# Health status of married women residing five communities in Nepal: Unexpectedly high prevalence of anemia in a well-off community of Kathmandu

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## ABSTRACT

The high prevalence of anemia and underweight among reproductive age women is a serious health concern in Nepal. The objective of the present study was to describe anemia prevalence and nutritional status of married women in Nepal. Total of 278 women were included in the present analysis. The five communities included an urban commercial area (W) in Kathmandu, an agricultural village (K) in Lalitpur District, an agricultural village in Chitwan District (C) and one in Ilam District (I) with intensive cash cropping, and another rural village in Kaski District (P) with high number of international out-migration of males. The study procedure included anthropometric measurements, blood collection for hemoglobin measurement, and stool collection for examination of hookworm infection, and a structured interview on their reproductive history including contraceptive use. The altitude adjusted prevalence of anemia was 65%, 23%, 16%, 49% and 58% in communities C, I, K, P and W respectively. The hookworm prevalence of each community was not associated with the anemia prevalence. In the urban well-off community W, although 38% of the women had BMI≥25 and only 2% of women had BMI<18.5, 58% of the women were anemic. A logistic regression analysis on the anemia risk at the individual level showed no effect of helminth infection, but a significant negative effect of Depo-Provera (depot-medroxyprogesterone acetate) use. Causes of high anemia prevalence among the women resided in the urban well-off area should be investigated in future studies.

**Keywords:** Nepal, anemia, Depo-Provera.

## INTRODUCTION

Anemia and underweight is a serious health concern among Nepali women of reproductive age. Anemia during pregnancy increases the risk of low birth weight and preterm delivery,[1] and increases infant and maternal mortality.[2,3] The anemia prevalence of pregnant, breastfeeding, and non-pregnant and non-breast feeding women aged 15–49 in Nepal was 42.4%, 40.3%, and 34.0% respectively, in 2006.[4] Low-iron intake and hookworm infection, which is a major public health problem in Nepal,[5-7] are the major risk factors of anemia in the country.[8] It has also been reported that use of Depo-Provera injections are associated with higher hemoglobin concentrations among Nepali women of reproductive age.[9]

Undernutrition of women increases the risk for maternal and infant mortality.[10] Prepregnancy underweight is associated with increased risk for spontaneous abortion,[11] and the infants born to underweight mothers are at increased risk for fetal growth deficits associated with infant morbidity.[12] The proportion of underweight (body mass index; BMI<18.5) Nepali women of reproductive age was high in rural areas (25.9%) compared to that in urban areas (16.6%) in 2006.[4] When the women are grouped by BMI categories, the prevalence of anemia among women with BMI<18.5 was 44.6%, which was almost double the prevalence among women with BMI≥25 (23.3%).[4] Therefore, it is suspected that underweight women in rural areas are at increased risk of anemia.

While underweight is still being a serious health problem, overweight has been continuously increasing in the women of developing countries.[13] It is also reported that many of the overweight women do not meet the iron intake requirement and suffer from anemia.[14] In Nepal, between 1996 and 2006 the prevalence of overweight (BMI≥25) among women 15-49 years increased from 1.6% to 10.1%, whereas the prevalence of underweight (BMI<18.5) did not show much decrease.[15] This data suggests that underweight and overweight coexist among Nepali women.

