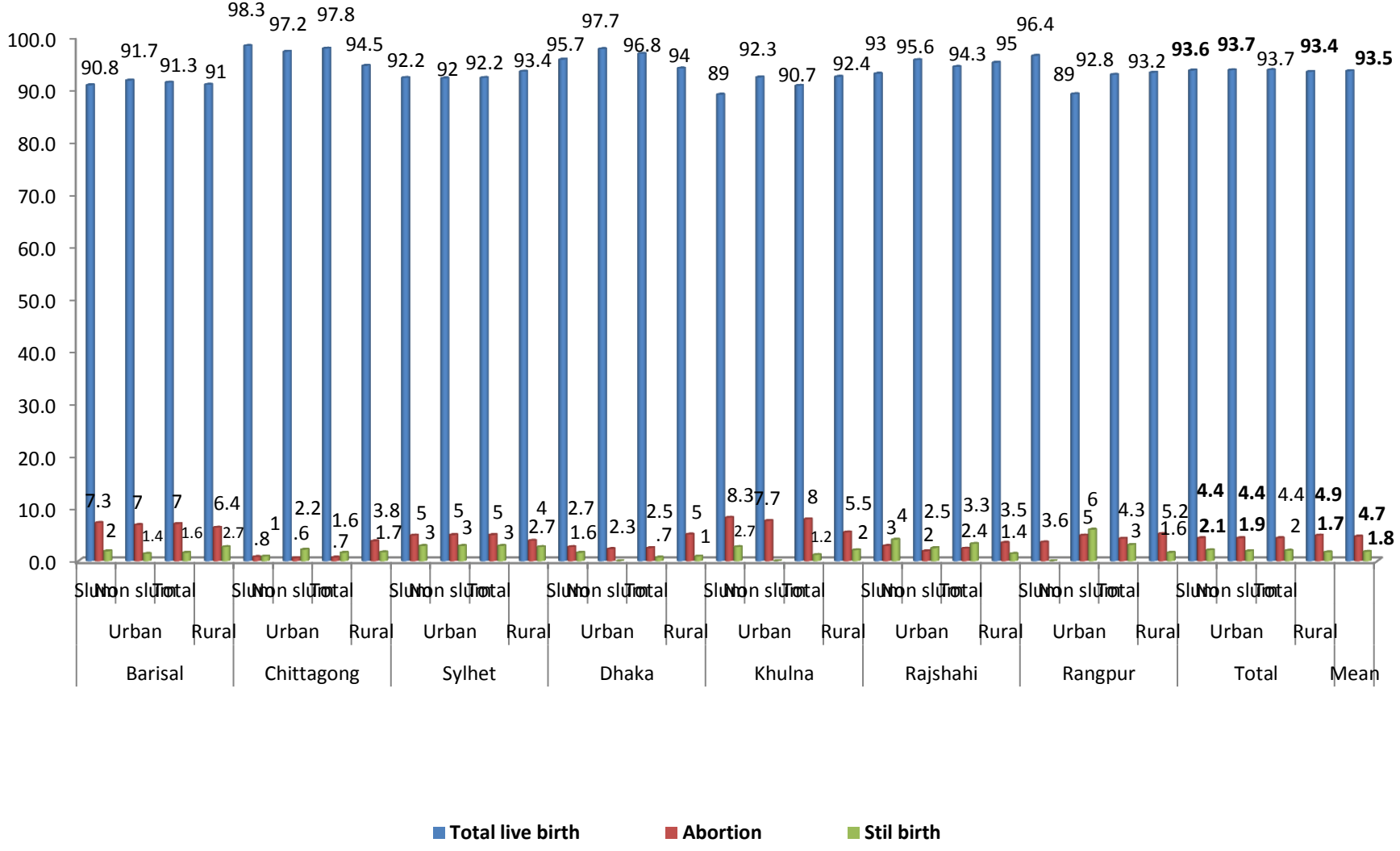
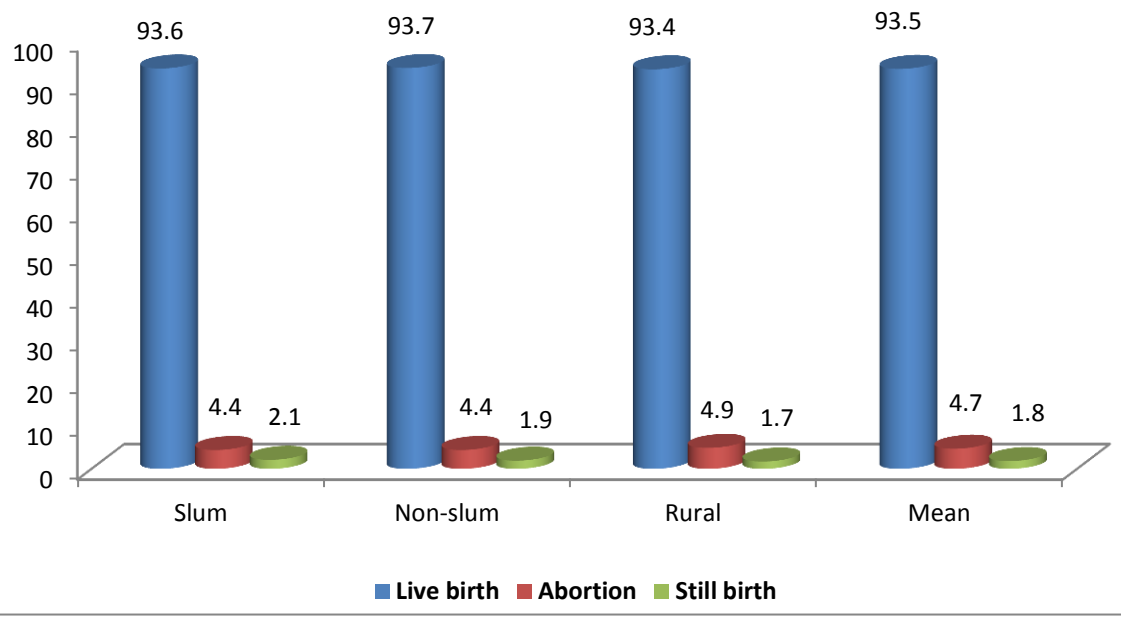


Fig 30.2 Pregnancy outcome (summary) by urban (slum and non-slum) and rural areas (N=4,398)



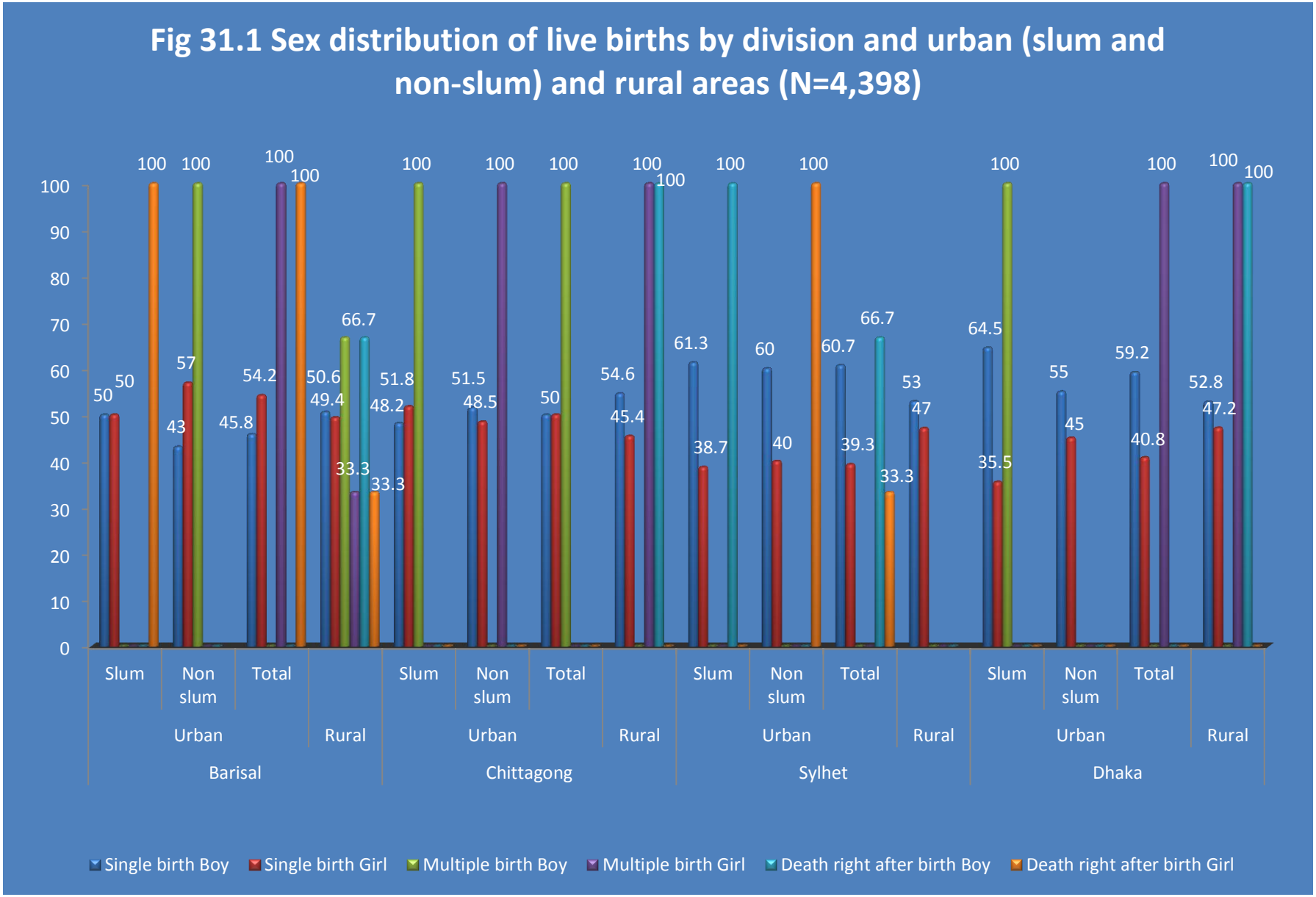
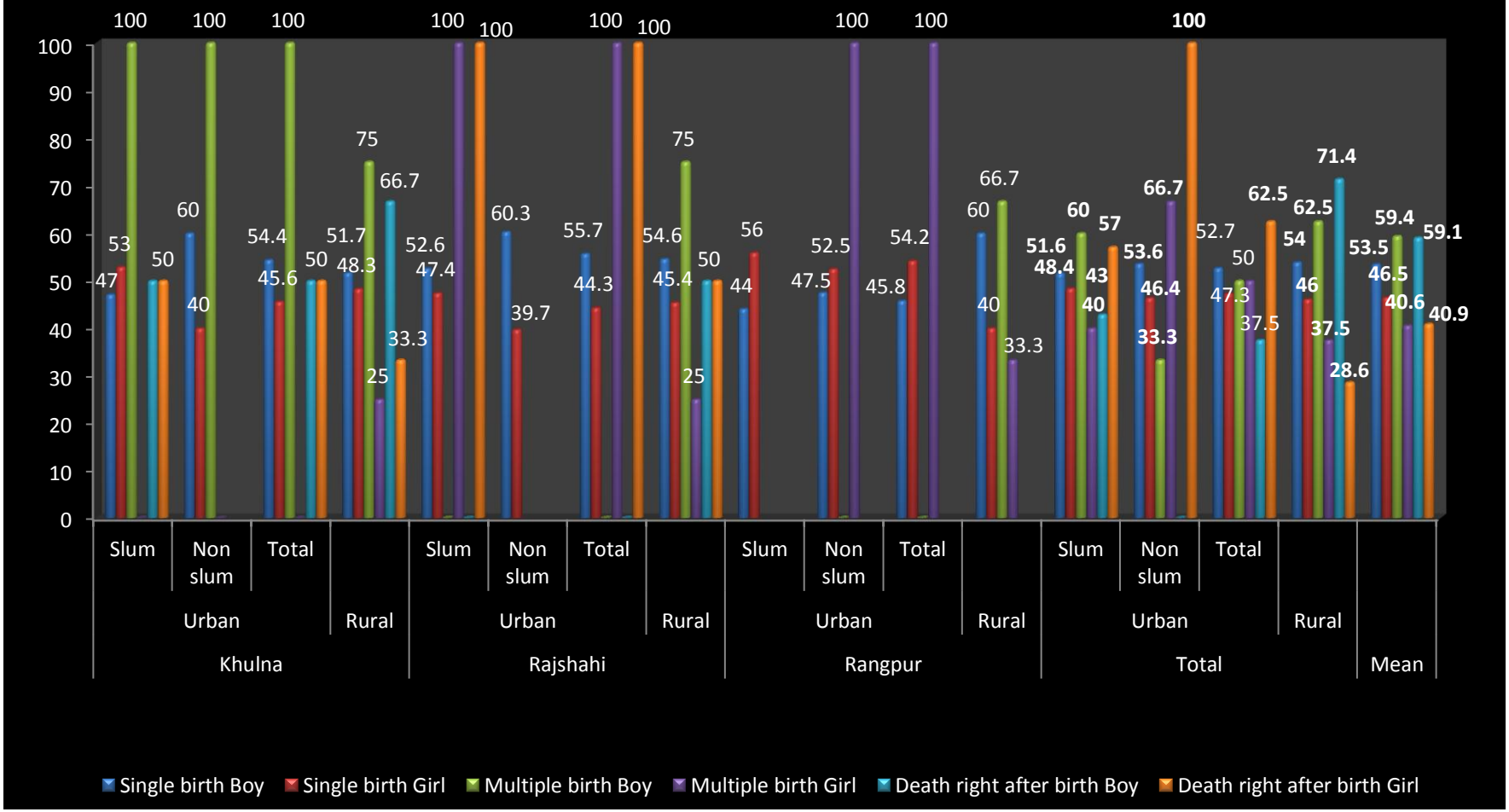


Fig 31.1 Sex distribution of live births by division and urban (slum and non-slum) and rural areas (N=4,398)
100
90
80
70
60
50
40
30
20
10
0
Slum
Non slum
Total
Urban
Rural
Barisal
Chittagong
Sylhet
Dhaka
Single birth Boy
Single birth Girl
Multiple birth Boy
Multiple birth Girl
Death right after birth Boy
Death right after birth Girl

Fig 31.2 Sex distribution by division and urban (slum and non-slum) and rural areas (N=4,398)



Place of delivery

Of all the deliveries 24.5 percent were conducted in public hospitals and 27.2 percent in private hospitals, 4.2 percent were conducted in NGO health facilities, while 42.3 percent were conducted at home, the remaining 1.5 percent were conducted in other places.

In slums 28.8 percent and 18.5 percent went to public and private hospitals respectively for child delivery. In the non-slum areas 32.6 percent and 27.7 percent went to public and private hospitals respectively, while it was 22 percent and 28.7 percent respectively in rural areas.

Pregnant women from slums in Barisal, Chittagong, Khulna and Rajshahi went to public hospitals for child delivery the most, if not using home. In Sylhet the scenario was opposite- more in slum went to private hospitals and those living in non-slum and rural areas went to public hospitals. In Dhaka while rural women preferred private hospitals, more of those from slums and non-slum areas went to public hospitals. In Rangpur in all the locations - urban (slums or non-slum areas) and rural areas, private hospital was more preferred place to go for child delivery (Fig 32.1 – 32.3).

Process of delivery

While not much difference was seen in the rates of assisted delivery, e.g., forceps delivery, marked change was noted between the rates of Caesarian operation in the past and the present mode of child delivery- 35.5 percent to 21.3 percent. This upward trend of Caesarian operations has been noted in all the three locations- slums, non-slum areas and rural areas equally, albeit by absolute amount the least in the slums and the highest in the non-slum areas (almost half of the pregnant women of non-slum areas went through surgical method for child birth, especially in Rajshahi, Dhaka, Khulna and Barisal). Difference was also notable in the rate of assisted delivery in urban slums and non-slum areas, but not much in rural areas (Fig 33.1 – 33.3).

Fifty five percent of the deliveries were conducted by physicians, nurses, family welfare visitors (FWV), and sub-assistant community medical officers (SACMO); 26.4 percent by community based skilled birth attendants (CSBA), 10.7 percent by untrained birth attendants and the rest 7.9 percent by relatives and neighbors. Among the non-slum pregnant women the delivery was conducted by physicians/ nurses/ FWVs/ SACMOs in almost 71 percent of cases, least was among the rural women. But this shortfall was compensated by CSBAs in the rural areas, where 29.2 percent of delivery was conducted by them. In urban areas also CSBAs conducted deliveries although in a lesser number (25.9 and 14.3 percents respectively). Unskilled birth attendants conducted deliveries in about 11 percent rural families and 10.0 percent families in urban areas (Fig 34). Neighbors/ relatives conducted the least number of deliveries in non-slum areas (less than 5 percent). Rajshahi. Khulna and Dhaka non-slum areas saw the highest number of deliveries conducted by physicians/ nurses/ FWVs/ SACMOs (about 80 percent or more). CSBAs conducted the highest number of deliveries in Sylhet division as a whole (Fig 34.1 - 34.2)..

Fig 32.1 Place of delivery by division and urban (slum and non-slum) and rural areas (N=4,398)

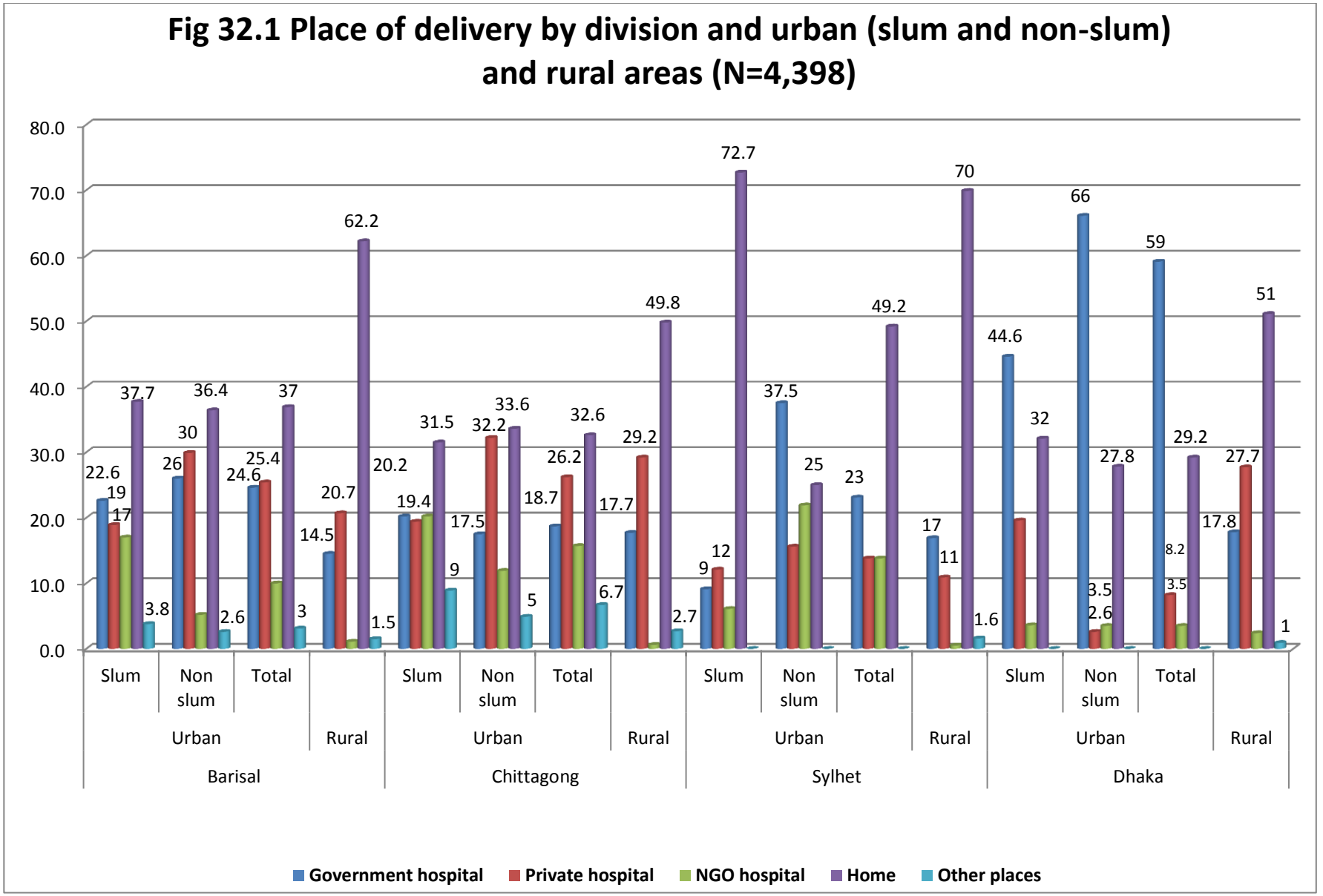


Fig 32.2 Place of delivery by division and urban (slum and non-slum) and rural areas (N=4,398)