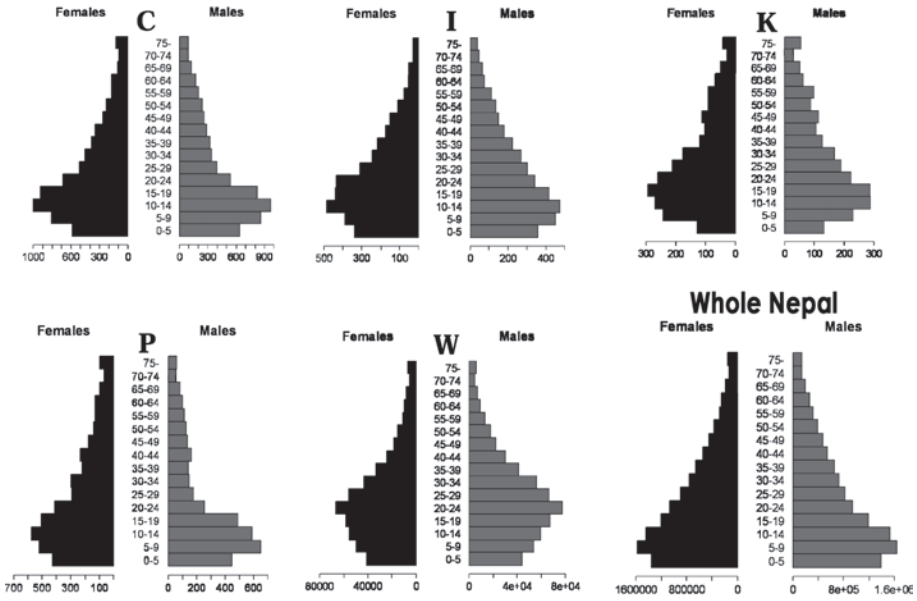


**Fig. 1.** Age-sex composition of the target communities and of whole Nepal in 2001

The objective of the present study was to describe health status, including anemia, underweight, and overweight, of married women who reside in five communities in Nepal in relation to hookworm infection and reproductive history. In order to describe the settings of each study community in more detail, the demographic characteristics of each population is also described in the present paper.

## SUBJECTS AND METHODS

The present study was conducted as a part of the Environmental Research in Rural Asia (ENVRERA) project that aimed to examine the effects of subsistence change on the chemical exposures and on well-being of the people. The study sites of ENVRERA covered total of 32 communities in Nepal, Bangladesh, Vietnam, China, and Papua New Guinea. The study procedures were explained and ethical approval was obtained from the Ethical Committee of the University of Tokyo and Nepal Health Research Council (NHRC).

***Study communities:*** The ENVRERA project included five communities in Nepal with various ecological settings. They included an urban well-off community, Kuleshwor (W), in the capital Kathmandu, an agricultural village Khokana (K) in the Lalitpur District, one agricultural village Birendranagar (C) in the Chitwan District and one village Kanyam (I) in the Ilam District with intensive cash cropping, and one rural village Dhikur Pokhari (P) in the Kaski District characterized by the high number of international out-migration of the adult males. The demographic characteristics of the five communities are described in Table-1. The life expectancy of the five districts are all longer than that of the whole Nepal (55.5 years), but varied from 56.5 years in Chitwan to 67.0 years in Kathmandu. The infant mortality rate (IMR) was 34 and lowest in W among the five communities (Table-1).

The age-sex compositions of the target communities and the whole country in 2001 are illustrated in Fig. 1. While for the whole country the number of children aged 5–9 was highest among all the age groups, in C, I, and P communities those aged 10-14 was highest and in K and W those aged 15-19 or 20-24, respectively, was highest in number. Sex ratio by age groups is shown in Fig. 2. Whereas for the national population the ratio is close to 1.0 for all age groups, the sex ratio for P is significantly lower than 1 especially in ages from 20 to 50 reflecting males' out-migration to overseas countries. The similar tendency is observed in C, although the degree of sex bias is much smaller compared to that of P. On the other hand, the high sex ratio is observed in the urban W population in working age.

## METHODS

A health camp was set either in a hospital, a public hall, or in a house in each of the target communities.

**Table-1:** Demographic characteristic of the target communities and the whole Nepal

| Target community | Birendranagar | Kanyam | Khokana | Dhikur Pokhari | Kuleshwor | — |
|---|---|---|---|---|---|---|
| Shortened name | C | I | K | P | W | (Whole Nepal) |
| Population in 2001 | 13,270 | 7,190 | 4,542 | 8,081 | — | 23,151,423 |
| District in which the community locates | Chitwan | Ilam | Lalitpur | Kaski | Kathmandu | 2.3 |
| Characteristics of each district/whole Nepal | | | | | | 55.0 |
| Population in 2001 | 472,048 | 282,806 | 387,785 | 380,527 | 1,081,845 | 93 |
| Annual population growth rate (%) during 1991-2001 | 2.9 | 2.1 | 2.7 | 2.6 | 4.7 | 48.3 |
| Life expectancy (y) in 1996 | 56.5 | 61.3 | 63.0 | 60.0 | 67.0 | |
| IMR[a] (per 1,000 births) in 1996 | 82 | 74 | 51 | 68 | 34 | |
| Female literacy rate (%) in 2001 | 62.8 | 58.2 | 60.3 | 61.5 | 66.4 | |

Source: Informal Sector Research and Study Center (2002); Gurung (2006); a: Infant mortality rate

Surrounding the health camp, approximately 50 households that included at least two adults and two children were selected. Four members (two adults and two children) from each of the selected households were asked to participate in the study. Once had they agreed to participate in the study, a small plastic vial was given on the day before their enrollment to bring their stool samples to the health camp next morning.

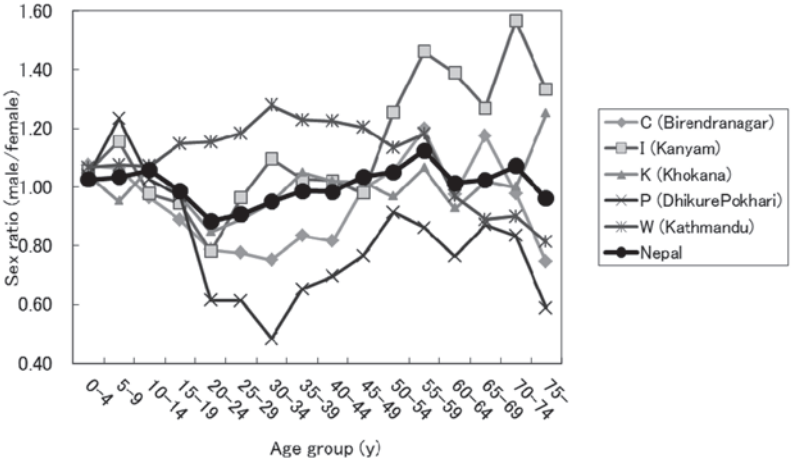


**Fig. 2.** Sex ratio by age groups of the target communities and of whole Nepal in 2001

The participants were invited to the health camp in the morning. At the study site, each participant was given an explanation on the purpose and procedure of the study and asked to sign (or fingerprinted in case of illiterate) the informed consent form if they had agreed to participate. Stool samples were collected at the reception for Kato-Katz test. Anthropometric measurement was done by one of the researchers (E.T.) for height, weight, mid-upper-arm circumference (MUAC), and triceps skinfold thickness following the standard methods.[16]

One ml of blood was drawn from venipuncture by a medical doctor. Hemoglobin concentration was measured on site using a battery operated photometric analyzer (Test-mate; EQM Research, Cincinnati, OH, USA). Stool samples were also analyzed on site by an experienced laboratory technician using Kato-Katz method, which provides an accurate measure of the number of eggs present.[17]

From the participants of the ENVRERA project in Nepal (n=1085), only married females and widows (n=322) were asked to answer questions on reproductive health. The questions regarding their reproduction were asked by a female Nepali researcher (S.S.) using Nepali language. In the K community where some of the residents only spoke *Newari* language, a female *Newari* researcher asked the questions using their native language. The items asked included age at marriage, age at menarche, number of live births, abortions, stillbirths, and number of children died after births, together with types of contraceptive method ever used. Whether the abortion was spontaneous or induced was not asked in the present survey, because induced abortion was illegal in Nepal, under any circumstance, before Sept 26, 2002.[18] Among the 322 women who completed the questionnaires, 278 women whose age at the interview were equal to or less than 50 were included in the present analysis.

*Statistical analysis:* As an index of fertility, mean number of live births was calculated by community and duration of marriage (0–9, 10–19, and 20– years). Total number

**Table-2:** Nutritional status and prevalence of hookworm infection of the participants shown as mean (SD) or proportions