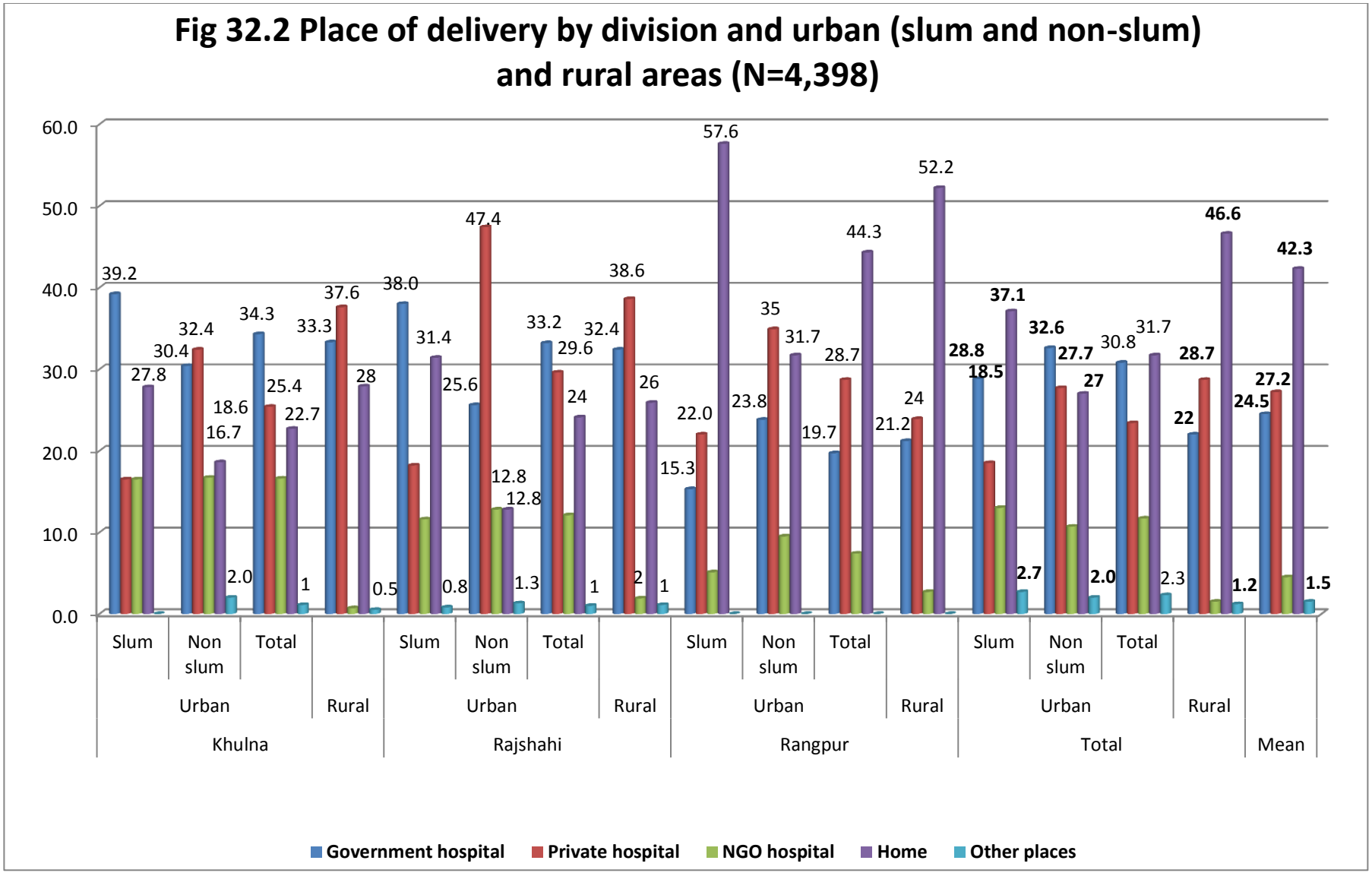


Fig 32.3 Place of delivery (summary) by urban (slum and non-slum) and rural areas (N=4,398)

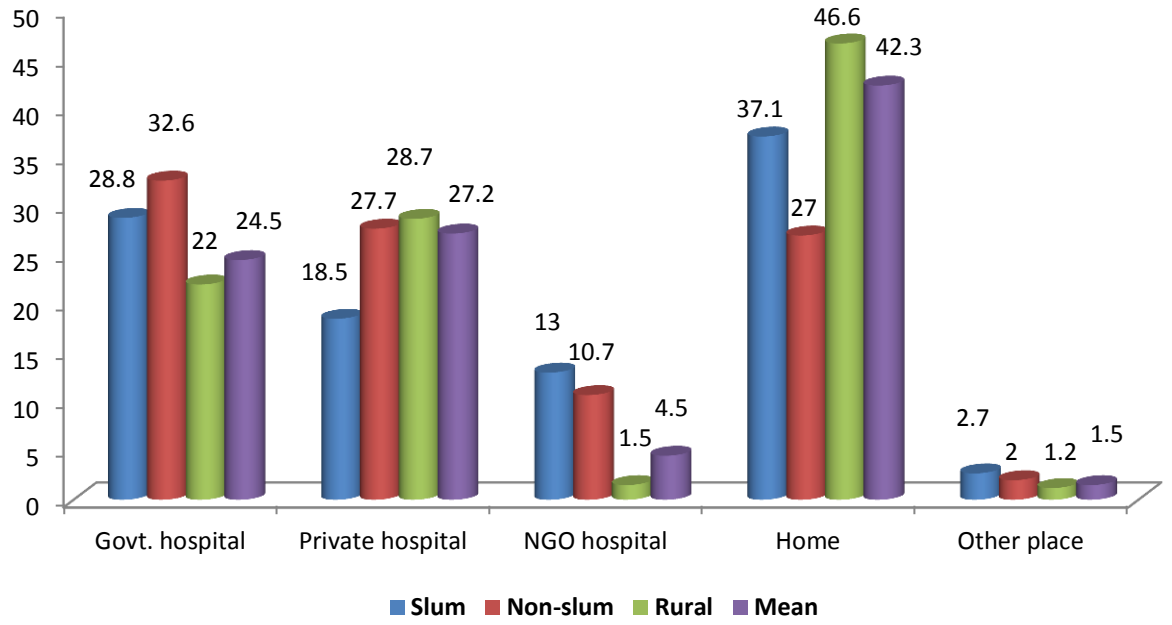


Fig 33.1 Process of delivery by division and urban (slum and non-slum) and rural areas (N=4,398)

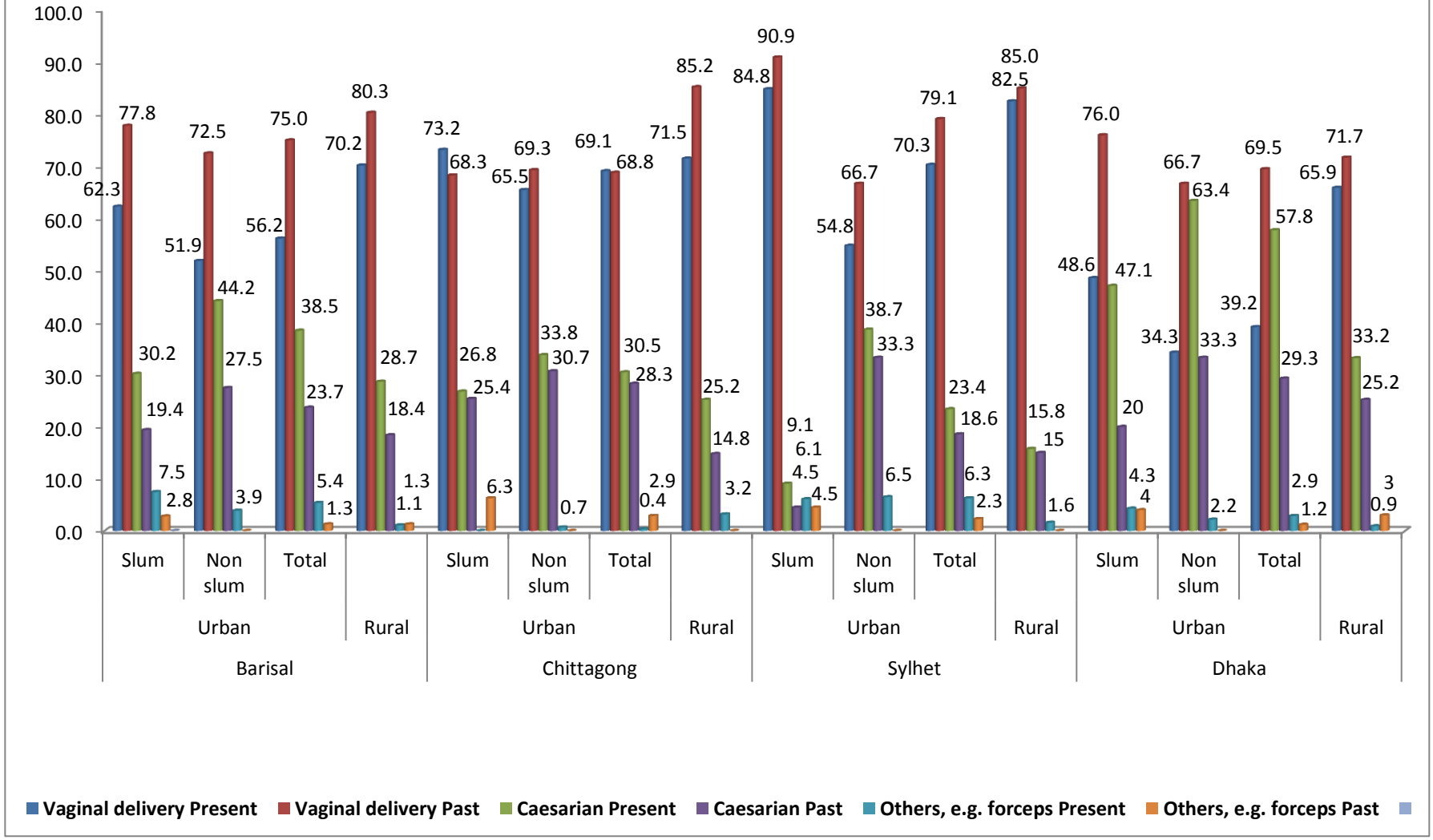


Fig 33.2 Process of delivery by division and urban (slum and non-slum) and rural areas (N=4,398)

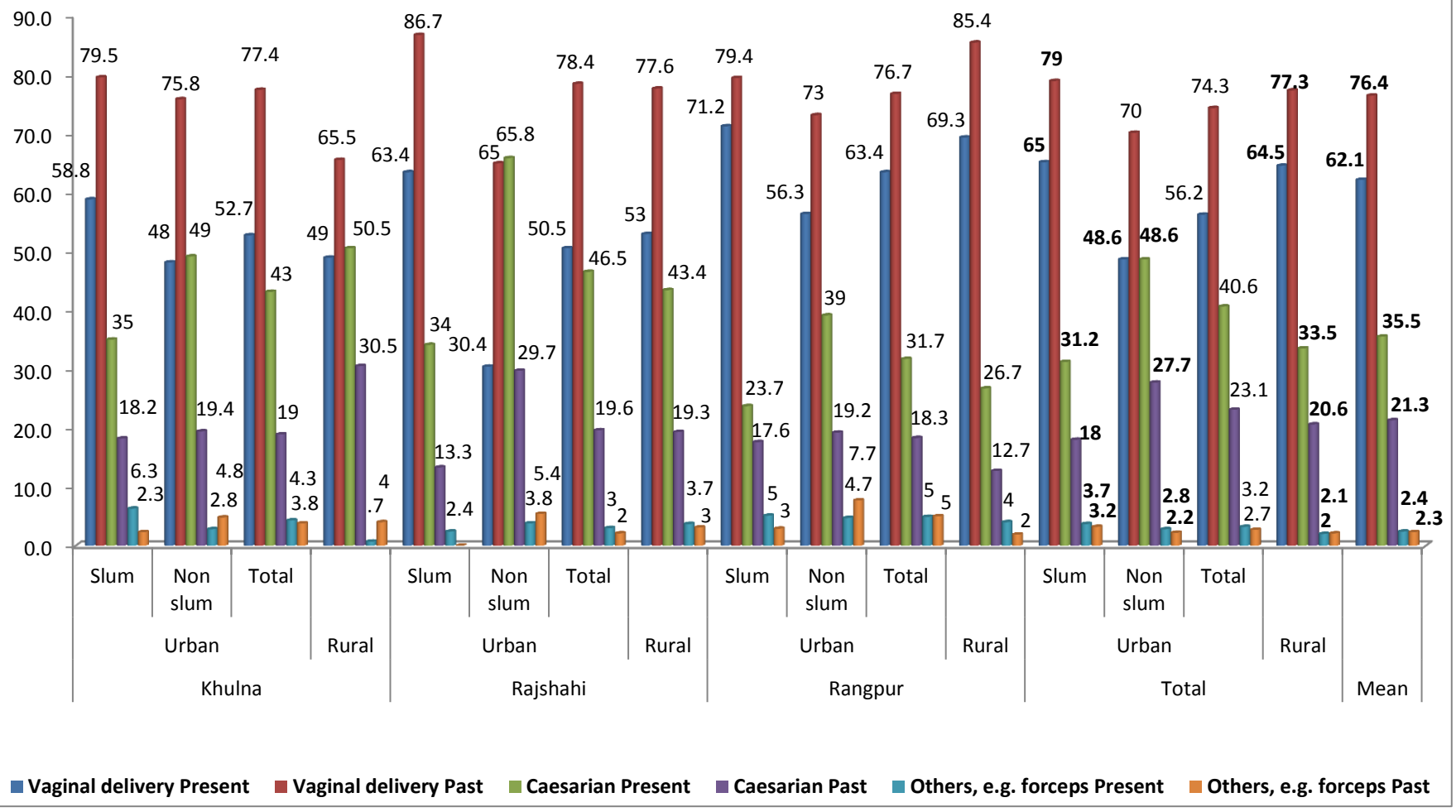


Fig 33.3 Process of delivery (summary) by urban (slum and non-slum) and rural areas (N=4,398)

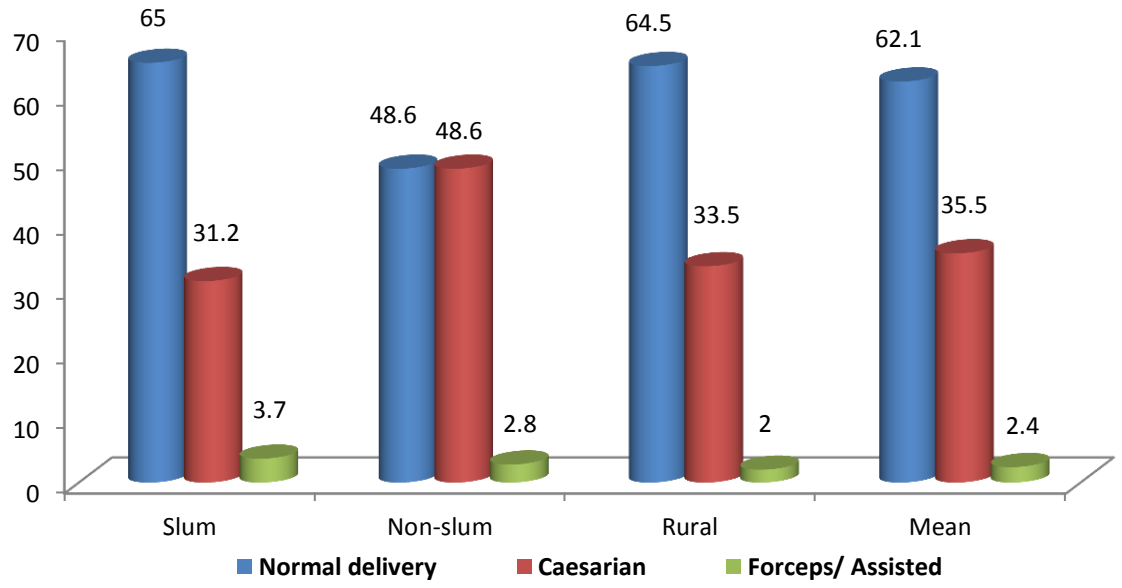


Fig 34.1 Provider of child delivery by division and urban (slum and non-slum) and rural areas (N=4,398)

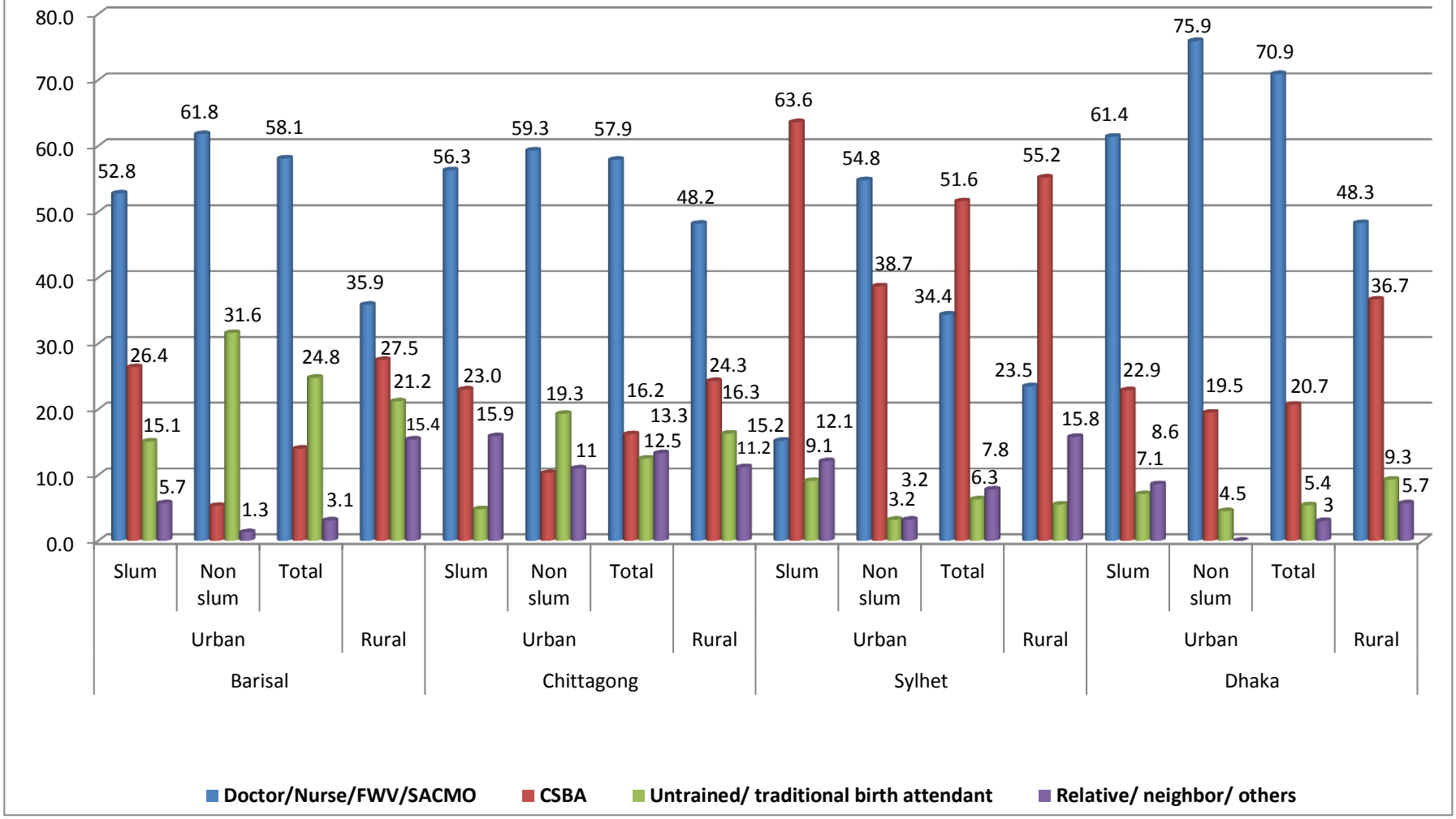


Fig 34.2 Provider of child delivery by division and urban (slum and non-slum) and rural areas (N=4,398)