| | C (n=68)[a] | I (n=60)[a] | K (n=49)[a] | P (n=53)[a] | W (n=48)[a] | p-value | Combinations with significant difference[b] |
|---|---|---|---|---|---|---|---|
| Age (y) | 34 (8) | 33 (8) | 33 (7) | 36 (9) | 36 (9) | 0.144† | None |
| Height (cm) | 151.7 (4.8) | 152.2 (5.8) | 151.2 (5.6) | 149.9 (5.7) | 152.2 (5.7) | 0.133‡ | None |
| Weight (kg) | 50.9 (9.4) | 53.2 (9.0) | 52.9 (6.9) | 45.0 (6.4) | 57.2 (10.0) | <0.001‡ | CP, CW, IP, KP, PW |
| MUAC (cm) | 25.1 (3.2) | 25.6 (2.6) | 25.0 (2.0) | 23.1 (2.3) | 27.4 (3.0) | <0.001‡ | CP, CW, IP, IW, KP, KW, PW |
| Triceps skinfold (mm) | 17.4 (7.9) | 15.9 (7.0) | 14.5 (5.3) | 11.6 (5.2) | 21.7 (7.3) | <0.001† | CP, CW, IP, IW, KP, KW, PW |
| BMI (kg/m$^2$) | 22.1 (3.9) | 23.0 (3.7) | 23.1 (2.7) | 20.0 (2.4) | 24.7 (4.1) | <0.001‡ | CP, CW, IP, KP, PW |
| Underweight (BMI<18.5) | 19% | 13% | 4% | 26% | 2% | 0.001§ | |
| Overweight (BMI≥25) | 25% | 27% | 27% | 4% | 38% | 0.002§ | |
| Hb (g/dl)[A] | 11.2 (1.4) | 13.2 (1.6) | 13.4 (1.1) | 12.4 (1.5) | 11.9 (0.9) | <0.001‡ | CI, CK, CP, IP, IW, KP, KW |
| Anemia[cA] | 65% | 23% | 16% | 49% | 58% | <0.001§ | |
| Hookworm infection[B] | 1% | 7% | 20% | 17% | 0% | 0.005§ | |

a Numbers of missing values are shown below in A) and B). b Multiple comparison by Holm's procedure ($p<0.01$). c Anemia defined by cutoffs that considers the altitude of their residence (C <12.0 g/dl, I&P <12.5 g/dl, K&W <12.3 g/dl) (CDC, 1998). † Kruskal-Wallis test, ‡ One-way ANOVA, § Chi-square test, Numbers of missing values: A) C (n=16), B) C (n=1), I (n=1),

of pregnancies was estimated by summing the number of live births, abortions, and stillbirths that were reported by the participant women. Proportion of abortions and stillbirths was then calculated by dividing the number of abortions and stillbirths by the total number of pregnancies. The proportion of children died after births was calculated as a proportion to the total number of live births.

BMI was calculated as (weight in kg) / (height in m)$^2$. Underweight and overweight was defined as BMI<18.5 or ≥25.0, respectively, according to WHO criteria.[19] Anemia was defined following CDC criteria adjusting for altitude.[20] The cutoff values of hemoglobin used to define anemia were <12.0 g/dl for C, <12.5 g/dl for I and P, and <12.3 g/dl for K and W communities. Prevalence of the hookworm infection was calculated as the proportion of women who had egg intensity (>0 egg per gram (epg)) in each community.

The statistical significance of community differences were tested with one-way ANOVA for normally-distributed continuous variables, or with Kruskal-Wallis test for the variables with skewed distributions. The community differences for the categorical variables were tested using chi-square test. Combinations of the communities with the significant differences were obtained using the multiple comparison by Holm's procedure ($p < 0.01$).

In order to elucidate the risk factors of anemia at an individual level, a logistic regression analysis was conducted with anemia as a dependent variable. The independent variables of the model included age, BMI, hookworm infection, current and past use of Depo-Provera and pill, and the community of residence.

All the statistical analyses were conducted using R version 2.11.1.[21] $P<0.05$ was set as a statistical significance except when noted otherwise.

## RESULTS

Age, nutritional status, and the prevalence of hookworm infection of the participants in each community are summarized in Table-2. There was no community differences in the age of the participants. The mean (SD) height varied from 149.9 (5.7) cm in P to 152.2 (5.7) cm in W, however, there was no statistically significant difference. For the other anthropometric parameters, i.e. weight, MUAC, triceps skinfold thickness, and BMI, significant inter-community differences were found ($p < 0.001$ for all). The women in W showed the highest and the women in P showed the lowest measures. The proportions of the subjects categorized as underweight were low in the urban W (2%) and in the peri-urban K (4%), whereas it was highest in the rural community P (26%). The prevalence of overweight was lowest in P (4%) and highest in W (38%).

**Table-3:** Mean numbers of live births per woman by community and duration of marriage

| Duration of marriage (y) | C (n=64) | I (n=59) | K (n=49) | P (n=51) | W (n=48) |
|---|---|---|---|---|---|
| 0-9 | 1.4 | 1.2 | 1.2 | 1.0 | 0.8 |
| 10-19 | 2.5 | 3.1 | 2.2 | 3.8 | 1.8 |
| 20- | 4.6 | 4.3 | 3.8 | 5.1 | 2.9 |

The hemoglobin concentration of the blood showed large inter-community differences ranging from 11.2 (1.4) g/dl among C women to 13.4 (1.1) g/dl among K women ($p<0.001$). The prevalence of anemia adjusted for the altitude of their residence was highest (65%) for C women, whereas it was lowest (16%) for K women. The prevalence of hookworm infection was 20% and highest among K women, followed by 17% in P, 7% in I, 1% in C, and 0% in W communities.

Mean number of live births per woman by community and duration of marriage was summarized in Table 3. Between-community differences of the number of live births are greater among women whose duration of marriage is longer. For those women who had been married for more than 20 years the number of children ranged from 5.1 in P to 2.9 in W.

The variables related to reproductive history are summarized in Table 4. Age at marriage showed significant variation between communities; the median age at marriage was 16 with the range of 6 to 22 for P women, whereas it was 22 with the range of 15 to 30 for W women. The age at marriage of W women was statistically higher than that of any other four communities ($p<0.01$ for all pairs). The median age at menarche was 14 or 15 in each community, but the multiple comparisons indicated that P women's age at menarche was higher compared to W and C women. Among the total number of pregnancy reported, in the communities K and C, 5% and 16% respectively, ended in abortion. Five to 10% of the children born alive were dead by the time of interview, for which there was no statistically significant community difference. The proportion of women who had ever used Depo-Provera was highest in K (63%), whereas ever use of pill was highest in I (55%). The proportion of ever-using Depo-Provera or pill was lowest in C (29% for Depo-Provera, 13% for pill), followed by the women of the most urban community W (31% for Depo-Provera, 19% for pill).

Table 5 shows the result of logistic regression analyses for the risk of anemia. Ever use of Depo-Provera was associated with the decreased risk of anemia with OR

**Table4:** Reproductive variables of the participants shown as median [minimum, maximum], numbers, or proportions

| | C (n=68)[a] | I (n=60)[a] | K (n=49)[a] | P (n=53)[a] | W (n=48)[a] | p-value | Combinations with significant difference[b] |
|---|---|---|---|---|---|---|---|
| Age at marriage (y)[A] | 18 [13,25] | 19 [13,25] | 18 [11,28] | 16 [6,22] | 22 [15,30] | <0.001† | CW, IP, IW, KP, KW, PW |
| Age at menarche (y)[cB] | 14 [11,17] | 14 [11,20] | 15 [11,21] | 15 [12,19] | 14 [11,17] | <0.001† | CK, CP, PW |
| Total no of abortions and stillbirths[dC] | 35 (16%) | 19 (10%) | 6 (5%) | 19 (8%) | 15 (14%) | 0.009¶ | |
| Total no of children died after birth[eC] | 14(8%) | 8 (5%) | 9 (8%) | 21 (10%) | 4 (4%) | 0.256¶ | |
| Ever use of Depo-Provera[D] | 29% | 55% | 63% | 40% | 31% | 0.001¶ | |
| Ever use of pill[D] | 13% | 57% | 27% | 15% | 19% | <0.001¶ | |

a Numbers of missing values are shown below in A) to D). b Multiple comparison by Holm's procedure (p<0.01). c Two women with primary amenorrhoea were excluded (one each from I and W). d Total number of abortion and stillbirths and their proportion to the total number of pregnancy. Induced and spontaneous abortion could not be distinguished from the present data. e Number of children died after live birth and its proportion to the total number of live births. Number of missing values: A) C (n=2), K (n=2), W (n=2). B) C (n=2), I (n=1), K (n=3), W (n=2). C) C (n=4), I (n=1), P (n=2). D) C (n=6), K (n=8), P (n=6).