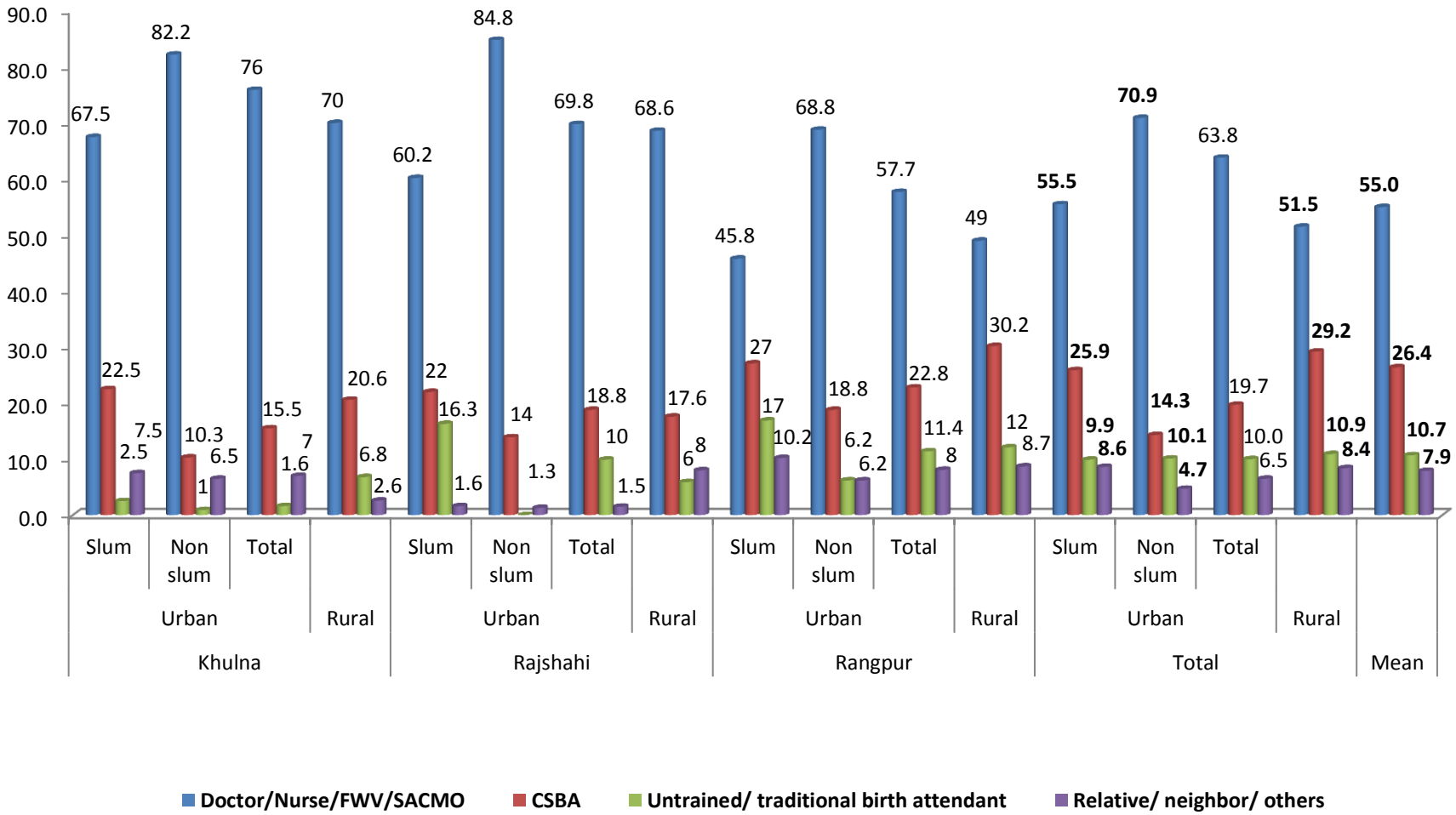
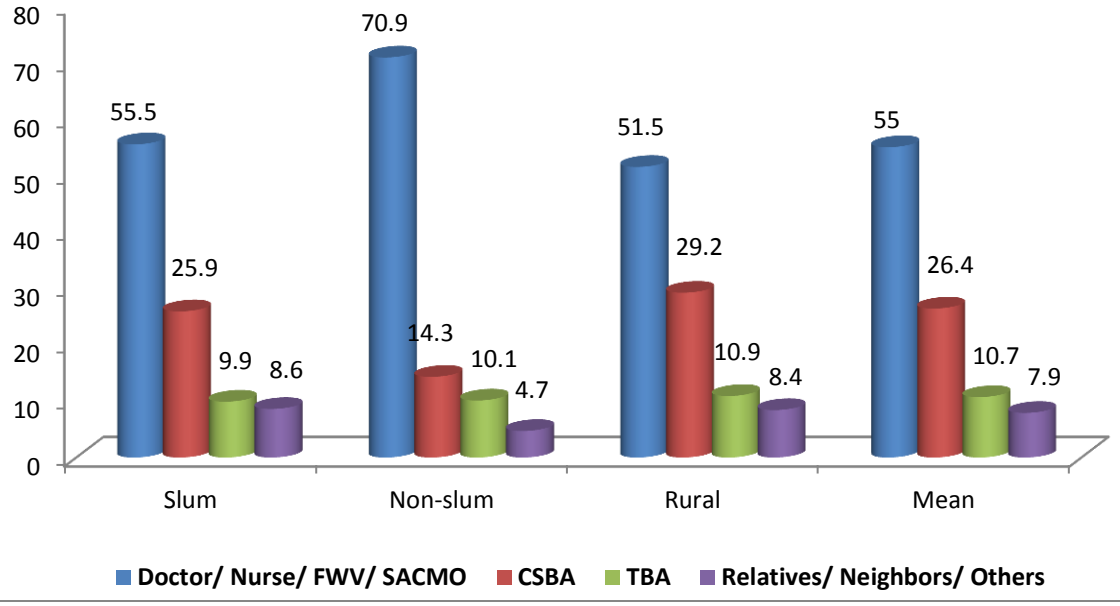


Fig 34.3 Provider of child delivery (summary) by urban (slum and non-slum) and rural areas (N=4,398)



Birth weight

The average birth weight among the newborns was 2.9 Kg.Low birth weight has been found in 22.6 percent of the newborns. Birth weight above 2.5 Kg was the least among the urban slum pregnant women- 76.1 percent, in the non-slum newborns 77.9 percent were above 2.5 Kg of birth weight. In total 77.1 percent of urban newborns weighed more than 2.5 Kg. In rural areas 77.4 percent newborns weighed more than 2.5 Kg. This shows that while non-slum urban newborns weighed the most, rural newborns weighed more than the urban slum newborns. Except in Chittagong, in all other divisions, urban non-slum newborns had higher birth weight than slum and rural newborns. In Dhaka division, newborns in rural areas weighed slightly more than the urban newborns (79.4 percent to 79.2 percent). In Rangpur, Sylhet, Dhaka and Barisal rural newborns weighed more than their counterparts in urban slums substantially. While in Khulna urban slum newborns weight slightly higher than the rural newborns; but in Rajshahi and Chittagong this difference is quite substantial in this difference (Fig 35.1 – 35.4).

Throughout, boys weighed more than girls irrespective of whether they are from rural or urban areas (Fig 36 and 37). On average 20.7 percent of boys and 24.8 percent of girls weighed less than 2.5 kg in this study. In all the divisions boys weighed more than girls, in particular in Barisal, Sylhet and Rajshahi and Dhaka (Fig 36).

Low birth weight naturally was more among those who took birth before 37 weeks of gestational period- 27.11 percent of them. Interestingly, it started to climb up in the 42nd week of gestation and thereafter, although not to that extent as before the 37 week of gestation (Fig 38).

The intrauterine growth retardation (IUGR) rate was quite high- 72.9 percent (Fig 38). But the identification of IUGR should be taken up cautiously, as the cut-off used for the identification, which is the 37th week, is difficult to pin-point, as rural and slum women would not declare their pregnancy status unless they are sure that they would be able to retain their pregnancy, which is after two to three months of last menstrual period.

Birth weight was found to be higher among those who were born in health facilities, irrespective of whether they were delivered in rural or in urban areas, while the average birth weight was almost same irrespective whether they were born in rural or urban areas (Fig. 39). More babies were bornless than 2.5 Kg at birth when delivered athome, irrespective of the location of delivery- urban slum, non-slum or rural areas;the percentage of such babies was more however, in rural areas (Fig 40).

Fig 35.1 Birth weight (unadjusted) by division and urban (slum and non-slum) and rural areas (N=4,398)

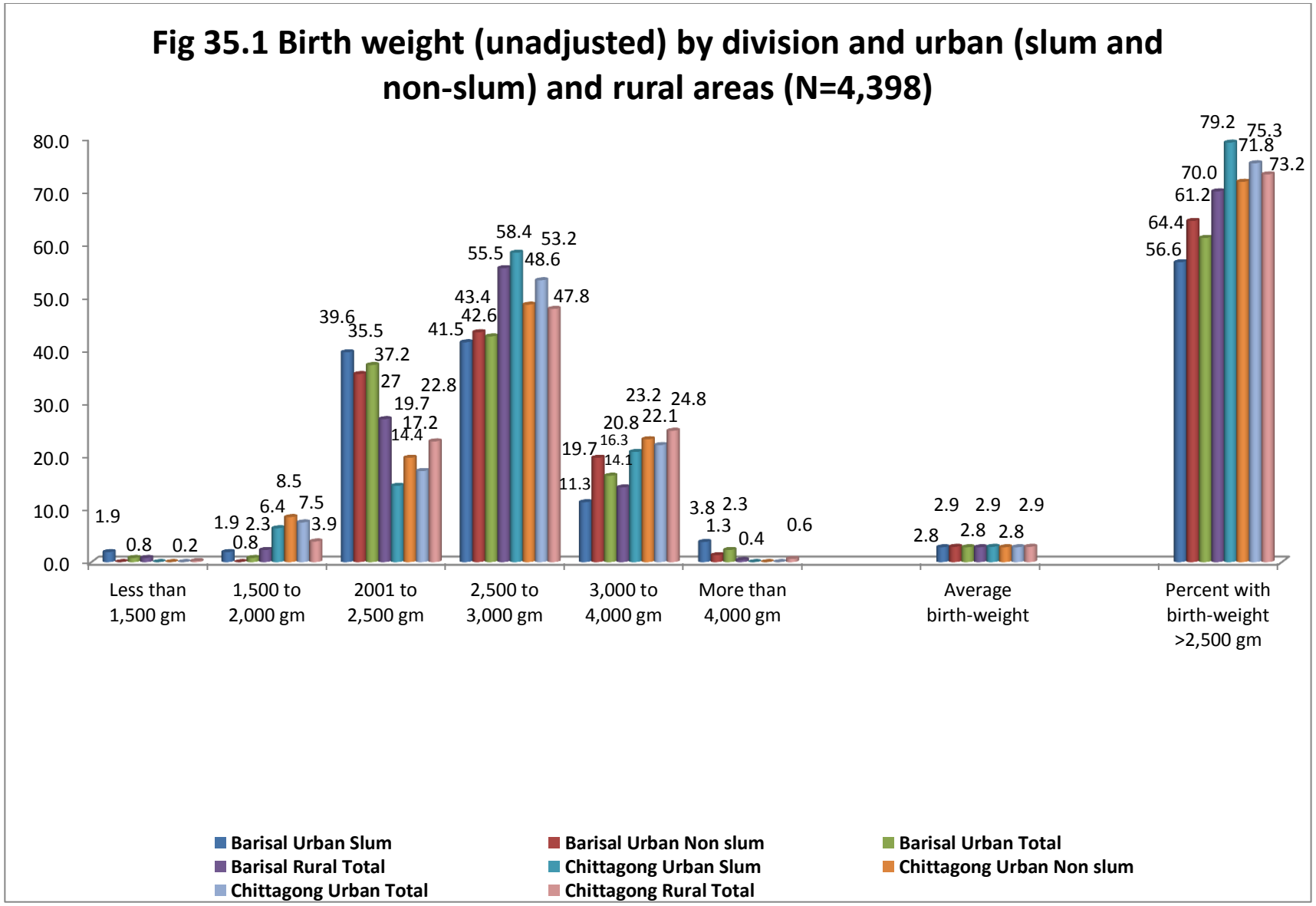


Fig 35.2 Birth weight by division and urban (slum and non-slum) and rural areas (N=4,398)

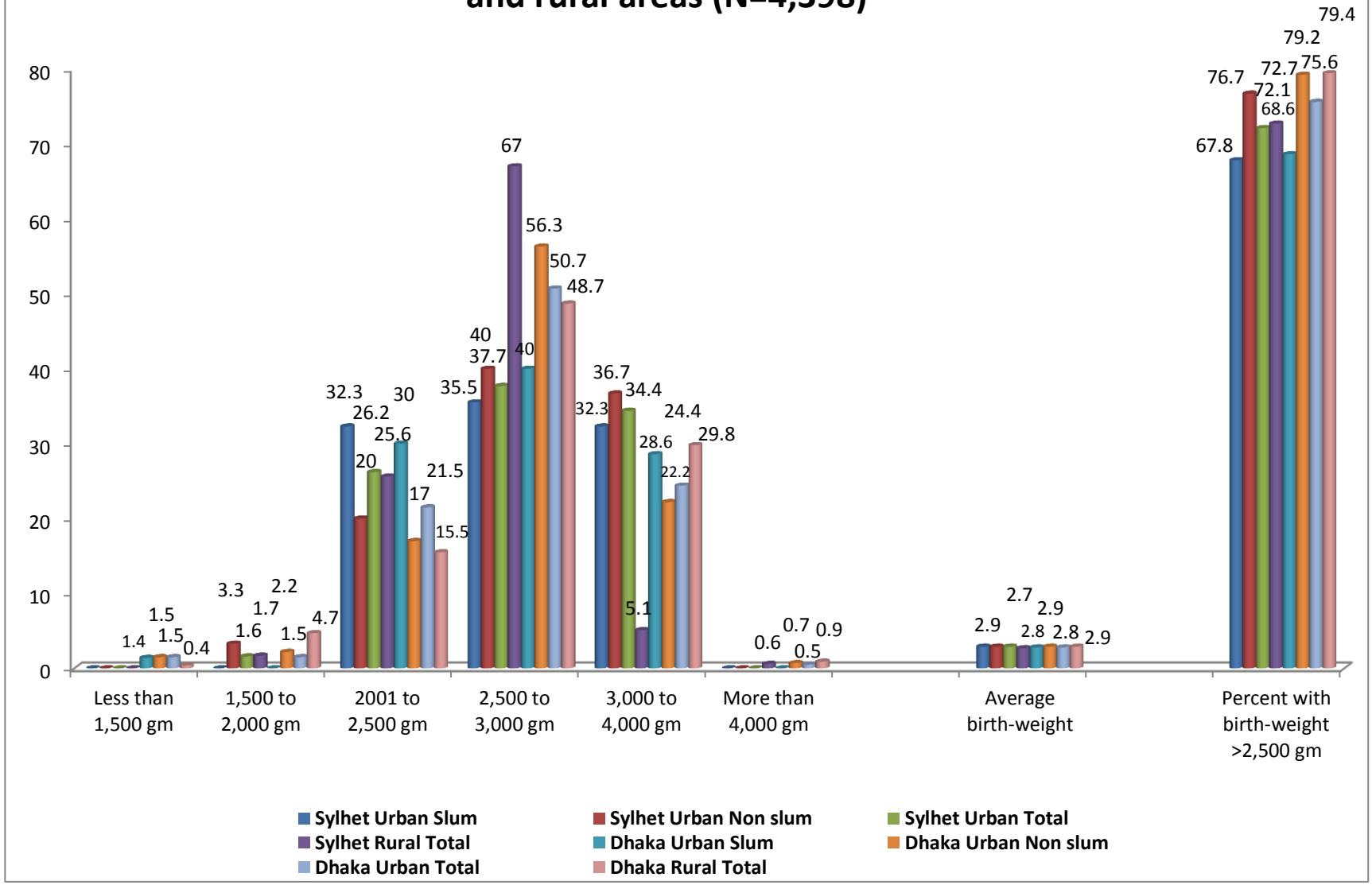


Fig 35.3 Birth weight by division and urban (slum and non-slum) and rural areas (N=4,398)

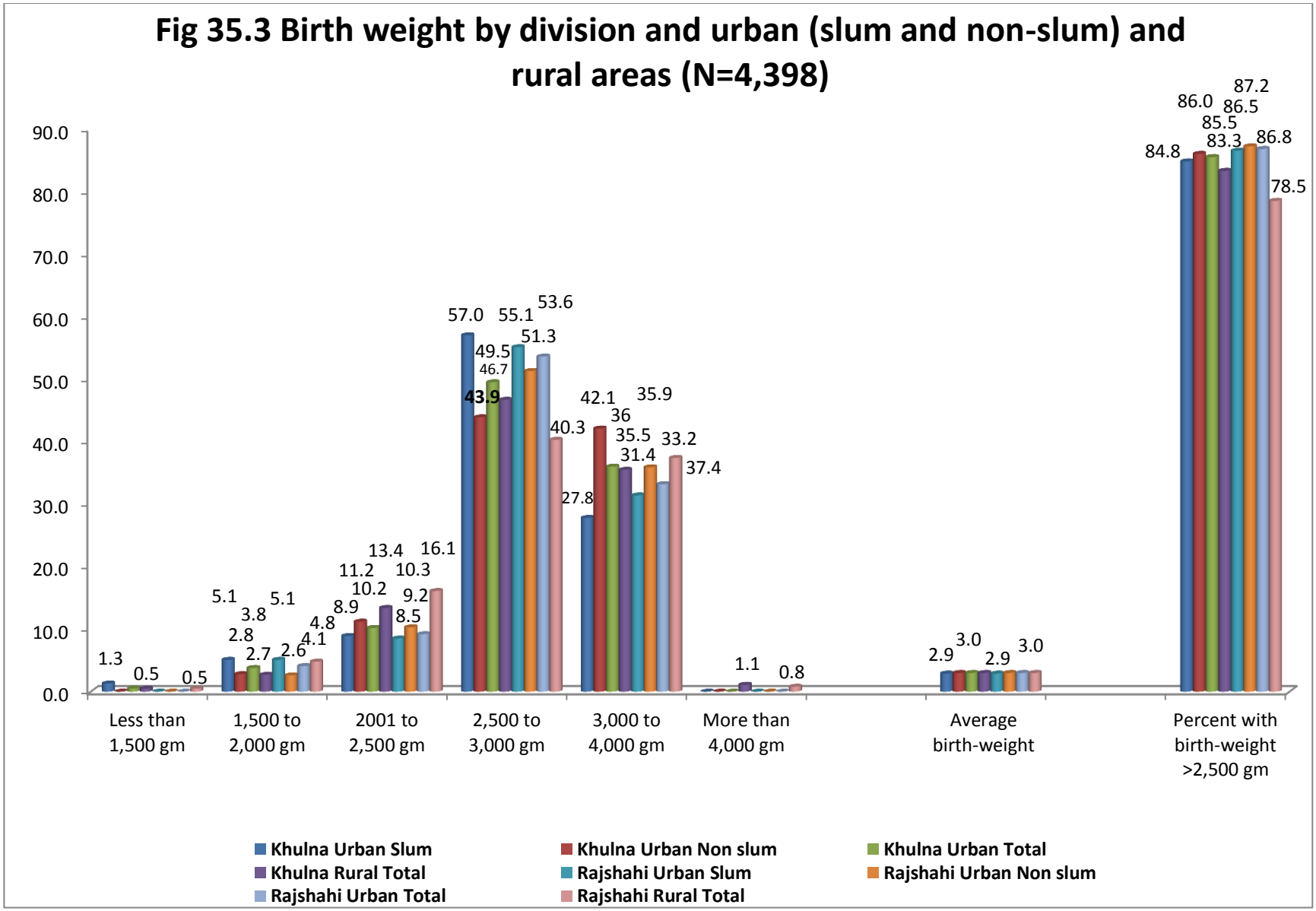


Fig 35.4 Birth weight by division and urban (slum and non-slum) and rural areas (N=4,398)

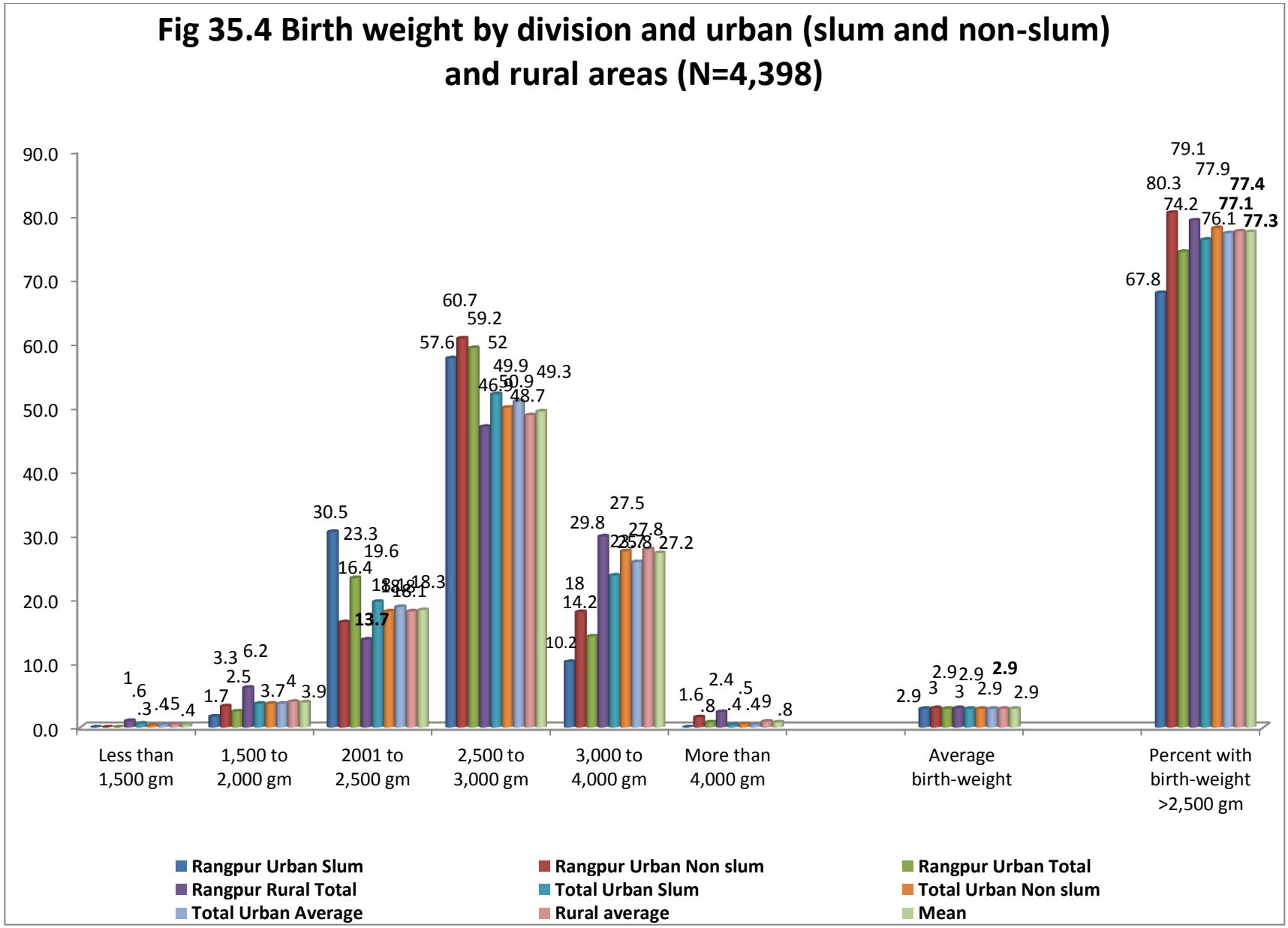


Fig 36. Birth weight <> 2.5 Kg by division and sex (N=4,108)

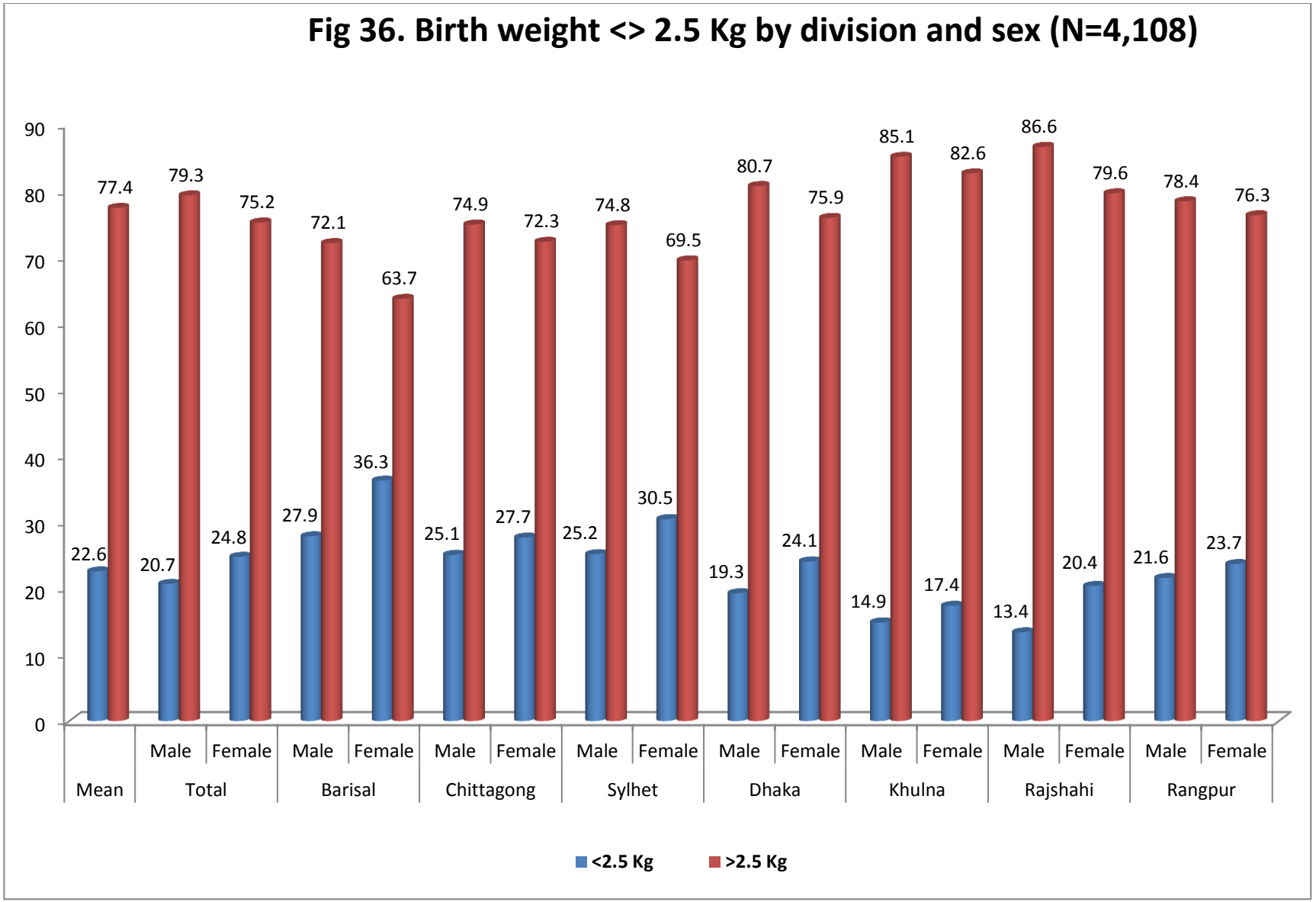


Fig 37. Birth weight (summary) by sex and urban areas (slum and non-slum) (N=1,161)

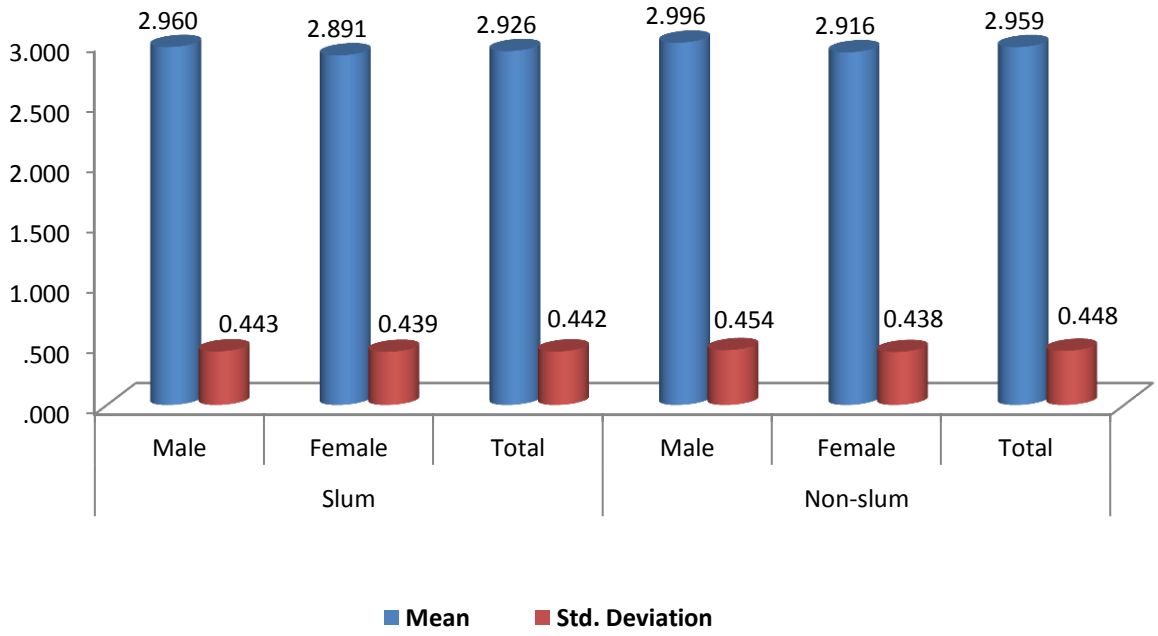


Fig 38. Birth weight <> 2.5 Kg (summary) by gestational weak and other measures (N=4,398)

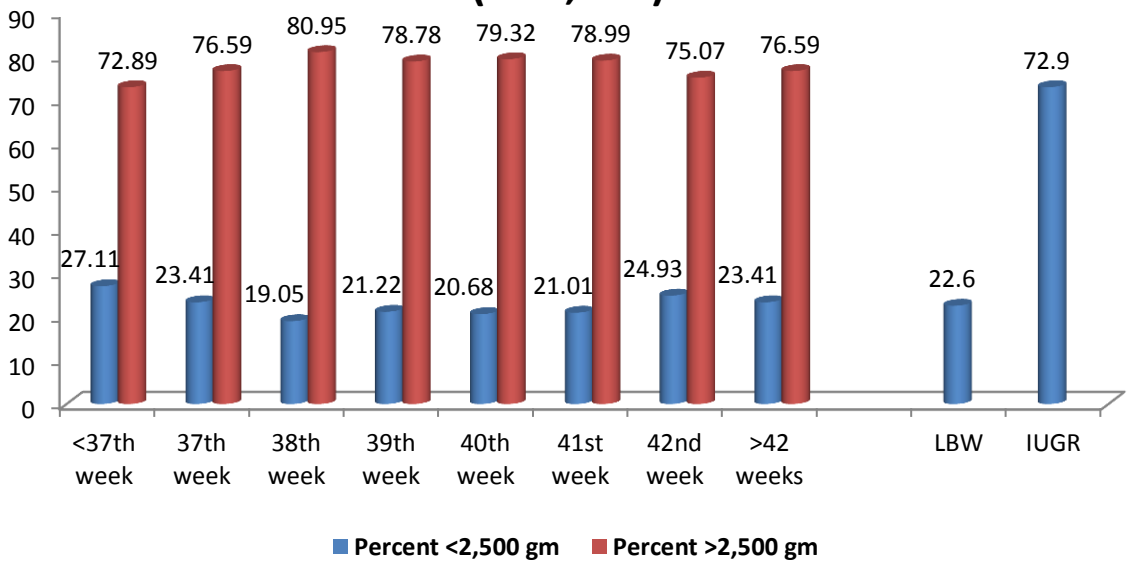


Fig 39. Birth weight by place of delivery

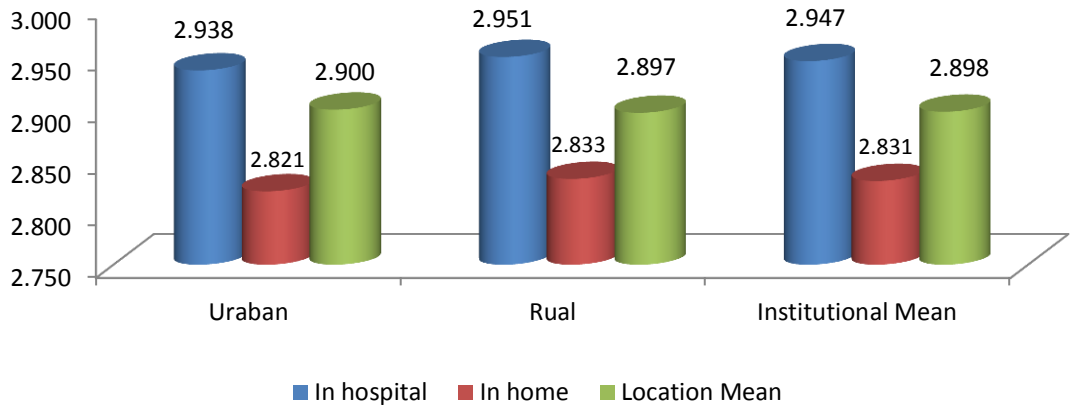
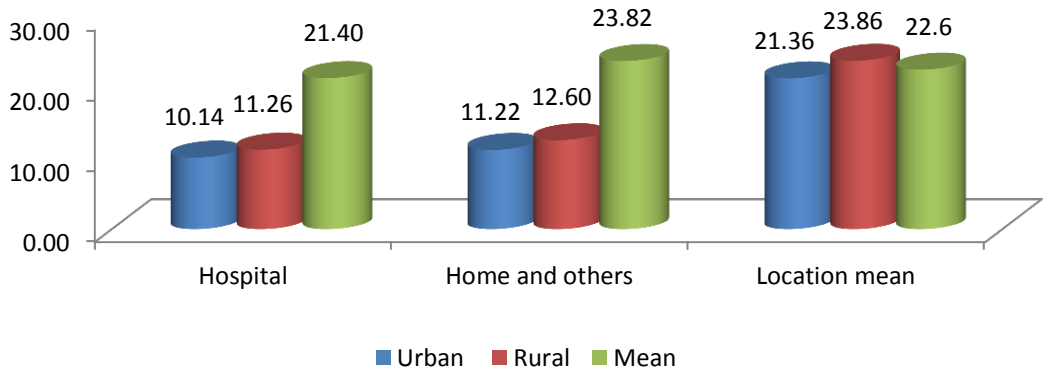


Fig 40. Percentage of newborns weighed <2.5 Kg by location and place of delivery



Birth length

The average birth length was estimated to be 47.3 cm. The average birth length among boys was 47.4 cm and among girls 47.2 cm (Fig 41). While birth length was the smallest in those who were born before 37 weeks of gestation (which is natural), it was again lower in advanced gestational period - after the 37th and the 38th week of gestation, without any particular pattern or trend, as was seen in case of birth weight. The trend in length by gestational age was however, not completely linear, i.e., swings/ notches were noticeable, when birth length was matched with gestational week, completed before birth. These swings/ notches were also noticed when matched by location- urban slums and non-slums and rural areas. In general the birth length was highest among the rural newborns and slightly higher among the newborns in the non-slum urban areas. Rural estimate was higher because of mainly Chittagong, Dhaka, and Khulna divisions. Birth length especially was the lowest in Dhaka division urban areas. In Barisal, the rural estimate was lower. In other divisions urban estimates were higher, particularly in urban non-slum areas, except in Rangpur, where slum newborns measured markedly longer.

The estimates of birth length in Dhaka urban areas (39 cm in urban areas, i.e.,36.2 cm and 40.9cm in slum and non-slum areas respectively) gave an unexpectedly low birth length of newborns (Table 3).If the Dhaka estimates are excluded the average birth length would stand at 48.1 cm, 48.3 cm and 47.8 cm for urban slums, and urban non-slum and rural areas respectively. Location-wise, tallest newborns were observed in Chittagong rural areas, Sylhet non-slum areas, Rajshahi urban areas as a whole (both in slums and non-slums) where the birth length was more than 49 cm, next were Rangpur, Chittagong and Sylhet slums, and Khulna rural areas, the birth length wherein was more than 48 cm (Fig 42

A clear trend is noticeable in the birth length in favor of boys, in aggregate and also by divisions, which is more evident in Sylhet and Khulna (Table 4).

Table 3. Birth length (cm) by gestational weeks, division and urban (slum and non slum) and rural areas (N=4,108).

Gestational weeks	Barisal				Chittagong				Sylhet				Dhaka			
	Urban			Rural	Urban			Rural	Urban			Rural	Urban			Rural
	Slum	Non slum	Total		Slum	Non slum	Total		Slum	Non slum	Total		Slum	Non slum	Total	
<37 weeks	45.1	49.9	46.8	45.4	48.4	47.8	48.1	49.4	48.1	49.2	48.6	47.7	23.1	32.3	29.3	46.0
37th week	46.6	46.4	46.5	47.2	48.8	50.3	49.8	50.0	0.0	51.1	51.1	45.6	49.0	50.2	50.1	47.5
38th week	47.1	47.9	47.6	47.7	48.7	47.3	48.0	50.5	0.0	53.0	53.0	47.7	52.3	49.5	50.2	47.8
39th week	45.0	47.9	47.3	42.8	46.7	48.7	47.5	49.5	0.0	0.0	0.0	47.0	45.1	49.7	47.8	45.7
40th week	46.0	48.6	47.8	47.7	46.9	46.3	46.5	50.3	50.0	0.0	50.0	47.0	35.8	51.0	44.9	48.6
41st week	48.7	48.5	48.6	48.5	49.3	46.3	47.3	48.2	0.0	46.0	46.0	46.7	33.6	42.3	36.7	47.6
42nd week	46.0	46.0	46.0	34.7	47.8	47.3	47.6	49.9	0.0	0.0	0.0	44.0	51.0	52.5	52.0	44.6
>42 weeks	0.0	0.0	47.2	47.0	50.7	47.9	48.8	49.8	0.0	0.0	0.0	46.0	0.0	0.0	0.0	46.0
Average (cm)	46.2	47.8	47.2	45.9	48.1	47.8	47.9	49.7	48.2	49.7	48.9	47.3	36.2	40.9	39.0	46.7

Gestational weeks	Khulna				Rajshahi				Rangpur				Total				Mean
	Urban			Rural	Urban			Rural	Urban			Rural	Urban			Rural	
	Slum	Non slum	Total		Slum	Non slum	Total		Slum	Non slum	Total		Average (slum)	Average (non-slum)	Average (slum and non-slum)	Average	
<37 weeks	46.3	47.5	47.0	48.4	49.5	49.3	49.4	47.1	48.1	47.9	48.0	48.0	44.9	44.1	44.5	47.4	46.6
37th week	49.4	49.3	49.3	47.9	49.1	50.9	49.8	47.6	49.3	48.0	49.0	49.8	48.6	49.4	49.0	48.1	48.4
38th week	49.3	50.0	49.7	47.8	50.0	48.9	49.5	46.6	50.8	47.6	49.0	49.0	49.3	48.8	49.0	48.3	48.5
39th week	49.0	47.2	48.3	48.4	50.3	50.5	50.3	50.6	49.0	41.0	42.3	47.7	47.0	47.9	47.5	47.0	47.2
40th week	44.3	42.3	42.8	50.5	0.0	50.0	50.0	47.8	49.0	47.5	48.0	44.8	44.1	46.5	45.6	48.7	47.6
41st week	50.3	54.1	52.5	50.5	0.0	0.0	0.0	51.0	0.0	50.0	50.0	41.2	42.8	47.1	45.3	47.2	46.5
42nd week	0.0	0.0	0.0	49.7	0.0	0.0	0.0	51.5	0.0	0.0	0.0	48.4	48.0	48.6	48.3	47.3	47.5
>42 weeks	0.0	0.0	0.0	51.5	0.0	0.0	0.0	47.0	0.0	46.5	46.5	45.4	50.7	47.6	48.4	47.5	47.7
Average (cm)	47.7	47.5	47.6	48.5	49.5	49.5	49.5	47.2	48.7	47.3	48.0	47.9	46.4	47.3	46.7	47.6	47.3

Fig 41. Average birth length (summary) in cm by division and sex (N=4,108)

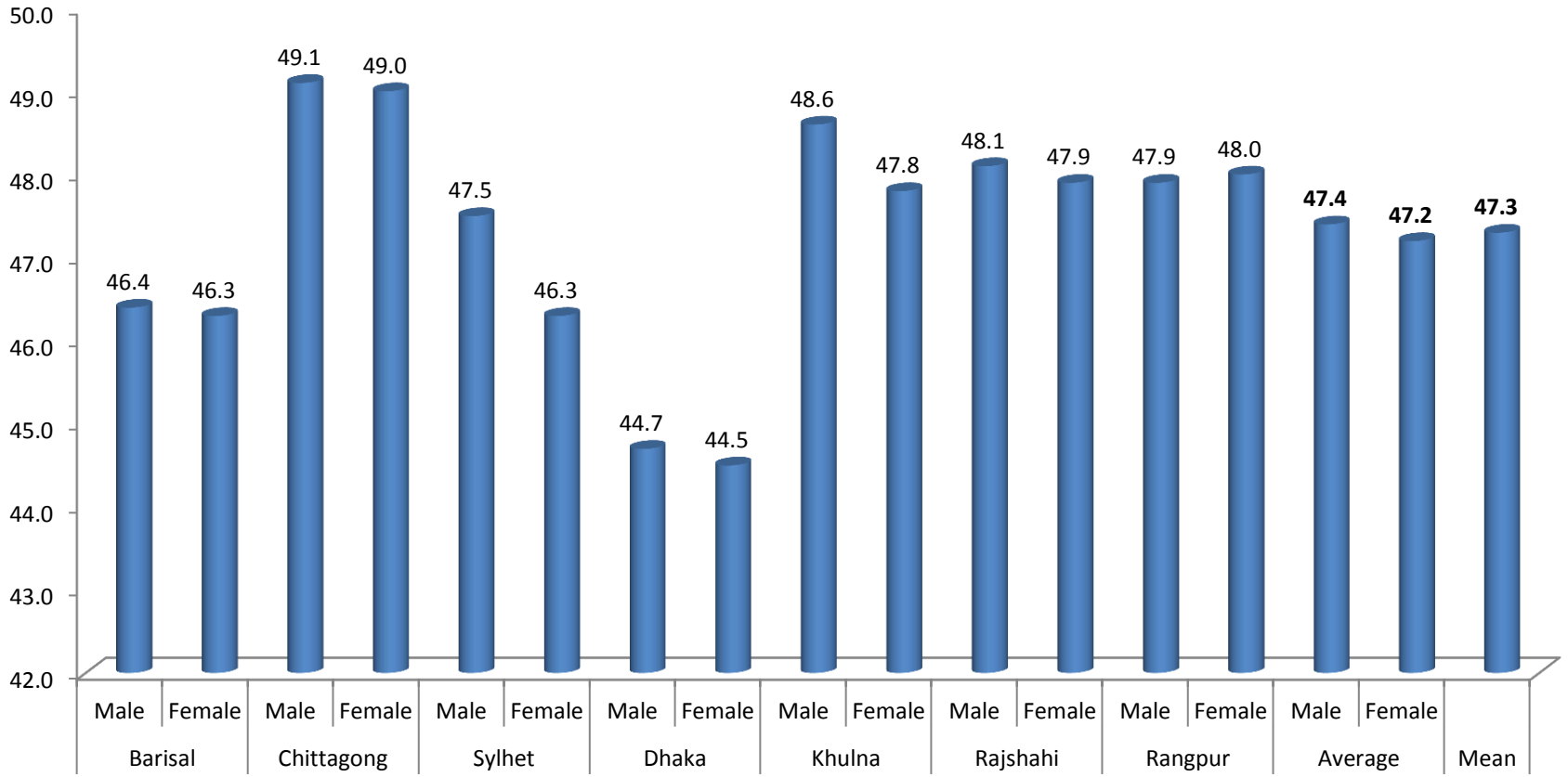


Fig 42. Average birth length in cm (summary) by urban (slum and non-slum) and rural areas (N=4,108))