0.84 (95%CI 0.77–0.99). Hookworm infection was not associated with increased or decreased OR of being anemia. The significant community difference of the anemia prevalence remained after adjusting for the covariates.

## DISCUSSION

The major finding of the present study is that the women resided in W community showed high anemia prevalence, despite the high prevalence of overweight. Use of Depo-Provera was shown to decrease anemia risk among the subject women, but the significant regional difference remained after controlling for other covariates including hookworm infection, BMI, and hormonal contraceptive use.

The women resided in the urban well-off community W showed the highest weight, BMI, MUAC, and triceps skinfold thickness, which is consistent with many other studies that showed increasing overweight with modernization.[22] It is suspected that the participant women in W show low physical activity level, since none of them were engaged in agriculture. In addition, most of their husbands were wage earners or running their own business, which make them able to purchase various foods with high energy content. On the other hand, the women of the P community showed lowest value of these indices. The mean height was 2.3 cm lower and the mean weight was 12.2 kg lighter among the women in P compared to the women in W community. Many of the study participants in P complained that they were suffering from uterine prolapse, which is due to undernutrition and heavy workload during pregnancy and soon after delivery.[23] Since there was little opportunity for cash earning in P, many married males had gone to overseas countries to work leaving their wives in the village with their heavy workload. In other words, it is speculated that decreased sex ratio in the P community as shown in Figure 2 imposes health risk for the reproductive age women by giving them heavy physical work.

Despite the low prevalence of Depo-Provera and pill use among W women compared to K and C women, the fertility of W women was lowest, which may be due to higher age at marriage and use of abortion in this urban community. In addition, husbands' preference for less number of children can also affect. Several respondents told the interviewer (S.S.) that they were using rhythm method for fertility control.

Both C and I communities are characterized by intensive cash cropping. In terms of anthropometric parameters, there was no significant differences between C and I women, whereas hemoglobin concentration was significantly higher among I compared to C women. Even the altitude adjusted prevalence of anemia shows the significant higher prevalence among C than I women. It is consistent with the previous finding that the hemoglobin concentration of women in the lowland *Terai* is higher compared to the women in other regions in Nepal.[4]

The women residing in both K and W communities showed high prevalence of overweight, however, the prevalence of anemia was only 16% in K, whereas it was 58% in W. The significant difference in hemoglobin concentration between K and W women seem to be partly due to different way of controlling fertility as shown in the logistic regression analysis. Use of Depo-Provera has been reported to reduce the risk of anemia.[24,25] Hookworm infection increases risk of anemia[8], but in the present participants hemoglobin lowering effect of hookworm infection was not observed. It may partly be due to the relatively low egg density among women testing positive for hookworm infection (range 37-500 epg with mean (SD) of 129 (124) epg).

**Table-5:** A logistic regression analysis for anemia[a]

| Independent variables | All communities | |
|---|---|---|
| | OR | 95% CI |
| Age | 1.00 | 0.99–1.01 |
| BMI | 0.99 | 0.97–1.00 |
| Hookworm (y/n) | 0.94 | 0.75–1.18 |
| Ever use of Depo-Provera | 0.87 | 0.77–0.99* |
| Ever use of pill | 0.96 | 0.83–1.11 |
| Community of residence | | |
| C | 1.00 | (reference) |
| I | 0.66 | 0.55–0.80*** |
| K | 0.64 | 0.52–0.79*** |
| P | 0.83 | 0.68–1.02 |
| W | 0.93 | 0.76–1.12 |

*p < 0.05, ** p < 0.01, *** p < 0.001

a Anemia defined by cutoffs that considers the altitude of their residence (C <12.0 g/dl, I&P <12.5 g/dl, K and W <12.3 g/dl) (CDC, 1998)

One study targeting Tanzanian children did not find the association between helminth infection and lower hemoglobin concentrations,[26] in which the mean epg (106.78, 95% CI 68.77-165.81 epg) was comparable to that of the current study.

The five study communities greatly varied in terms of their ecological, demographic, and health characteristics. Underweight and overweight coexists in the study populations. The most significant finding of the present study is that women of the urban well-off community with high prevalence of overweight showed very high anemia prevalence. The cause of high anemia prevalence among the urban women with high prevalence of overweight should be investigated in future studies.

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