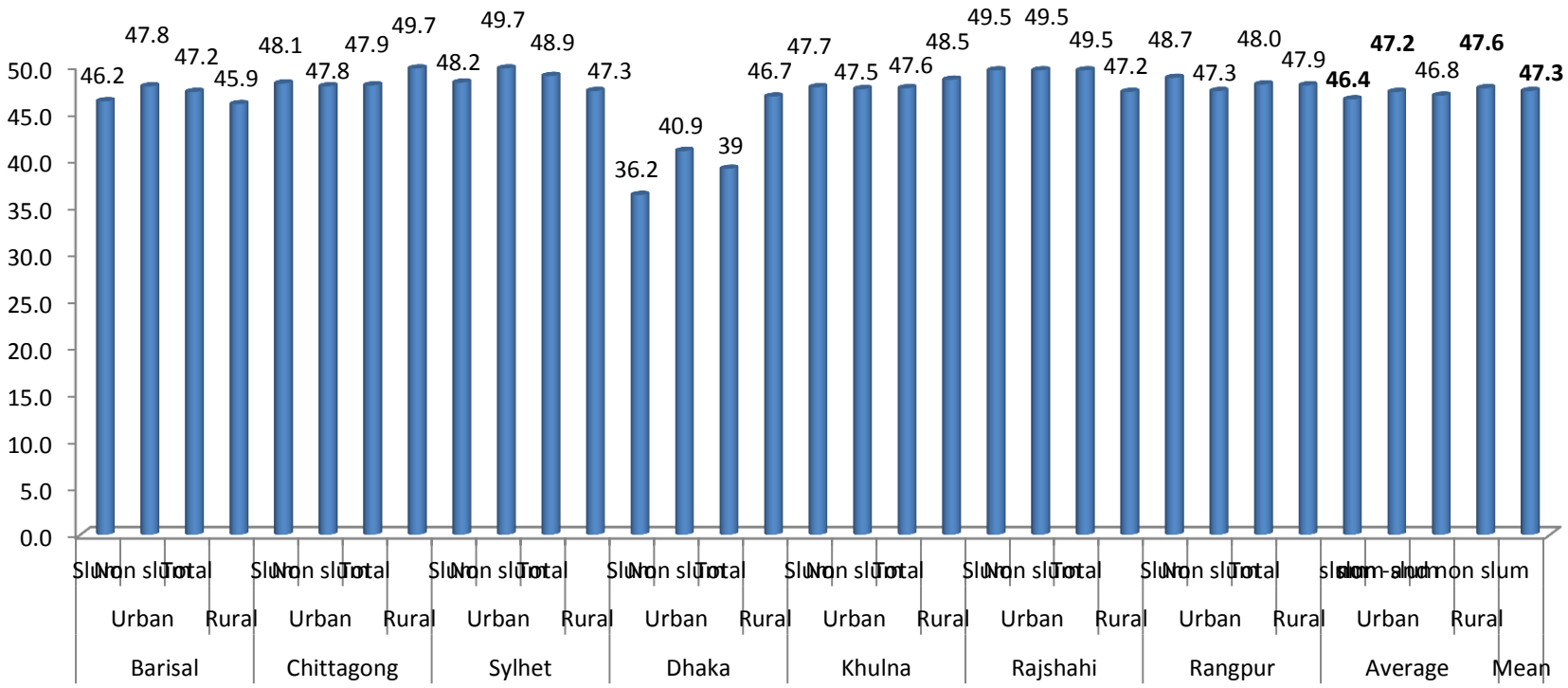


Table 4. Birth length by gestational week, division and sex (N=4,108)

Gestational weeks	Barisal		Chittagong		Sylhet		Dhaka		Khulna		Rajshahi		Rangpur		Average		
	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Mean
<37 weeks	46.1	45.2	49.0	48.9	47.6	48.3	42.8	43.0	48.0	48.2	48.2	47.6	48.1	47.9	46.6	46.6	46.6
37th week	47.3	46.5	49.5	50.6	46.2	47.4	47.8	47.9	48.7	48.2	47.9	48.8	50.5	47.9	48.4	48.3	48.4
38th week	47.7	47.6	50.0	49.7	48.3	47.9	48.2	48.5	50.1	46.1	47.4	47.5	47.9	50.5	48.9	48.1	48.5
39th week	44.6	44.9	48.4	49.2	48.0	45.0	46.9	46.0	49.6	47.0	50.9	50.0	49.0	41.6	47.7	46.6	47.2
40th week	47.8	47.7	48.2	48.7	48.5	0.0	46.8	48.8	46.2	46.5	46.5	49.4	40.9	50.2	46.9	48.3	47.6
41st week	47.8	48.8	49.3	46.7	46.5	46.5	41.6	46.0	52.3	50.7	52.0	50.0	41.1	46.0	45.6	47.4	46.5
42nd week	12.0	46.0	49.2	48.8	0.0	44.0	52.3	43.7	50.5	48.8	50.0	53.0	47.8	51.0	48.3	46.8	47.6
>42 weeks	47.0	0.0	49.5	48.1	0.0	46.0	43.8	47.6	50.7	53.9	47.0	0.0	44.3	52.0	47.1	48.9	47.7
Average (cm)	46.4	46.3	49.1	49.0	47.5	46.3	44.7	44.5	48.6	47.8	48.1	47.9	47.9	48.0	47.4	47.2	47.3

Standard deviations in the estimates of birth weight and birth length were quite low (Table 5 and Table 6), indicating that the standard error was quite low in the survey estimates. A good confidence interval has therefore been obtained.

Table 5. Mean and standard deviations of birth weight by division and sex

Division	Sex of baby	Mean	Std. Deviation
Barisal	1 Male	2.8366	0.43565
	2 Female	2.7555	0.43923
	Total	2.7953	0.43880
Chittagong	1 Male	2.8714	0.44656
	2 Female	2.8246	0.46108
	Total	2.8487	0.45393
Sylhet	1 Male	2.8149	0.30942
	2 Female	2.7594	0.29539
	Total	2.7902	0.30388
Dhaka	1 Male	2.939	0.47375
	2 Female	2.8548	0.41709
	Total	2.9012	0.45091
Khulna	1 Male	2.9828	0.46169
	2 Female	2.9433	0.44042
	Total	2.9644	0.45197
Rajshahi	1 Male	3.0081	0.43492
	2 Female	2.9192	0.43865
	Total	2.9672	0.43850
Rangpur	1 Male	2.945	0.51368
	2 Female	2.9175	0.46090
	Total	2.9328	0.49076
Total	1 Male	2.9285	0.45880
	2 Female	2.8638	0.43784
Mean		2.8985	0.45029

Table 6. Summary estimates of length

Location	Sex of baby	Mean	Std. Deviation
1 Slum	1 Male	45.8436	9.60399
	2 Female	46.3663	8.31831
	Total	46.0961	9.00129
2 Non slum	1 Male	46.8506	8.77516
	2 Female	45.647	8.77053
	Total	46.2979	8.78653
3 Rural	1 Male	47.5442	6.59827
	2 Female	47.684	5.82035
	Total	47.6087	6.25102
Total	1 Male	47.2166	7.43874
	2 Female	47.1851	6.78363
	Total	47.202	7.14163

Statistical analyses

Tests of birth weight

On bivariate analysis the following variables were found to be associated (Table 7.1):

Saving status and place of delivery with mother's education; savings, place of delivery and mother's education with Caesarian operation.
Low birth weight was found associated with the following variables: savings, mother's education; sex of the newborn; pregnant women's initial weight; consumption of fruit, meat, egg and milk; hypertension; heavy work; rest; mental peace; complication of pregnancy; assisted delivery; still birth; month of child birth/ season.

Trend in association was observed between low birth weight and hemoglobin level of pregnant women, tobacco consumption

Table 7.1 Variables found to be associated through bivariate analyses

Variables		P-value	Comment
Savings	Mother's education	0.000	
Place of delivery	Mother's education	0.000	
Savings	C-section	0.000	
Place of delivery	C-section	0.000	
Mother's education	C-section	0.000	
Savings	Low Birth Weight	0.001	
Mother's education	Low Birth Weight	0.028	As mothers' education increase, the odds of LBW decrease (but not significantly).
Sex of the newborn	Low Birth Weight	0.002	
Pregnant women's initial wt	Low Birth Weight	0.001	
Consumption of fruit	Low Birth Weight	0.032	Irrespective of amount
Consumption of meat	Low Birth Weight	0.014	
Consumption of egg	Low Birth Weight	0.064	Trend
Consumption of milk	Low Birth Weight	0.005	
Hemoglobin level	Low Birth Weight	0.058	The odds of LBW are 15% higher for those who have low level of hemoglobin, but not significantly.
Hypertension	Low Birth Weight	0.005	The odds of LBW are 12% lower for those who have high blood pressure, but not at significant level. On the other hand, the odds of LBW are 6% higher for those who have low blood pressure
Heavy work	Low Birth Weight	0.022	The odds of LBW are 6% lower for those involved in heavy work. The odds of LBW are 3% higher for those involved in moderate work. These are however, not significant.
Rest	Low Birth Weight	0.000	No different was seen between adequate and moderate amount of rest.

Mental peace	Low Birth Weight	0.000	As compared to those who are in mental peace, the odds of LBW increase for those who had moderate or no mental peace, although not at a significant level.
Complication of pregnancy	Low Birth Weight	0.000	
Assisted delivery	Low Birth Weight	0.000	
Still birth	Low Birth Weight	0.039	No significant difference in LBW for those who had any abortion or still birth in the past.
Tobacco consumption	Low Birth Weight	0.072	Users have 23% higher odds of LBW, but it was not significant
Month of child birth/ season	Low Birth Weight	0.000	

Statement on the associations, which were not significant on bivariate analysis

- As age of the pregnant women increases, chance of low birth-weight (LBW) decreases.
- The odds of LBW are 11% lower for those in non-slum as compared to rural areas.
- The odds of LBW are 14% lower for those who had high sugar.
- The odds of LBW are 28% lower for C-section as compared to normal
- The odds of LBW are higher for those who had a little or substantially more gain in weight than the average.
- No significant difference is observed in LBW between home deliveries and private/NGO health facility deliveries.
- Those whose parity is more than 2, have 22% lower odds of LBW.

A multiple regression was run on the following variables: age of the pregnant women; their residential locations; biochemical conditions: anemia, hypertension, and blood sugar level; workload during pregnancy; pregnancy complications; Caesarian operation for delivery; level of education; savings status; rest taken during pregnancy; mental peace during pregnancy; sex of the newborn; weight gain during pregnancy; pre-pregnancy weight; consumption of tobacco; adverse pregnancy outcome: abortion, and still birth; place of delivery; parity; and season of delivery.

The test established association between low birth weight and: sex of the baby, complication of pregnancy, season of delivery, initial weight of the pregnant women, saving status, and rest during pregnancy (Table 7.2). A trend was observed with mental peace and place of delivery.

Table 7.2 Variables found associated with birth weight through multiple regression

Variable	P-value	Comment
Complication of pregnancy	0.000	Odds of LBW is almost double
Sex of the baby	<0.01	Odds of LBW is 52% higher for females
Season	0.011	Odds of LBW is 64% higher for the deliveries between March-November, as compared to Dec-Feb
Initial weight of the pregnant women	0.020	Inversely related
Place of delivery	0.020	30% lower for those deliveries made in Govt. hospital as compared to home-deliveries, at 10% level
Savings	0.040	Odds of LBW is 40% higher for those in loan in comparison to solvent
Rest during pregnancy	0.040	Odds of LBW is almost double among those who cannot rest

Tests on birth length

A bivariate analysis showed that birth length is associated with: pregnant women's level of education; height; pre-pregnancy weight; weight gain during pregnancy; consumption of fruit, fish, vegetable, milk; anemia; heavy work; mental peace during pregnancy; iron folate and vitamin intake; complication of pregnancy; assisted delivery, season of delivery and toilet facility (Table 7.3)

Table 7.3 Variables associated significantly with birth length (bivariate analysis)

Variable	P value
Pregnant women's education	0.000
Pregnant women's height	0.005
Pregnant women's pre-pregnancy weight	0.000
Weight gain during pregnancy	0.013
Consumption of fruit	0.002
Consumption of fish	0.000
Consumption of vegetable	0.000
Consumption of milk	0.000
Anemia	0.030
Heavy work	0.052
Mental peace during pregnancy	0.047
Consumption of iron tablet	0.000
Consumption of vitamin tablet	0.000
Complication during pregnancy	0.000
Assisted delivery	0.003
Season of delivery	0.000
Toilet facility	0.028

Statement on the associations, which were not significant on bivariate analysis

- As age increases, chance of short-baby (SB) decreases
- The odds of SB are 18% lower for those in slum as compared to rural areas. The odds of SB are 7% lower for those in non-slum as compared to rural areas.
- The odds of short birth length (SB) are 52% higher for those who have high blood pressure
- The odds of SB are 15% lower for those who have low blood pressure
- The odds of SB are 58% lower for those who had high level of blood sugar
- The odds of SB are 33% higher for those are involved in heavy work
- The odds of SB is higher for those who had a little or more gain in weight
- The odds of SB are 25% lower for those who are at break-even as compared to those who are solvent. Statistically significant at 10% level
- Those whose parity is more than 2, have 14% higher odds of SB
- As mothers height increases the odds of SB decreases. Significant at 10% level

A linear regression test was done for birth length. Variable(s) entered were: age, residence, anemia, hypertension, blood sugar, work-load, pregnancy complication, Caesarian operation, mothers education, savings status, rest during pregnancy, mental peace during pregnancy, sex of the baby, weight gain during pregnancy, pre-pregnancy weight, tobacco consumption, abortion and still-birth, place of delivery, parity of pregnant women, season of delivery, height of pregnant women. Table 6.4 shows the result of the linear regression

Table 7.4 Variables associated significantly with birth length (linear regression)

Variables	P -value	Comment
Age of mother	0.033	
Pregnancy complication	0.006	The odds of SB is 44% higher
Caesarian operation	0.001	The odds of SB is 44% lower
Education of mother SSC and above	0.002	SB is 33% lower for SSC as compared to primary/below primary. No different between Primary and HSC/above
Mental peace	0.053	
Pre-pregnancy weight	0.040	
Place of delivery (Govt. hospital)	0.020	No significant difference is observed in LBW between home deliveries and Priv./NGO deliveries
Season: March-Nov/ Dec-Feb	0.000	

Birth length was established to be associated, through the linear regression, with age of mother, pregnancy complication, Caesarian operation, education of mother, mental peace, initial weight of the pregnant women, delivery in government hospital, season of birth/ pregnancy and saving status (at 10% level of significance) (Table 6.4).There is trend between the length of newborn and height of the pregnant women and saving status but these associations were not significant.

Explanation of the findings in the 2015 survey

The analysis of birth weight in urban areas by slum and non-slum locations showed that non-slum newborns have a slight edge over the slum newborns, keeping the advantage of boys in both places, on birth weight (Table 1)

Table 1. Birth weight in gm by sex and urban slum and non slum (N=1,102)

Location	Sex	
	Boys	girls
Slum	2.96	2.89
Non slum	3.0	2.92

When birth length was analyzed in the urban areas by slum and non slum divide, the result was the same, as given in Table 2.

Table 2. Birth length in cm by sex and urban slum and non slum (N=1,102)

Sex	Location	
	Slum	Non slum
Boys	46.7	47.8
Girls	46.5	47.3

Slum, non-slum differences are also noticeable, although small, in case of parity as may be seen in Table 3. This small difference is also seen when an urban and rural difference is examined, as may be seen in Table 4.

Table 3. Parity in urban slums and non slums (N=1,102)

Sex	Location	
	Slum	Non slum
Primipara	49.4	50.4
Multipara	50.6	49.6

Table 4. Parity by urban and rural areas (N=4,398)

Parity	Location	
	Urban	Rural
Primipara	50.1	51.3
Multipara	49.9	48.7

The information shown in Table 3 and 4hides the information given in Tables 1 and 2. Table 4, as may be seen, hides the slum situation, when only urban area is compared with rural area. Tables3 and 4 also show that primipara are less (i.e., multiparity more) in slums than non-slum areas, which indirectly indicates a higher number of teenage pregnancies (<18 years) in the urban slums than non slums and rural areas.

The rural birth length was found to be higher than the urban birth length. This, we believe, is a function of birth of more boys in rural areas (Table 5). This possibly could also be due to a small difference in birth length of boys and girls in urban and rural areas, or mix up of gestational weeks. In the Canadian study, mentioned further below, this difference in length among boys and girls between the different gestational weeks was not marked either, unlike the birth weight, where it is more distinct.

Table 5. Breakdown of number of births in rural and urban areas

Sex of newborns	Urban areas	Rural areas	Total
Boys	630	1573	2203
Girls	560	1345	1905
Total	1190	2918	4108

Comparison with the similar studies done in Bangladesh and abroad

The first ever national survey on birth weight and birth length was done in 2003-2004. This study has been undertaken in 2015, 13 years afterwards. Methodologically, almost same approach was followed, except the data collectors, measuring instruments, researchers, sampling frame and size (initial and final, after follow up loss) and some additional variables. Below (Table 6) is a comparative description of the two studies.

Table 6. Comparison between 2003-2004 and 2015-2016 survey

2003-2004 survey	2015-2016 survey
Data collectors: Local married women	CSBA
Births weighed by Seca 345 (N=1,749), and Uniscale(N=1,345)	Birth weighed by Salter and metallic spring type
Sample size 3,085 (1,548 boys and 1,537 girls)	Sample size 4,398 (4,108 when sex-wise information was taken: 2,203 boys and 1,905 girls).
Birth length measured 3,085 (?)	As above
Measures taken about 10% after 72 hours	Measures taken invariably within 24 hours
Mean family size- 5.4	Mean family size- 4.5
Female headed households – 3.4%	Female headed households – 2.2%
Father's education: Illiterate- 48.2%, <SSC- 38.7%	Father's education: Illiterate- 6.5%, <SSC- 68.7%, SSC -12.4% HSC and graduate and above- 12.5%
Literacy of pregnant women: illiterate (45.6%), <SSC (48.1%)	Pregnant women's education: Illiterate (4%), primary incomplete (15.8%), primary completed (27.9%), secondary incomplete (31.5%), SSC (11.8%), HSC (6.4%), graduate and above (2.6%)
Husband's literacy: NA	Husband's literacy: illiterate (6.5%), <SSC (68.7%), SSC and HSC- (19.7%), graduate and above- (5.2%)
Father's occupation- agriculture and allied field- 17.3%, workers or clerical staff- 74.8%, professionals- 4.2%, beggars, unemployed, physically challenged, retired- 3.6%	Father' occupation- agriculture and allied field- 31%, business-26.5, workers or clerical staff-12.5%, professionals-1.7%, maid servant, engine/engineless driver, artisan, beggars, unemployed, physically challenged, retired- 28.5%
Occupation of pregnant women: housewife (96.8%)	Occupation of pregnant women: housewife (>95%), clerical/similar level job (2.1%), business (1.2%)

Assets- electricity- 31.8%, television- 17.8%	Assets- electricity- 66.4%, Fan- 63.3%, television- 48.1%, cycle-34.7%, fridge- 19.5%, motorcycle- 9.4%, car- 2.7% and air conditioner- 1.3%
Housing type (roof): tin (82.2%), concrete (3.6%), other (14.2%)	Housing type: tin (63.2%), brick wall with tin roof (23.6%), concrete (3.5%), thatched (7.9%), other (1.8%)
Type of latrine: water seal (17.3%), pit (35.2%), hanging and open (47.5%)	Type of latrine: water seal (81.9%), commode (9.3%), pit (7.4%), hanging and open (0.7% each)
Economic status: surplus (31.4%), break-even (31.2%), deficit (37.4%).	Economic status: surplus (21.7%), break-even (43.7%), deficit (34.6%).
Number of pregnancies, including the present one: 1 (27.5%), 2-5 (61.2%), >6 (11.3%)	Primipara: 49.2 Multipara: 50.8% (none more than 3)
Percent of pregnant women with history of past abortions: 12.5%	Percent of pregnant women with abortion in last pregnancy: 1%
Pregnant women's height : 149.9 cm (mean)	Pregnant women's height : 150.3 cm (mean)
Pregnant women's initial weight?	49.1 Kg. (50.2 Kg. and 48.6 Kg. in urban and rural areas respectively)
Height <145 cm: 15.7%	Height <145 cm: 16%, Height <150 cm: 34.7%. Average height 150.3 cm
Clinical features during pregnancy Fever (39.6%) Edema (34.2%) Vomiting (28.3%) Bleeding (4.3%) None (23.4%)	Clinical features during pregnancy Fever (7%) Edema (4.1%) Vomiting (4%) Hypertension (3.1%) Diabetes (2.3%) None (73.7%)
Complications during delivery: Prolonged labor (>12 hours): 24.6%, Bleeding: 16.1%	Complications during delivery: Early rupture of amniotic sac: 36.4%, prolonged labor (>12 hours): 7.5% abnormal presentation: 1.5% bleeding/ convulsion: <5% Death among pregnant women: 8
Adequate rest during pregnancy: 85.4%	Adequate rest during pregnancy: 42%, no rest at all: 3.4%;
Psychological stress: ?	Psychological stress: 4.5%
Amount of food taken during pregnancy: More than normal (15.7%)	Adequacy of food (average): Fish, meat, egg, milk and fruit about 20% each Vegetable: about 30% Oil (> 2 liters/ month): 66.6% to 68%
Iron supplementation during pregnancy: 28.8% (7.9% for >4 months)	Supplementation during pregnancy: iron- 50.8% (regular), vitamin/ calcium- 44.3%
Gestational weight gain: NA	8.2 Kg
Place of delivery: Govt. hospital (4.1%), private hospitals/clinics (3.3%), home (92.6%)	Place of delivery: Govt. hospital (24.5%), private hospitals/clinics (27.2%), NGO hospitals (4.5%) and home (42.3%), others (1.5%)

Type of delivery: normal (96.3%), caesarian and others (3.7%)	Type of delivery: vaginal (62.1%), caesarian (35.5%) and others (2.4%)
Delivery by: Doctor, nurse or FWA (8.8%) Trained TBA (13.6%) Untrained TBA (29.9%) Neighbor, relative or others (47.8%)	Delivery by: Doctors, nurses, FWVs, SACMO: (55%) CSBA: (26.4%) Untrained TBA: (10.7%) Neighbor, relative or others: (7.9%)
Gestation at delivery: <37 weeks (15.7%) and >37 weeks (84.7%)	Gestation at delivery: <37 weeks (54.0%) and >37 weeks (46%)
Outcome of pregnancy: Live birth (?) Single (99.3%)	Outcome of pregnancy: Live birth Single (94.1%)
Sex of child: boy (50.5%)	Sex of child: boy (53.5%)
The mean birth weight of infants in Bangladesh is 2,632 g (2,665 g in boys and 2,599 g in girls; 2,698 g urban and 2,622 g in rural areas; 2,577 g in Dhaka division and 2.721 g in Chittagong)	The mean birth weight of infants in Bangladesh is 2,940 gm (average for boys was 3,000 g and for girls 2,900 g; urban and rural percentage >2,500 gm was 77.1% and 77.4% respectively – 76.1% and 77.9% in urban slums and non-slum areas respectively)
Low birth weight (<2,500 g) affects 36% of infants {(36.4% by Seca baby scale, 30.2% by UNISCALE and 33.7% when combined} (37.9% in girls and 33.3% in boys; the most in Dhaka, Barisal, Rajshahi and Sylhet); <1% of infants were born <1,500 g).	Low birth weight (<2,500 g) affects 22.6% of newborns (24.7% in girls and 20.6% in boys); Highest percent of LBW in Barisal, Chittagong and then in Dhaka); <0.5% of infants were born <1,500 g).
77% of LBW infants were growth retarded	72.9 percent of LBW infants were growth retarded
The prevalence of LBW was found to be higher in rural areas (37 percent) than urban areas (29 percent).	The prevalence of LBW was found to be 22.9 percent in urban areas (25.9 percent in urban slums and 22.1 percent in non-slum areas) and 22.6 percent in rural areas
Mean birth length: 48.5 cm (48.2 cm in girls and 48.7 cm in boys; Chittagong division with the tallest and Dhaka with the shortest)	Mean birth length: 47.3 cm (47.4 cm in boys and 47.2 cm in girls; Chittagong, Khulna, Rajshahi, Rangpur, and Sylhet division have the tallest in that order and Dhaka the shortest)
Mother's and father's education, economy, pregnancy in adolescence and older age (primigravida and grand multiparity), short stature, iron folate intake are associated with LBW (which statistical analysis not clear)	Multiple regression established association between low birth weight and: sex of the baby, complication of pregnancy, season, initial weight of the pregnant women, economy, and rest during pregnancy
Birth length varied with socio-economicstatus, maternal characteristics and variables related to the birth in a similar pattern to birth weight (which statistical analysis not clear)	Birth length was established, through linear regression, to be associated with residential location of pregnant women, pregnancy complication, Caesarian operation, mother's education, weight gain during pregnancy, initial weight of the pregnant women

Additional variables studied in the 2015 survey were: Religions, occupations of husbands, literacy rate of husbands, source of water for cleansing utensils, source light at home, smoking habit of husbands and pregnant women, backyard kitchen garden, horticulture, poultry and cattle rearing, feeding practices (fish, meat, egg, milk, fruit, vegetable and oil), height and weight of husbands, clinical/ medical conditions of the pregnant during present and past pregnancies, pregnancy outcome in the past pregnancies, health care practices (vaccine, iron folate intake and vitamin/ calcium intake, amount of rest taken, physical work done during pregnancy, psychological stress, and cleanliness during pregnancy), overall physical condition of the pregnant women during pregnancy, gestational weight gain and place of birth.

Comparison has been made between some socio-demographic variables and child birth practices as found in the Urban Health Survey of 2013, Bangladesh Demographic and Health Survey 2014 and this study (2015), as shown below (Table 7)

Table 7. Comparison between Urban Health Survey 2013, Bangladesh Demographic & Health Survey (2014)and NLBS 2015

Urban Health Survey 2013	Bangladesh Demographic and Health Survey 2014	National Low Birth Weight Survey 2015
86% of the walls in slum households are made of tin/ cement/ bricks. Use of rudimentary materials like jute/ bamboo/ mud for the walls 9% in 2013 in slums. 19% and 75% in slums have earth or sand or concrete floor.	66.6% floors in urban areas is either of tiles or concrete in rural areas this is 18%; tin roof is 70% in urban areas and 90.8% in rural areas; 04% roofs are thatched and 29% concrete or ceramic in urban areas and 1.8% and 5.4% in rural areas respectively; about 10% wall are thatched or mud, 30.2% tin and about 59% of brick/ concrete in urban areas and in rural areas these are about 26%, 48.3% and about 23% respectively.	63.3%, 47.7%, 66.55% roofs are made of tin in urban slum, urban non-slum and rural areas respectively. 5.8%, 8/1%, and 2.1% houses had concrete roofs and 1.9%, 0.3% and 2.1% houses had bamboo roofs.
Access to electricity is universal in all three urban domains	90.7% in urban areas from national grid and 2.6% solar; in rural areas these are: 5.4% and 14.6% respectively	89.6%, 5.1% and 4.9% sources of light are from national grid, solar, and hurricane/ lamps in slums; in non-slums these are: 93.1%, 4.6% and 2.2% respectively and in rural areas: 82.1%, 8.1% and 10.9% respectively
Access to "improved" water source is universal in all three urban domains. However in slums, sharing of a water source with other households is 65%. >50% slum households have piped water		24.9%, 70.8%, 0.7%, and 4.1% households use water from tap, tube well, well and pond respectively for cleansing utensil in slums; in non-slums the rates are: 34.5%, 60.5%, 0.9% and 10.5% in non-slum areas respectively and in rural areas these are: 13.3%, 77.5%, 0.7% and 11.2% respectively
13% households in slums had access to improved sanitation compared with over 50 percent in the non-slum and other urban areas.		7.8%, 13.5%, and 8.7% households possess commode in slums, non-slum and rural areas; 87.3%, 81.4% and 81.0% have water seal latrines/ panes respectively; 0.9%, 0.1%, 1.8% families use hanging latrines open areas

The mean household size is 4.1 (slum) to 4.3 (other than slum) persons	NA	The mean household size is 4.3 persons (slums), 4.5 (non-slums) and 4.6 (rural areas)
14% slum households have a refrigerator versus 59% in non-slum households	70.6% and 33% households in urban and rural areas respectively possessed TV; 40.6% and 12.3% possessed refrigerator; 1.3% and 0.1% had air-conditioner; 1.2% and 0.6% possessed car; 8.0% and 5.7% possessed motorcycle	16.6%, 34.5%, 16.7% families possess refrigerator in slums, non-slum and rural areas respectively; 53.9%, 66.1%, 43.2% possess TV; 0.7%, 1.3% and 1.3% possess air-conditioner; 1.2%, 2.4% and 3% possessed care respectively
75% slum households are in the lowest two wealth quintiles compared with 20% in non-slum areas. 60% non-slum households are in the two richest wealth quintiles compared with 7% in slums.	17.9% families belonged to lowest quintile, 18.0% to second quintile, 40.2% to third and fourth quintile and 23.9% to the highest quintile	NA
NA	17.7% and 65.6% families owned cattle; 23.7% and 67.0% owned poultries in urban and rural areas respectively.	43.4%, and 72.7% families owned poultry and cattle in urban areas and in rural areas these were: 66.9% and
45% women in slums have completed at least primary education compared with 79% in non-slum and 69% in other urban domains. 49% men in slums have completed at least primary education compared with 79% in non-slum and 69 percent in other urban areas. 33% women in slums works full time compared with 17% in non-slum areas. 32% in slum are illiterate. 26% males are illiterate in slums.	24.9% are illiterate, primary incomplete 18.0%, primary complete 11.1%, secondary incomplete 31.5%, 14.4% secondary complete and above	5.7% illiterate, 23.8% primary incomplete, 35.2% primary complete, 21.3% secondary incomplete, 9.1% secondary complete, 4.1% higher secondary complete and 0.9% above HSC level education in slums; in non-slums: 3.1%, 12.7%, 31.5%, 23.6%, 15.5%, 8.6%, and 5.0% in non-slum areas and 3.9%, 15.0%, 25.9%, 35.0%, 11.5%, 6.3% and 2.4% respectively in rural areas
Teen age pregnancy: in slum 42.8% and in non-slum 32.8%	NA	73% in slums, 68.3% in non-slum areas and 69.5% in rural areas

Facility delivery in non-slums is 65% and in slums 37%. Place of delivery: in slum=12.8 in public facility, 11.4% in private facility and 16.1 % in NGO facilities; in non-slums 16.8% in public facilities, 40.9% in private facilities, and 8.5% in NGO facilities; in other urban areas=18.8% in public facilities, 31.6% in private facilities and 2.4% in NGO facilities	In total 42.1 deliveries occur at home in urban areas, while it is 69.1% in rural areas. In urban areas 15.8%, 35.6%, and 5.4% deliveries are conducted in public, private and NGO sector hospitals. In rural areas these are: 11.8%, 17.7%, 1.1% respectively.	Facility delivery in non-slum is 71% and 60.3% in slums. 28.8%, 32.6% and 22% deliveries among slum, non-slum and rural area pregnant women took place in public hospitals; 18.5%, 27.7% and 28.7% deliveries took place in private hospitals respectively and 13.0%, 10.7%, and 1.5% deliveries were conducted in NGO hospitals; 42.2% and 1.5% births took place at home or at other places than home of hospitals
Medically trained providers for delivery is 68% in non-slums, 56% in other urban and 37% in slums. (58% in non-slums and 44% in the other urban areas are doctors, while in slumsuntrained birth attendant are 35%.	60.5% deliveries in are conducted in trained hands in urban areas and 35.6% in rural areas. Education-wise 17.1%, 26.6%, 69.50% and 75.0% births are conducted by medically trained among illiterate, primary incomplete, <SSC and HSC and above educated women. Wealth-wise 17.9%, 28.2%, 43.2% and 73.4% deliveries are conducted trained hands	In slums 55.5%, 25.9%, 9.9% and 8.6% deliveries were conducted by doctors/ nurse/ FWV/ SACMO; CSBA; TBA and others (relatives/ neighbors) in slums. In non-slum areas: 70.9%, 4.3%, 10.1% and 4.7% respectively; and 51.5%, 29.2%, 10.9% and 7.9% respectively in rural areas
C-section in non-slums is 42% and in other urban areas it is 33% and 16.3% in slums. (In slums 44.8% in public hospitals, 65.3% in private hospitals and 23.9% in NGO facilities conduct Caesarian. In non-slum 56.6%, 72.5% and 38.9% health facilities conduct Caesarian)	38.1% deliveries are by Caesarian in urban areas and 17.6% in rural areas. Among illiterate this is 7.0%. Among primary education incomplete this is 10.1%. Among <SSC it is 38.4%. Among those with HSC and higher level of education this is 51.2%. Among the lowest economic quintile the rate is 6.8%, among the second quintile it is 9.6%, among the third and fourth quintiles and 44.3% among the highest it was 49.8% respectively.	31.2% of deliveries were conducted through Caesarian operation in slums; 48.6% in non-slum areas; and 33.5% in rural areas

	Among illiterate 8.0%, 6.3% and 1.3% deliveries are conducted in public, private and NGO facilities. Among primary education incomplete the rates are: 11.1%, 9.4%, and 2.5% respectively. Among <SSC these rates are: 26.7%, 39.2% and 4.1% respectively. Among those with education of HSC or higher level these rates are: 15.5%, 50.3% and 2.7% respectively.	Place of delivery is influenced by mothers' education
	Wealth-wise among the lowest quintile 8.5%, 6.1% and 0.4% get delivery service from public, private and NGO service providers; Among the second quintile the rates are: 11.6%, 10.6% and 0.4%. Among the third and fourth quintiles the rates are: 26.9%, 43.3% and 5.4% respectively. Among the highest these rates are: 16.8%, 48.1% and 4.6% respectively.	Mothers' education determines place of delivery

The 2003-2004 survey found the birth weight to be associated with the residential location. Other variables associated were: socio-economic status, education, age at child birth, gravidity, maternal stature, antenatal check-ups and iron supplementation during pregnancy and lack of adequate rest during pregnancy (it was not clear however, if these were found based on bavariate or multivariate analyses). In this study (2015), although these variables were found to be associated with birth weight on bivariate analysis, the logistics regression analyses showed that only initial weight of the pregnant women, complication of pregnancy, Caesarian operation, saving status (economy) and rest during pregnancy were associated with LBW.

Birth length was found to be associated through bivariate analysis with pregnant women's education, height, pre-pregnancy weight, weight gain during pregnancy, consumption of food (fruit, fish, vegetable, milk, anemia, heavy work, mental peace during pregnancy, consumption of iron tablet and vitamin tablets independently, complication during pregnancy, assisted delivery, Season of delivery and presence of toilet in the family. But a linear regression test, confirmed the association with residential location of pregnant women, pregnancy complication, Caesarian operation, mother's education, weight gain during pregnancy, and initial weight of the pregnant women. It also showed a trend of association of maternal health but this association was not statistically significant at 5 percent level.

Although literature cited in the 'Introduction' section states that while in the west pregnant women gain on average about 15 Kg, in developing countries the average weight gain is only 5 Kg. In this study the average weight gain was 8.2 Kg. This parameter was not studied in the past in Bangladesh. Although the weight gain is better than expected in Bangladesh, the fact warrants targeted efforts to improve weight gain during pregnancy, as it is a direct reflection of birth weight and length.

Studies in Bangladesh in the past[113] show (Table8) a very high rate of LBW (much more than the projected estimation made at global level for Bangladesh).

Table 8. Studies on birth weight in Bangladesh

Location	Year of data collection	Sample size	Mean birth weight(g)	Prevalence of LBW (percent)	Reference
Rural Bangladesh	-	-	2,420	51	Goodburn et al., 1994
Shaharasthi subdistrict,Comilla	1999	447	2,513	48	Shaheen et al., 2000
Slum areas of Dhaka	1994-5	1,654	2,516	46	Arifeen et al., 2000
National low birth weight survey	2003-2004	4,414 (3,085)	2,632	36	Bureau of Statistics 2005

Some low birth weight surveys conducted in Bangladesh give confusing figures. Low birth weight was estimated to be more in 2007[116] than the estimate obtained in 1994 (Good burn et al. Table 8) in some areas of Bangladesh. The study carried out between 2004-2007 in Gaibandha[116], through a Project on neonatal vitamin A supplementation, found the mean birth weight as 2,433 g with 55.3

[113]Bangladesh Bureau of Statistics. National Low Birth weight Survey of Bangladesh, 2005.

percent of the babies born low birth weight; females born 80 g lighter than males ($P < 0.0001$) and had higher rates of LBW (59.7% vs. 50.9%, $P < 0.0001$). The mean birth length was 46.4 cm. Boys were born, on average, 0.5 cm longer[114].

In a recently completed RDNS study conducted between 2007 and 2014, the prevalence of LBW was found to be 36.0 percent and 39.5 percent in a lipid-based nutritional supplement (n=898) versus IFA (n=2551) supplementation. The unadjusted mean birth weights were 2,629 gm and 2,588 gm respectively[115]. Showing again a higher LBW in 2014 than 2003-2004.The above figures seem contradictory and do not match with each other, including WHO and UNICEF estimates, shown above. It is also interesting to note that while the LBW estimate that should have been quoted from the 2003-2004 Bangladesh study as 33.7 percent has actually been quoted as 36.4 percent. The estimate of 36.4 percent actually is based on 1,740 newborns (a slightly higher than half of the sample size in the survey), the other half (N=1,345) gives the estimate to be 30.2 percent.

The differences seen in some parameters by urban and rural divide and slum and non slum divide, range from just nominal to noticeable. While the differences in birth length and weight is less pronounced between urban and rural areas, when the urban area is broken down by slum and non-slum, non-slum areas show an advantage, corroborated by some relevant determinants, e.g., age at marriage of the pregnant women, by the parity number and to some extent the initial weight of the pregnant women, gestational weight gain etc., some of which however, are lost when broken down to slum and non-slum areas.

Different studies have come up with different estimates of LBW and IUGR for the same country. In fact these estimates show escalation rather than improvement even after a decade's gap (1990 and 1999-2000) in the measurements (Table 9 and 10). How to explain these findings? Also, these estimates of 1990 and 1999, even from Nepal and India, are much lower than the Bangladeshi estimates of 2003-2004, 2004-2007, and 2008-2012. These study findings in Bangladesh referred to above, need to be matched with some other-wise improving nutritional indicators, e.g., lowering of the stunting rate from 60 percent in 1996-1997 to 36 percent in 2014 according to the same surveyors over all these years. Not all of these estimates which contrast with each other, and with other relevant indicators, can be taken as accurate.

If LBW is taken to be 51 percent in 1994 (Table 8) then a gradual decrease in the prevalence of LBW (from 51 percent to 36 percent) is evident. Between 1994 and 2003-2004, i.e., in one decade, about 29.4 percent decline is observed in 10 years (taking 51 percent prevalence as the baseline. In this study being reported the LBW rate has been found to be 22.6 percent (unadjusted), a fall of 37.2 percent, in 13 years, taking 36 percent prevalence as the baseline. How may one offer a feasible explanation to this fall? There are several factors, some methodological explanation was given above (In the 2003-2004 study there are four areas which clearly differ from the present study- drop in

[114]Rolf D.W. Klemm, Rebecca D. Merrill, Lee Wu, Abu Ahmed Shamim, Hasmot Ali, Alain Labrique, Parul Christianand Keith P. West Jr. Low-birthweight rates higher among Bangladeshi neonates measured during active birth surveillance compared to national survey data. *Maternal and Child Nutrition* (2015), **11**, pp. 583–594

[115] Malay K Mridha, Susana L Matias, Camila M Chaparro, Rina R Paul, Sohrab Hussain, Stephen A Vosti,Kassandra L Harding, Joseph R Cummins, Louise T Day, Stacy L Saha, Janet M Peerson, and Kathryn G Dewey. Lipid-based nutrient supplements for pregnant women reduce newborn stunting in a cluster-randomized controlled effectiveness trial in Bangladesh. Am J Clin Nutr 2016;103:236–49.

sample size from 4,400 to 3,085; changing of measuring instrument midway into the study; data collectors, who have not been clearly identified and therefore their skill is unknown; reportedly in more than 9 percent of newborns weight and height measurements were taken after 72 hours, when weight in newborns fall for sometimes, while birth-time length increases). Improvement in birth weight may also be feasible because of the presence and functioning of the community clinics in the rural areas, almost all with community skilled birth attendants (CSBAs), who are quite active in the catchment areas (in fact, all our data collectors knew the names of the pregnant women they were following up and also their family members very well indeed, at family level). This familiarity was not an outcome of the survey they were undertaking but because they were working in these areas for long, which affected the health consequences of the women in general (as they are the overwhelming majority who visit the community clinics, especially in pregnancy). Since community clinics are present throughout the rural areas, so this phenomenon should be universal across the country.

Table 9. Prevalence of low birth weight and intra-uterine growth retardation in South East Asian countries

Country (Location)	Year	LBW (%)	IUGR-LBW (%)
People's Republic of China (Shanghai)	1981-1982	4.2	3.4
India (Pune)	1990	28.2	24.8
Indonesia (Bogor)	1983	10.5	8.0
Myanmar (rural+urban)	1981-1982	17.8	12.7
Nepal (rural)	1990	14.3	11.8
Nepal (urban)	1990	22.3	18.2
Sri Lanka (rural)	1990	18.4	15.8
Thailand (rural+urban)	1979-80	9.6	6.9
Viet Nam (Hanoi + 1 rural district)	1982-1984	5.2	4.2

A WHO-UNICEF study reported in 2004, show that in neighboring countries the rate of fall in LBW was less sharper (please match Table 9 and Table 10estimates). In a decade (i.e., from 1990 to 1999 in India, from 1990 and 2001 in Nepal, and in 2000 in Sri Lanka) in fact LBW rate has been noted to be higher in later years than 1990). These differences in the estimates of birth weight are baffling, which indicates a need of replication of these estimates through different enumerators.

Table 10. LBW in South Asia*

Country	Year	LBW (percent)
Bhutan	1999	15
India	1999	30
Maldives	2001	22
Nepal	2001	22
Pakistan	1991	19
Sri Lanka	2000	22

* Cited from National Low Birth Weight Survey of Bangladesh 2005 (BBS and BRAC)

Some of the results in this survey, which do not exhibit a strong difference between different variables, mainly relate to the fact that the gestational period and the expected date of delivery (EDD), hinge on identification of the last menstrual period (LMP) accurately, which in Bangladeshi cultural

context is difficult to ascertain, for reasons described earlier. Rigorous studies need to be undertaken, and selected married women need to be identified, followed up on a monthly basis, and tested for pregnancy right after their marriage.

Interestingly, to understand better, as to why so much variation has been observed in the different studies, we did a simulation, i.e., increase the birth weight by only 50 gm. The result was astonishing- the LBW rate comes down to 10.8 percent, instead of 22.6 percent. This is a good pointer that very meticulous measures need to be taken during measuring birth weight and in particular the birth length.

A study conducted in Canada[116] among, Caucasian, Chinese and South Asian descent newborns found the following estimate for the South Asian group of newborns, who should be close to the estimates in Bangladesh (Table 11). This comparison also evidences that although children born are the descendants from South Asia, their parents' living in and their conception in Canada, impart distinct advantage to them, as reflected in their birth weight and length.

Table 11. Birth weight and birth length by gestation

Gestation (weeks)	Birth weight				Birth length			
	Canadian study (children from South Asia)		NLBW Survey 2015		Canadian study(children from South Asia)		NLBW Survey 2015	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
<37			2.896	2.828			46.6	46.6
37	3060.0	2956.8	2.953	2.875	48.7	48.2	48.4	48.3
38	3201.8	3118.4	3.013	2.924	50.2	48.8	48.9	48.1
39	3361.2	3311.7	2.914	2.914	50.2	49.5	47.7	46.6
40	3452.5	3376.1	2.972	2.916	50.4	50.0	46.9	48.3
41	3674.7	3411.4	3.048	2.948	51.4	50.6	45.6	47.4
42			2.819	2.893			48.3	46.8
>42			2.965	2.878			47.1	48.9

[116]Patricia A Janssen, Paul Thiessen, Michael C Klein, Michael F Whitfield, Ying C MacNab, Sue C Cullis-Kuhl. Standards for the measurement of birth weight, length and head circumference at term in neonates of European, Chinese and South Asian ancestry. Department of Health Care and Epidemiology, University of British Columbia, 5804 Fairview Ave. Vancouver BC V6T 1Z3; pjanssen@interchange .ubc.ca

Discussion on the determinants of LBW

Birth weight is affected to a great extent by the mother's own fetal growth and her diet from birth to pregnancy[117], and determining her body composition prior to conception. Mothers in deprived socio-economic conditions tend to have low birth weight infants. In those settings, the infant's low birth weight emanates from the mother's poor nutrition and health over a long period, including during pregnancy, the high prevalence of infections, or from pregnancy complications, often related to poverty (poverty therefore should be the determinant). In this study initial weight of the pregnant women and their economic status have been found to be associated with the birth weight of the studied newborns, and so also with pregnancy complications.

Physical labor by pregnant women in the third trimester was associated with lower birth weights[118, 119, 120] and more placental infarcts, compared to women who remained at home (Naeye RL, and Peters EC, 1982). Working had the strongest negative association with fetal growth in mothers who were underweight at conception, had low pregnancy weight gain, and whose work required standing. In this study also, an association was found in a logistic regression test between birth weight and the period of rest, as an indirect measure of hard work.

Mothers who are younger (<20 years) or older (>35 years) have also been found to give birth to low birth weight newborns in comparison to those women who are aged 20-35 years[121, 122123]. Research has shown that adolescents who are still growing are likely to give birth to a smaller baby than mature women of the same nutrition status[124, 125]. This is probably due to competition for nutrients between the growing adolescent and the growing fetus[126, 127]and poorer placental function[128] which in turn increases the risk of LBW and neonatal mortality[129]. Childbearing during adolescence imposes a

[117]WHO and UNICEF. Low Birth Weight. Country, regional and global estimates. 2004.

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greater demand on nutrition requirement, as the adolescent pregnant woman struggles to complete her own growth while also providing the nutrients to the developing fetus in her womb. Low birth weight has also been found to be more common among mothers of higher parities than those of parity 1-6 (Tin et al. 1994). This study however, could not establish this relationship between adolescent pregnancy and LBW. However, if the theoretical proposition is that due to younger age pregnant women who conceive before their own physical growth is complete is prone to deliver LBW babies, then it,in fact, surrogates pre-pregnancy growth of the pregnant women, which is an indicator of the physical growth. In other words, it is not age but physical growth or the pre-pregnancy weight of the women, which is the determinant of the birth weight of their babies, as was found in this survey.

Mothers who give birth to LBW infants tend to have a lower level of education[130,] (Dhar et al., 2003) and are of lower socio-economic status (Dhar et al., 2003),[131] than those who give birth to normal weight infants. In this study on bivariate analysis education was found to be associated with birth weight but the association was lost on multivariate analysis, showing that this association was due to confounding, probably by economic condition).

Certain prior experience; clinical, physical and nutritional conditions are known to influence pregnancy outcome (WHO and UNICEF, Low Birth Weight, 2004). Some of which have been discussed below.

For the same gestational age, girls weigh less than boys, the firstborn infants are lighter than subsequent infants, and twins weigh less than singletons (in this study also boys were found to weigh more than the girls at birth and twins to be lighter than the singletons; however, whether the birth weight of the first borne is lower than the subsequent births was not tested);

Women of short stature, women living at high altitudes, and young women have smaller babies (in thus study, like some others, did not find any association between pregnant women's height or age at pregnancy. The age factor has been explained above).

Mother's nutrition and diet, lifestyle (e.g., alcohol, tobacco or drug abuse) and other exposures (e.g., malaria, HIV or syphilis), or complications such as hypertension can affect fetal growth and development, as well as the duration of pregnancy. (None was found taking any drug or alcohol in this study. In fact a study, conducted by this firm- SSMF, found drinking to be prevalent among only 2 percent population in the national capital- Dhaka city, which therefore is assumed to be much less in other cities and towns and not to mention about the rural areas). This study found the consumption of tobacco in3.6 percent; while no pregnant woman was ill with malaria, HIV or syphilis. While hypertension was found to be associated with birth weight on bivariate analysis it did not stand the test of the multivariate analysis done to analyze the findings in this survey), perhaps because of a low number.

The WHO Collaborative Study (referred above) on Maternal Anthropometry and Pregnancy Outcomes data (Villar J and Belizan JM 1982), between 1959 and 1989, conducted astudy on 111,000 women in 25 populations across the world, show that being in the lowest quartile of pre-pregnancy

[130] Shoham-Yakubovich I, Barell V. (1988) Maternal education as a modifier of the association between low birthweight and infant mortality. Int. J. Epidemiol. 17: 370-377.

[131] Dickute J, Padaiga Z, Grabauskas V. et al. (2004) Maternal socio-economic factors and the risk of low birth weight in Lithuania. Medicina 40: 475-482.

weight carries an elevated risk of IUGR of 2.5, compared to the upper quartile. It also found that women in the lowest quartile of both low pre-pregnancy weight, and pregnancy weight gain (to week 20, odds ratio 5.6; or to week 36, odds ratio 5.6) were at highest risk of delivering an IUGR infant. A preconception weight of 40 kg (assuming average height is 150 cm) has been proposed as a useful cut-off for predicting IUGR risk in developing countries. As stated, this study also proves this through a multivariate analysis (while the average height of the women in this survey in fact was 150 cm).

Maternal weight during gestation predicts, on the other hand, IUGR risk slightly better than pre-pregnancy weight because it considers weight gain both in pregnant women and the fetus. Comparing women in the lowest quartile of attained weight to those in the highest quartile, the odds ratios (OR) for IUGR are 2.7, 3.0 and 3.1 at 20, 28 and 36 weeks of gestation respectively. When short (below average) maternal height was considered as well, the OR increased to about 3.5, whereas including below-average pre-pregnancy weight increased the odds ratio to closer to 4.0[132]. Maternal height contributes to total maternal mass, but it has less value than weight or BMI for predicting IUGR (WHO, 1995). Low height is rather a good indicator of obstetric complications such as obstructed labor and need for assisted delivery (WHO 1995). In this study also, no association was found between maternal height and birth weight. This study again, could not establish any relation between birth weight/ IUGR and pregnancy weight gain. Some other studies (discussed below) also explained why no association may be found between gestational weight gain and newborn birth weight.

Malaria in endemic areas[133] and maternal infections that can cause loss of appetite, higher nutrient losses-especially when requirement is high, abnormal placental blood flow or structure, or fetal infections[134], can cause low birth weight. As stated above, no pregnant woman in this study was found suffering from malaria or any infectious diseases, other than minor fever (7 percent), except, some chronic non-communicable diseases, e.g., hypertension, diabetes, anemia and pre-eclampsia). No attempt was made therefore to see the effect of these medical conditions on birth weight.

6.7 percent of LBW infants are born preterm in developing countries[135]. But in this study this fact could not be proved, as the gestational period could not be established with accuracy, since the pregnant women do not declare their status before third or fourth month of pregnancy, when they are sure of retaining the pregnancy. (Tests done in this survey on those who missed one menstrual cycle were few).

The fetus is known to increase maximally in length at 20-30 weeks of gestation, and in weight during the third trimester[136].Wasting is thought to result from under nutrition that occurs late in pregnancy, when fat deposition is most rapid. In fact, only one percent of fetal body weight is fat at 26 weeks,

[132]http://www.unsystem.org/SCN/archives/npp19/ch15.htm#TopOfPage

[133]Tomkins A, Murray S, Rondo P, Filteau S (1994) Impact of maternal infection on foetal growth and nutrition. *SCN News* 11: 18-20.

[134]Tomkins A, Watson F (1989) Malnutrition and Infection. ACC/SCN State-of-the-Art Series Nutrition Policy Discussion Paper No. 5. Geneva: ACC/SCN.

[135] Villar J, Belizan JM (1982) The timing factor in the pathophysiology of the intrauterinegrowth retardation syndrome. Obstetrical Gynecology Survey 37: 499-506.

[136]Falkner F, Hozgreve W, Schloo RH (1994) Prenatal influences on postnatal growth: overview and pointers for needed research. European Journal of Clinical Nutrition 48: S15-S24.

compared to 12 percent at 38 weeks. However, stunting may represent undernutrition during the entire period of pregnancy[137]. This study did have the scope to assess these facts.

In developed countries, majority of LBW is caused by premature delivery, cigarette smoking during pregnancy (probably the most important cause of IUGR), followed by low gestational weight gain and low BMI at conception[138]. As stated earlier, the smoking rate was only 3.6 percent among the pregnant women in this survey. No association between smoking and birth weight could therefore be established in this survey. While weight gain showed a trend in its association with birth weight on bivariate analysis, the association was lost in multivariate analysis. No association was found in this survey between birth weight and BMI. There is increasing evidence that deficiencies of some micronutrients, such as folic acid, increase the risk of preterm delivery. In this survey, no association was found between birth weight and iron folate, calcium or vitamin intake. On bivariate analysis a strong trend (P,0.058) has been noted in the association between birth weight and anemia but not substantiated by the multivariate analysis.

Although some studies suggest that women with a low BMI and who do not gain adequate weight, are at greatest risk of delivering a LBW infant[139], and likewise, pregnancy weight gain has a stronger positive effect on fetal growth in initially thinner women than in those who are fatter, contrasting explanations are also found. In the WHO Collaborative Study (WHO 1995), mothers with a BMI in the lowest quartile were observed to be about twice as likely to produce an IUGR infant compared to those in the upper quartile. However, maternal BMI was noted to be a poorer predictor of IUGR than either pre-pregnancy maternal weight or attainment of weight during pregnancy, in other studies.BMI as an indicator of IUGR risk has limitation as fatness, which reflects BMI, influences physiological adaptations to energy available during pregnancy. The thinnest women gain most weight during pregnancy and the fattest gain least. In fact, recommended pregnancy weight gains in USA (Institute of Medicine, 1990) and Europe are inversely proportional to BMI at conception. In Indonesia[140], Pakistan[141], Taipei, China[61] and rural Mexico[62], the highest pregnancy weight gains occurred in the thinnest women. For example, in the Pakistan study, women weighing <45 kg postpartum gained 4.5 kg during one reproductive cycle.Those weighing 45-56 kg lost 0.6 kg, and those >56 kg gained 0.6 kg[60]. Total pregnancy weight gain, as noted in the Mexican study, was negatively related to preconception BMI, skinfolds, and percent body fat (correlation about -0.5), and thinner women also spontaneously consumed more energy during pregnancy[142]. Conversely, for women with a high BMI (>27) at conception, birth weight is practically independent of pregnancy weight gain (Institute of Medicine, 1990).

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[137] Villar J, Belizan JM (1982) The timing factor in the pathophysiology of the intrauterine growth retardation syndrome. Obstetrical Gynecology Survey 37: 499-506.

[138] Kramer MS (1998) Socioeconomic determinants of intrauterine growth retardation. European Journal of Clinical Nutrition 52: S29-S33.

[139]Institute of Medicine (1990) Nutrition during pregnancy. Washington DC: National Academy Press.

[140]Kusin JA, Kardjati S, Renqvist UH (1994) Maternal body mass index: the functional significance during reproduction. EuropeanJournal of Clinical Nutrition 48 (Supplement 3): S56-S67.

[141]Winkvist A, Habicht J-P, Rasmussen KM (1998) Linking maternal and infant benefits of a nutritional supplement during pregnancy and lactation. American Journal of Clinical Nutrition 68: 656-61.

[142]Martínez H, Allen LH, Lung'aho M, Chávez A, Pelto GH (1994) Maternal fatness in Mexican women predicts body composition changes in pregnancy and lactation. Advanced Experimental Medical Biology 352: 99-107.

Interactions between pre-pregnancy BMI and gestational weight gain can be explained by the fact that the resting metabolic rate of fatter women is increased dramatically during pregnancy, thereby consuming more energy, heading towards a lower weight gain[143]. On the other hand, the metabolic rate of thin women may in fact even fall in early pregnancy[64]. Their energy requirement of pregnancy is apt to be much lower, and their pregnancy weight gain may be substantially more than that of fatter women.Serum leptin concentration is strongly correlated with maternal BMI prior to pregnancy and in the second trimester[144]. Higher leptin is normally associated with a higher metabolic rate. In contrast, thinner women become more efficient at utilizing dietary energy for weight gain during pregnancy. This is especially true if their energy intake is low; an intervention with a protein-energy supplement in The Gambia did benefit birth weight[145].

Based on the above considerations it does not seem useful to choose low BMI as the indicator of IUGR risk, compared to low pre-pregnancy weight or attained weight during pregnancy. It appears to be low lean tissue mass, rather than low fat mass (BMI), that predicts IUGR.

It has been estimated[12] that most women in South Asia gain little more than 5 kg rather than the 10-15 kg gain by women in developed countries. Weight gain is inversely related to BMI, as explained above. So, it will be higher in thinner women as long as the energy-sparing adaptations associated with low fat mass can buffer any concurrent low energy intakes. It has been hypothesized that the degree of maternal undernutrition may affect the response to supplementation[146]. Supplementation of moderately malnourished women produces an increase in birth weight but has little impact on maternal weight gain. However, when seriously malnourished women are supplemented they cannot 'afford' to direct the energy to the fetus and therefore such supplementation improves maternal weight gain more thanbirth weight[147, 148]. This needs to be tested through more studies. Using weight gain as the only predictor of IUGR therefore would be risky. This study found the amount of consumption of meat and milk to be associated with weight gain on a bivariate analysis, which however, was not substantiate this association

Mid-pregnancy maternal weight gain and increments in thigh skinfolds were significantly associated with the newborn's length, weight and head circumference and were more effective predictor of birth weight and other newborn outcomes than the maternal measures in late pregnancy. Similarly, low income teenagers in USA were almost twice as likely to deliver an IUGR newborn if they gained

[143] King JC, Butte NF, Bronstein MN, Kopp LE, Lindquist SA (1994) Energy metabolism during pregnancy: influence of maternal energy status. American Journal of Clinical Nutrition 59: 439S-445S.

[144] Williams MA, Havel PJ, Schwartz MW, Leisenring WM, King IB, Zingheim RW, Zebelman AM, Luthy DA (1999) Pre-eclampsia disrupts the normal relationship between serum leptin concentrations and adiposity in pregnant women. Paediatrics Perinatal Epidemiology 13: 190-204.

[145] Lawrence M, Lawrence F, Coward WA, Cole TJ, Whitehead RG (1987) Energy requirements of pregnancy in The Gambia. The Lancet 2: 1072-1076.

[146] Pelto G, Dickin K, Engle P (1999) A Critical Link: Interventions for Physical Growth and Psychological Development: A Review. Geneva: Department of Child and Adolescent Health and Development, WHO.

[147]Winkvist A, Habicht J-P, Rasmussen KM (1998) Linking maternal and infant benefits of a nutritional supplement during pregnancy and lactation. *American Journal of Clinical Nutrition* 68: 656-61.

[148]Olson RK (1994) Developing indicators that predict benefit from prenatal energy supplementation. Ithaca, New York: Cornell University.

inadequate amounts of weight in the first half of pregnancy, regardless of whether their weight gain caught up by the end of pregnancy[149].

Evidence for an effect of iron supplements on preterm delivery and birth weight is still weak[150, 151].In low income, mostly Afro-American women in USA, those with low folate intakes and low serum folate concentrations at the end of the second trimester had twice the risk of preterm delivery[152]. Zinc's role in cell division, immune-competence, and hormone metabolism, raises interest, with regard to its effect on pregnancy outcome, including birth weight. Cochrane meta-analyses however, found no effects of zinc supplementation on pregnancy outcomes or on maternal or fetal mortality or morbidity[153]. Calcium supplementation during pregnancy reduces the risk of hypertension, pre-eclampsia and eclampsia, and lowers the blood pressure of the neonate[154]. A Cochrane meta-analysis of randomized controlled clinical trials showed that this effect was strongest in women with lower calcium intakes (<900 mg per day), and that preterm delivery was reduced in women at high risk of developing hypertension. In India, calcium supplementation of women with low calcium intakes substantially reduced the risk of hypertension and eclampsia[155]. It seems that daily supplementation with 1-2 mg calcium is required to produce this response. As stated, in this study, no effect was found of supplementation with iron folate, calcium or vitamins on birth weight. A controlled study however, would be useful to seek these associations.

Maternal psychological factors, prior abortion (spontaneous, induced), sexual activity, prior still birth or neonatal death, prior infertility, urinary tract infection, genital tract infection, number of antenatal care visit and quality of antenatal care[156] were found to be associated with birth weight.In this study maternal psychological condition was found to be associated with birth weight on a bivariate analysis, which however, could not be substantiated in the multivariate analysis. No association was noted between prior abortions or still births and the present birth weight.

[149]Hediger ML, Scholl TO, Belsky DH, Ances IG, Salmon RW (1989) Patterns of weight gain in adolescent pregnancy: effects on birth weight and preterm delivery. Obstetrical Gynecology 74: 6-12.

[150] Allen LH (2000) Anemia and iron deficiency: Effects on pregnancy outcome. American Journal of Clinical Nutrition 71 (Supplement 5): S1280-84

[151] Rasmussen KM (2001) Is there a causal relationship between iron deficiency or iron-deficiency anemia and weight at birth, length of gestation and perinatal mortality? Journal of Nutrition 131: 590S-603S.

[152]Scholl TO, Hediger ML, Schall JI, Khoo CS, Fischer RL (1996) Dietary and serum folate: Their influence on the outcome of pregnancy. American Journal of Clinical Nutrition 63: 520-525.

[153]Mahomed K (2000) Zinc supplementation in pregnancy. Cochrane Database Systematic Reviews: 16.

[154]Belizán JM, Villar J, Bergel E, del Pino A, Di Fulvio S, Galliano SV, Kattan C (1997) Long-term effect of calcium supplementation during pregnancy on the blood pressure of offspring: follow up of a randomized controlled trial. British Medical Journal 315: 281-285.

[155] Purwar M, Kulkarni H, Motghare V, Dhole S (1996) Calcium supplementation and prevention of pregnancy induced hypertension. Journal of Obstetrical Gynaecology Research 22: 425-30.

[156]Kramer M. Determinants of low birth weight: methodological assessment and meta analysis.Bulletin of the WHO, 1987-65,(5) 663-737

LIMITATON OF THE STUDY

- Salter scale has a minimum graduation of 10 g which was used in case of institutional delivery
- Spring scale has two sources of error : the measured weight varies with the strength of the local gravitational force (by as much as 0.5% at different locations), and the elasticity of the measurement spring can vary slightly with temperature. For accuracy, a spring scale must be calibrated where it is used. Its resolution is 100 g. It was used in case home delivery
- Food data was supposed to be collected on a weekly basis from the pregnant women. It is suspected that the data collectors did not visit them on a weekly basis. Instead either they took the information on phone or made up the data
- To avoid this pitfall, food data analyzed was from those collected during home visits by the data collectors while recording other data, e.g., pregnancy weight gain, blood pressure, sugar, anemia etc.
- 102 newborns were missed out on follow up, due to shifting of abodes by pregnant women or child delivery in far off areas, beyond reach (2.27%)
- Sex-based data was collected from 4,108 newborns, i.e., 392 missed out while recording the sex type (8.69%)

CONCLUSIONS

1. Socio-economic conditions of the study individuals has been observed to be better than were experienced in the last national survey on low birth weight in 2003-2004. Although in some areas effective interventions are required, e.g., marriage age, which is a strong reason of poorer physical conditions of married and pregnant women, with deleterious effect on the newborn's health and welfare.
2. Health practices have registered a noticeable upward swing, in comparison to the 2003-2004 study. Although in certain areas considerable improvement is required, e.g., physical labor, rest, psychological stress, ingestion of iron folate and trace elements// vitamins.
3. The rate of abortion has risen considerably.
4. An alarming rise has been noted in the rate of Caesarian operations.
5. Poorest have the lowest rate of Caesarian, although even among them the rate has been increasing;
6. Private and NGO hospitals conduct significantly high number of Caesarian operations than the government health facilities;
7. Institutional delivery and delivery in trained hands have seen encouraging changes.
8. Mean birth weight in Bangladesh is 2.9 Kg and mean birth length 47.2 cm.
9. Low birth weight (<2,500 g) affects 22.6percent of newborns in Bangladesh.
10. The burden of IUGR, the major cause of LBW in Bangladesh, is high at 73 percent in Bangladesh.
11. Estimation of LBW and IUGR is based on the gestational period and the cut off used is 37th week of gestation. In the cultural context of Bangladesh, it is difficult to identify however, the exact date of the last menstrual period (LMP) and hence accuracy in estimating LBW and IUGR is fraught with risk.
12. About 0.4 percent of newborns were born with very low birth weight (<1,500 g) more among girls and in urban slums.
13. Weight gain of the pregnant women needs further improvement in Bangladesh. But this will require a study for efficient dietary regime during pregnancy.
14. Both birth weight and birth length are better in urban non-slum areas than slums. In rural areas birth length was found to be more than urban areas, because of higher number of boys in rural areas.
15. Dhaka is the worst division in terms of nutritional indicators- birth weight and birth length. Barisal also needs program attention
16. Locally popular and committed data collectors are the most important instruments for ensuring collection of valid data, who however, would need effective supportive supervision, with full commitment of the project head.
17. Studies are required on the risk factors of LBW, IUGR and short birth length.
18. Difference between 2003-2004 and 2015 estimates on birth weight was due to the difference in sample size and drop outs, measuring instruments used, skill of data collectors, the data collection timing after birth of the newborns; beside a real improvement in the situation.
19. Low birth weight has been found to be associated with: saving status of a family (the poorer the economic condition, the more is LBW); sex of newborn(more LBW among girls); initial weight of pregnant women (linearly related); amount of rest taken (direct association); pregnancy complication (directly associated); and season of delivery;

20. No association was found between LBW and: age at marriage, maternal height or education; gestational weight gain (there is a trend with gestational weight gain though); kitchen garden; type of latrine (a trend is observed); amount of fish and egg taken (a trend is associated with egg- P=0.064); amounts of vegetables and fruits (a trend has been noted with the amount of consumption of fruit); anemia; diabetes (a weak trend is seen (diabetic women had slightly more LBW); albumin in urine; heavy work (LBW has rather been found to be significantly higher among those who did some heavy work, rather than those who did more heavy work); iron-folate and calcium intake and gravid/ parity.

RECOMMENDATIONS

1. Since undernutrition is a formidable problem and since LBW and IUGR are discomforting risks to the familial, social, educational, economic and national development, concerted efforts need to be planned for reducing LBW and especially IUGR.
2. Plan and strategy need to be developed for preventing adolescent marriage, and child bearing in adolescence, before a girl attains adequate pre-pregnancy weight.
3. Literacy of girls before marriage is warranted to reduce LBW, as it helps in the to be mother to attain adequate nutritional status to bear children.
4. Attention is warranted towards reduction of the rising trend of Caesarian operations. Strict monitoring of the private hospitals is advisable to prevent unnecessary Caesarians.
5. More care needs to be given to the pregnant, e.g., adequacy of rest, reduction of psychological stress, ingestion of trace elements, vitamins and adequacy of food in all the trimesters, especially at crucial periods of pregnancy. Studies are needed in this regard. Studies are required to explore what would improve gestational weight gain and also which trimester is affected and how by food and trace element supplementation, which may be different in our social and cultural context from what are noted in the west, because of at least the difference in the food type.
6. Studies are also required to assess IUGR by using periodic ultrasonography;
7. Measurement of head circumference is also warranted along with any future birth weight and birth length survey along with intra-uterine growth.
8. Studies are recommended for assessing the impact of different types of food, trace elements, micronutrients and vitamins on LBW, IUGR and birth length.
9. To understand the role of the determinants of LBW and IUGR, a more rigorous study is warranted over a period of three years that should start with identifying and enlisting newly married women, so that within the missing of their first menstrual period they may be identified and confirmed as pregnant without any doubt, followed up to two weeks of child delivery and all their pregnancy history is followed up immaculately, only then a completely accurate estimation of IUGR will be possible to be made.
10. A large sampled study is needed to assess the impact of age of marriage, anemia, diabetes, heavy work, albumin in urine, eclampsia, intake of iron folate/ calcium and vitamins on LBW
11. Social, physical, psychological and nutritional care of pregnancy should be a life cycle process and should start with those who are adolescents right now.
12. Especial attention is required towards Dhaka and Barisal divisions as these divisions have the highest LBW, in particular in the urban slums. In fact a study would be a good point of departure to understand the situation of Dhaka and Barisal with regard to LBW.
13. Understanding of the underlying and basic causes of LBW, e.g. household food security, maternal and child care, access to and quality of antenatal and other health services, sanitation and hygiene, education, gender discrimination and poverty are also necessary for developing long-term strategies for prevention.

ANNEXURE 1

LIST OF DATA COLLECTORS

LIST OF SUPERVISORS

LIST OF QUALITY IMPROVEMENT OFFICERS

Mr Abdur Razzak

Mr. Shamim Hasan Akul

Mr. Moshiur Hossain

Mr. Obaedul Haque Maruf

OFFICIALS OF SSMF INVOLVED IN THE STUDY

Shamim A Bano- Chairperson, SSMF

Project Manager

Mr. Abu Abdullah- Manager, Finance

Mr. A M Imdad Hussain- Field Operations Manager

Ms. Falah Zakir- Manager, Human Resources

Mr. Khaled Hossain- Research Officer

Mr. Jalal Ahmed- Project Officer

Ms. Rukhsana- Office Assistant.

LIST OF STUDY CONSULTANTS

Prof. (Dr.) Khurshid Jahan, INFS, Dhaka University

Prof. (Dr.) Abul Kalam Azad Choudhury, Dhaka Sishu Hospital

Dr. Taslim Sazzad Mallik, Dept. of Biostatistics, Dhaka University

Dr. A M Zakir Hussain, Social Sector Management Foundation (Team Leader)

COLLABORATIVE PARTNERS

Social Sector Management Foundation (SSMF)- lead organization

Dhaka Shishu (Children) Hospital

Bangladesh Association for Maternal and Neonatal Health (BAMANEH)

Institute of Nutrition and Food Sciences (INFS), Dhaka University

ANNEXURE 2

VERBAL CONSENT OF RESPONDENT/ HOUSEHOLD HEAD

(Data collector: Please read out the following clearly to the respondent/ household head and take his/ her verbal consent before taking interview) In order to improve the quality of health services in Bangladesh, the Government has decided to a conduct "National Survey on Low Birth Weight" through the Partners in Social Sector Management Research & Development (PSSMRTD) in collaboration with INFS, Dhaka Shisu Hospital and BAMANEH. To conduct this survey, pregnant woman's weight, height and MUAC measurements and estimation of hemoglobin, blood sugar level and pregnancy test will be undertaken. Socio-demographic, economic and other information about the household will also be collected. The weight and length of the newborn immediately after delivery (within 24 hours) will be measured. You will be informed about the weight and length measurements on the spot. You will be advised to consult with doctor if the measurements of newborns are found lower than normal. All information given by you will be treated as confidential.

Under these circumstances to facilitate government efforts to improve maternal and newborn health are you willing to allow us to conduct the survey by providing the information as stated above? You will have the liberty however, to refrain from responding to any question that you feel uncomfortable for you to respond. All the information that will be given by you or whatever we get from you will be kept completely confidential, unless you want to reveal those.

Y	N

Start the interview after having consent of the respondent or the household head.

Confidential for research purpose only

QUESTIONNAIRES OF THE NATIONAL SURVEY ON LOW BIRTH WEIGHT 2015

Sponsoring Agency: Institute o Public Health Nutrition (IPHN), DGHS, MoHFW, GoB.

Implementing Agencies: Social Sector Management Foundation- lead agencyDhaka Shishu Hospital

Institute of Nutrition and Food Sciences, Dhaka University

Bangladesh Association for Maternal and Neonatal Health

DATA COLLECTION FORM: PART - B

HOUSEHOLD GENERAL INFORMATION OF THE PREGNANT WOMAN

Cluster No.	Household No.	Sl. No.	Name of the pregnant woman	Age (years)

Religion of the HH:
1= Islam, 2= Hinduism, 3= Christianity, 4= Buddhism, 5= Others

Number of males in the household

Number of females in the household

Information about household

SL. No.	Members of household	Name	Relation with household head (write only code)	Age (Year)	Main occupation (write only code)	Class passed (write only code)
1	2	3	4	5	6	7
1.	Household Head					
2.	Pregnant Women					
3.	Husband of Pregnant Women					

4. Sex of the household head: (Male= 1, Female= 2)

5. Relation with the household head:		(6) Main Occupation:	(7) Education:		
Self	01	Agriculture (Only own land)	01	Primary incomplete	
Wife	02	Farmer (Only leased land)	02	Primary complete	
Daughter	03	Farmer (Own & Leased land) Agri-labour / Day-labour	03	Secondary incomplete	
Daughter-in-law	04	Government worker	04	Secondary complete	
Grand daughter	05	Part-time maid servant	05	Higher secondary	
Sister	06	Non-motorized driver	06	Graduate & above	
Sister-in-law	07	Motorized transport driver	07	No education	
Niece	08	Potter/ Blacksmith/ Cobbler/	08		
Mother	09	Tailor/ Construction worker/ Fisher	09	Can sign only	
Mother-in-law	10	Middle class business	10		
Others ----------	11	Big businessman (Whole seller)	11		
		Govt.or non-Govt.(staff)	12		
		Govt. or non-Govt. officers	13		
		Professionals	14		
		Unemployed (>10 years)	15		
		Housewife	16		
		Disabled/ Old aged/Retired	17		
		Others Specify----------	18		
			19		

Name of data collector: ----------

Field Supervisor's Name: ---------- Signature: ----------

Quality Control Officer's Name: ---------- Signature: ----------

Consultant's Name: ---------- Signature: ----------

QUESTIONNAIRES OF THE NATIONAL SURVEY ON LOW BIRTH WEIGHT 2015

Sponsoring Agency: IPHN DGHS

Implementing Agencies:PSSMRTD

(Lead Agency) INFSDHAKA SHISU HOSPITAL

BAMANEH

DATA COLLECTION FORM: PART – C

ECONOMIC INFORMATION OF THE HOUSEHOLD OF PREGNANT WOMAN

Cluster No.	Household No.	Sl. No.	Name of the pregnant woman	Age (yrs)

	Questions	Code
	Total land owned by the household: Homestead (with surroundings) ---------- (Decimal) Cultivated land ---------- (Decimal)	
02	Does the household have the following items? 1= Yes; 2= No	
	Mosquito net	
	Blanket/ Quilt	
	Chair/ Table	
	Chouki (plain cot)	
	Cot	
	Bicycle	
	Electricity	
	Electric fan	
	Television	
	Freeze Car	
	What kind of vegetables did you grow around your house last year? 1= Yes; 2= No	
	Green/ colored leafy vegetables (Lal shak, data, Pui, Kachu etc)	
	Colored non leafy vegetables (Carrot, lau, Pumpkin, Peas etc.)	
	Roots (Potato, Kochu, Raddish etc)	
	Others vegetables (Lau, Potol, Bringal etc)	
	What kind of fruits did you grow around your house in the last year? 1= Yes; 2= No	
	Papaya	
	Banana	
	Boroi	

	Lemon	
	Mango	
	Pineapple	
	Water-melon	
	Guava	
	Other (specify) ----------	
	What are the building materials of your main building room? 1= earth, 2= straw/ shon, 3= Polythene, 4= brick, 5= tin, 6= bamboo, 7= other (specify----------)	
	Roof ----------	
	Wall ----------	
	Floor ----------	
06	Area of that room:	
	Length ---------- Hands	
	Breath ---------- Hands	
07 08	Type of latrine: 1= water seal; 2= pit; 3= hanging; 4= open defecations Source of water for cleansing utensils: 1=tap; 2=tube well; 3= well; 4= pond; 5=others	
09 10	Source of light: 1= electricity; 2= solar panel; 3=others What was the income expenditure gap in your household last year? 1= surplus; 2= equal; 3= sometimes deficit; 4= always deficit	
	How much did you spend for shoes/sandals in your family last year?--Tk.	
	How much did you spend for clothing for your family last year? -- Tk.	
13	Did you have enough warm clothing last winter? 1= Yes; 2= No	
	Is any member of this household involved in any Association, Saving or Income generating activities? 1= Yes; 2= No	
15	If yes, name of the organization ----------	
16	How long is the involvement? ---------- month	
	(For Urban Slum stratum only) How long have you been living in the city/ town? ---------- month	

Name of data collector: ----------

Field Supervisor's Name: ----------Signature: ----------

Quality Control Officer's Name: ----------Signature: ----------

Consultant's Name: ----------Signature: ----------

QUESTIONNAIRES OF THE NATIONAL SURVEY ON LOW BIRTH WEIGHT 2015

Sponsoring Agency: IPHN DGHS

Implementing Agencies:PSSMRTD

(Lead Agency) INFS DHAKA SHISU HOSPITAL

BAMANEH

DATA COLLECTION FORM: PART – D

INFORMATION ABOUT PAST OBSTETRIC HISTORY, BIOCHEMICAL AND ANTHROPOMETRIC MASUREMEENTS OF THE PREGNANT WOMAN AND HUSBAND

Cluster No.	Household No.	Sl. No.	Name of the pregnant woman	Age (years)
☐☐☐	☐☐☐	☐☐		☐☐

No.	Questions	Code
01.1.	What was your age at marriage? (age at first marriage in case of multiple marriages) ----- years	☐☐
01.2.	What was the age of your husband at marriage? (age at first marriage in case of multiple marriages) ----- years	☐☐
02.	Total number of living children at present (write 00 of 0 children)	☐☐
	Boys ----------	☐
	Girls ----------	☐
03.	Did you ever give birth to a child/ children who cried or had a sign of life immediately after birth but died after few hours, days or weeks? 1=Yes; 0= No, If yes,	☐
	Boys (no.) ----------	☐
	Girls (no.)----------	☐
04.	Did any of your under 5 children die during last 5 years? 1=Yes; 0= No. If yes,	☐
	Boys (no.)----------	☐
	Girls(no.) ----------	☐
05.	Did any of your pregnancy fail? 1=Yes; 0= No	☐
06.	If yes, how many? ----------	☐
07.	Total number of pregnancy including the present one ---------- (write adding together Q. 02+03+05+ present conceptions)	☐☐
08.	Do you remember the weight/size of your last baby at birth? 1= very big; 2= big; 3= normal; 4= small; 5= very small	☐
09.	How month ago was your last pregnancy delivered/ terminated?	☐
10.	How did your last pregnancy terminate?	☐

1= live (singlet); 2= live (twin); 3= still birth; 4= abortion; 5= miscarriage

11. Mode of your last delivery: 1= normal; 2= caesarian; 3= other (forceps) ☐

12.1 Do you have any physical illness at present? 1= Yes; 2= No, If yes.

Severe headache (1) ☐

Vomiting (2) ☐

Fever (3) ☐

Convulsion (4) ☐

Bleeding (5) ☐

High blood pressures (6) ☐

Edema (7) ☐

12.2 Did you have any physical illness in the past? 1=Yes, 2=No

Severe headache (1) ☐

Vomiting (2) ☐

Fever (3) ☐

Convulsion (4) ☐

Bleeding (5) ☐

High blood pressures (6) ☐

. Oedema (7) ☐

Other, specify ----------(99) ☐

13. Last menstrual period ---------- day/ ----------month/ 2015

14. Expected date of delivery ……..day……/month/2015

15. Is it your first pregnancy? 1= Yes; 2= No ☐

16. Did you breastfeed your last child? 1=Yes; 2=No; 8= No child ☐

17. Do you smoke? 1= Yes; 2= No ☐

18. If yes, how many per day? ☐

19. Does your husband smoke? 1= Yes; 2= No

20. If yes, how many per day? ☐

21. Height of the pregnant woman (cm) ☐

22. Weight of the pregnant woman (Kg) ☐

23. Height of the husband (cm) ☐

24. Weight of the pregnant husband (Kg) ☐

Name of data collector: ----------

Field Supervisor's Name: ----------Signature: ----------

Quality Control Officer's Name: ----------Signature: ----------

Consultant's Name: ----------Signature: ----------

QUESTIONNAIRES FOR THE NATIONAL LOW BIRTH WEIGHT SURVEY 2015

Sponsoring Agency: IPHN DGHS

Implementing Agencies:PSSMRTD

(Lead Agency) INFS DHAKA SHISU HOSPITAL

BAMANEH

DATA COLLECTION FORM: PART – EIFORMATION RELATED TO CURRENT PREGNANCY

Cluster No.	Household No.	Sl. No.	Name of the pregnant woman	Age (years)
☐☐	☐☐☐	☐☐		☐☐

No.	Questions	Code
01.	Did you face any complications after 6 months of your pregnancy up to the time of delivery? 1= Yes; 2= No	
	Severe headache (1)	☐
	Vomiting (2)	☐
	Fever (3)	☐
	Convulsion (4)	
	Bleeding (5)	☐
	High blood pressure (6)	
	Edema (7)	☐
	Other Specify (99)	☐
02.	Did you have any complication at the time of this delivery? 1= Yes; 2= No	
	Severe headache (1)	☐
	Vomiting (2)	☐

Fever (3)
Convulsion (4)
Bleeding (5)
More than 12 hours long labor (6)
High blood pressures (7)
Hand/ leg came out first (8)
Other specify(99)

03. Did you have any problem within 2 days of delivery? 1= Yes; 2= No
Severe headache (1)
Abnormal bleeding (2)
Bleeding with bad smell (3)
Fever (4)
Convulsion (5)
Any other, specify (99)

04. Did you go for treatment? 1= Yes; 2= No; if yes from where you sought treatment?
Govt. hospital/ clinic/ TH/ DH/ MCWC/ FWC/ RD/ HA/ FWA/ FWV (1)
Village doctor (2)
NGO clinic (3)
Private clinic (4)
Pharmacy (5)
Do not know (6)
Others ……..specify, (99)

5. Who gave decision regarding treatment of your antenatal/ delivery complication?
1= husband; 2= myself; 3= we together; 4= other members of family (father/ mother-in-law); 99= others (specify)

6. Did you consume the following yesterday? (1= Yes, 2=No) 1st trimester 3rd trimester
Fish
Meat
Egg
Milk
Fruit
Vegetable

Oil

Were the following food consumption adequate yesterday? (1= more than normal; 2= less than normal; 3= as before; 4= can't recall)

		1st trimester	3rd trimester
7.	Fish	☐	☐
	Meat	☐	☐
	Egg	☐	☐
	Milk	☐	☐
	Fruit	☐	☐
	Vegetable	☐	☐
	Oil	☐	☐

8. In your opinion, what should be given to the baby after birth? 1= colostrum; 2= honey; 3= sugar water; 4= mustard oil; 5= plain water; 6= others (specify) ----------; 99=do not know ☐

9. For how many months should the baby be breast fed (99= don't know ---------- months) ☐☐

10. For how many months should the baby be exclusively breast fed (99= don't know ---------- months) ☐☐

11. When should the baby be given supplementary food? ☐☐

Name of data collector: ----------

Field Supervisor's Name: ---------- Signature: ----------

Quality Control Officer's Name: ---------- Signature: ----------

Consultant's Name: ---------- Signature: ----------

QUESTIONNAIRES OF THE NATIONAL SURVEY ON LOW BIRTH WEIGHT 2015

Sponsoring Agency: IPHN DGHS

Implementing Agencies:PSSMRTD

(Lead Agency)INFS DHAKA SHISU HOSPITAL

BAMANEH

DATA COLLECTION FORM: PART – F

PREGNANT WOMAN's REGISTRATION AND NEWBORN'S INFORMATION CARD

Cluster No.	Household No.	Sl. No.	Name of the pregnant woman	Age (years)
☐☐☐	☐☐☐	☐☐		☐☐

LMP:	2. EDD:
Day Month Year	Day Month Year
3. Information about pregnancy (Total or average):	

Month 1	☐	☐☐	☐☐	☐	☐	☐
Month 2						

Month 3						
Month 4						
Month 5						
Month 6						
Month 7						
Month 8						

Month 9						
Month 10						

4. Monthly visit 1= Yes; 2= No	Month 3	Month4	Month5	Month6	Month7	Month8	Month9	Month10
Hemoglobin								
Albuminaria								
Blood sugar								
Blood pressure)								

Rest	☐	☐	☐	☐	☐	☐	☐	☐
Heavy work Mental condition	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Cleanliness	☐	☐	☐	☐	☐	☐	☐	☐
Physical condition	☐	☐	☐	☐	☐	☐	☐	☐

5. Suffered from following problem? 1= Yes; 2= No	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10
Severe headache								
Vomiting								
Fever								
Convulsion								
Bleeding								
High blood pressure								
Edema								
No complain								

6. Delivery plan:
Where (address)

7. Delivery result:

Maternal death: 1= Yes; 2= No. 

Cause of maternal death:

1= prolong labor; 2= placental obstruction; 3= bleeding; 4= hand, leg, placenta came out first; 5= convulsion; 6=others 

Place of delivery:

1= govt. hospital/ clinic; 2= private hospital/ clinic; 3= house; 4= any other place 

8.Informationon newborn:

8.1 Date and time of birth:
---- day----- month ------ year

1= morning (6-9 am); 2= late morning (10-12am); 3= noon (12-3pm); 4= afternoon (3-6pm); 5= evening (6-9pm); 5= late evening (10-12pm); 6= mid-night (12-3 am); 7= night(3-6am)

8.2 Date and time of taking birth weight and length:

-----day ------ month------year

1= morning (6-9 am); 2= late morning(10-12am); 3= noon (12-3pm); 4= afternoon (3-6pm); 5= evening (6-9pm); 5= late evening (10-12pm); 6= mid-night (12-3 am); 7= night(3-6am)

8.3 Outcome of pregnancy	S1. No of newborn	Sex	Weight (gm)	Length (cm)	Perception about baby's health	Data collector's comments during measurement
1= live birth; 2= still birth; 3= abortion; 4= death after live birth		1= boy; 2= girl	0000.0	000.0	1= good; 2= average; 3= bad	1= baby was quite; 2= baby was restless/ crying

9. Location of birth: 9.1=Govt. health facility; 9.2=Private health facility; 9.3=NGO health facility; 9.4= Home; 9.5= Any other

10. Delivery conducted by: 10.1=Physician/ Nurse/ FWV/ SACMO; 10.2=CSBA; 10.3=untrained birth attendant; 10.4= Relatives/ neighbors

11. Process of delivery: 11.1= Normal vaginal delivery; 11.2= Caesarian; 11.3= Assisted

12. What did you give in his/ her mouth after birth? 1= colostrum; 2= honey; 3= sugar water; 4= mustard oil; 5= plain water; 6= others (specify) ----------

After how many hours did you give breast milk to your baby? ---------- hours

Did you expel some milk before breast feeding for the first time? 1= Yes, 2= No

Description of visit (visits of data collectors):

Signature	Signature	Signature	Signature	Signature	Signature	Signature	Signature
date	date	date	date	date	date	date	date
Signature	Signature	Signature	Signature	Signature	Signature	Signature	Signature
date	date	date	date	date	date	date	date

Name of data collector: ----------

Field Supervisor's Name: ----------Signature: ----------

Quality Control Officer's Name: ---------- Signature: ----------

Consultant's Name: ---------- Signature: ----------