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Determinants of Knowledge Regarding Family Planning Among Reproductive-Age Women Attending Rural Immunization Clinics in Karnataka, India: A Cross-Sectional Analytical Study

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ABSTRACT: **Background**: Family planning is central to reducing maternal and neonatal mortality, yet 270 million of the world's 1.1 billion women with a need for family planning have an unmet need, and rural Indian women continue to lag behind national averages in comprehensive contraceptive knowledge despite near-universal awareness of at least one method. Simple bivariate comparisons cannot identify which socio-demographic factors independently drive knowledge once correlated variables, such as a woman's own and her husband's education, are accounted for.

Objectives: To assess the level of knowledge of family planning among reproductive-age women attending rural immunization clinics; to identify socio-demographic factors bivariately associated with knowledge; and to determine independent predictors of knowledge using multivariable logistic regression.

Methods: This cross-sectional analytical study included 100 married women aged 18-49 years attending immunization sessions at two rural Primary Health Centres (Adargunchi and Noolvi), Hubballi, Karnataka, between 15 September and 15 November 2023. A pre-tested, interviewer-administered questionnaire captured socio-demographic characteristics and family planning knowledge. Bivariate associations were tested with the chi-square test (Fisher's exact test where expected cell counts were below 5); variables

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significant at $p<0.10$ were entered into a binary logistic regression model, yielding adjusted odds ratios (AOR) with 95% confidence intervals (CI).

Results: Only 52% of women were aware of family planning, and only 42% attained a "good" composite knowledge score (⩾4 of 5 items); 52% scored "poor." Only 8% had heard of emergency contraception, and 53% could not describe the underlying concept of family planning. On bivariate analysis, women's own education ($\chi^2=16.587$, $p=0.002$), husband's education ($\chi^2=11.740$, $p=0.019$) and occupation ($\chi^2=5.160$, $p=0.023$) were significantly associated with awareness. The multivariable model was statistically significant overall (omnibus $\chi^2=20.436$, $df=7$, $p=0.005$; Nagelkerke pseudo-$R^2=0.247$), but only pre-university/diploma-level education in the woman herself remained an independent predictor (AOR=4.03, 95% CI 1.12-14.48, $p=0.033$); husband's education and occupation, despite their bivariate significance, did not retain independent significance after adjustment.

Conclusion: Awareness and depth of family planning knowledge remain low in this rural Karnataka cohort. A woman's own education, rather than her husband's education or occupation, emerged as the sole independent, modifiable determinant of knowledge once these inter-correlated factors were adjusted for one another. Health education strategies should therefore engage women directly, rather than assuming that a husband's schooling adequately proxies for household-level reproductive health literacy.

1. INTRODUCTION

Family planning - the ability of individuals and couples to anticipate and attain their desired number of children and to determine the spacing and timing of births - is one of the most cost-effective public health interventions available.[1] By spacing pregnancies and averting high-risk and unwanted births, family planning prevents an estimated one-third of maternal deaths and 44% of neonatal deaths, while also promoting educational attainment, gender equity and household economic wellbeing.[1,2] Despite this well-established benefit, access to family planning remains inequitable: of the estimated 1.9 billion women of reproductive age worldwide, 1.1 billion have a need for family planning, and 270 million of them have an unmet need for modern contraception.[3]

India has made substantial demographic progress since launching the National Family Welfare Programme in 1951, with the total fertility rate now close to replacement level at 2.2 children per woman.[4] Successive policy milestones - the 1997 merger with the Reproductive and Child Health Programme, the National Population Policy of 2000, the 2012 London Summit on Family Planning, and the 2018 integration of family planning into the Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+A) strategy - have expanded the range of contraceptive choices available.[5,6] A persistent gap between the demand for family planning and actual contraceptive behaviour nonetheless remains, particularly among adolescents, migrants and rural populations.[7,8] According to the fifth National Family Health Survey (NFHS-5), while 99% of currently married Indian women are aware of at least one modern method, only 58% are currently using any method of contraception - a striking 41-percentage-point knowledge-to-practice gap.[9]

This gap is not explained by lack of awareness alone; knowledge itself is unevenly distributed and shaped by socio-demographic determinants such as education, religion, family structure and household wealth. A community-based study among married Muslim women in Nepal found 94.5% overall knowledge of family planning methods, yet wealth rank - and not other socio-demographic factors - was significantly associated with actual practice.[10] In north-eastern Nigeria, 88.6% of women of childbearing age had heard of modern methods, largely from friends and relatives, but only 54.2% went on to use them, with male non-involvement, side-effects and distance to health facilities cited as key barriers.[11] In rural Jaipur, Rajasthan, 88.3% of 300 married women had some knowledge of family planning, with condoms, sterilisation and oral pills the best-known methods.[12] A study of urban slum-dwelling young married women in Lucknow reported an unmet need as high as 55.3%, driven by negligent attitudes, spousal opposition, embarrassment and inadequate knowledge.[13] Even among health-care workers themselves - a population expected to have superior knowledge - a Kashmir-valley study found that only 90.4% could

correctly identify different family planning methods, underlining that knowledge gaps persist across occupational strata.[14] Closer to the present setting, comparison of NFHS-4 and NFHS-5 data for Karnataka showed modern contraceptive usage rising from 51.3% to 68.2% and unmet need falling from 10.4% to 6.5% state-wide, yet a study of breastfeeding mothers in Bellary, Karnataka, found only 46% had adequate knowledge of family planning methods, with lack of awareness cited by 57.2% as the principal barrier to practice and decisions frequently made unilaterally by husbands or elders rather than by women themselves.[9,15] A more recent observational study among pregnant tribal women in Mysore, Southern India, similarly found that only 39.3% had heard of any temporary contraceptive method, reinforcing that low, unevenly distributed knowledge persists in under-served Indian populations even today.[16]

Almost all of the studies cited above - including the parent Knowledge-Attitude-Practice (KAP) survey from which the present dataset was drawn - report only simple, unadjusted (bivariate) associations between socio-demographic characteristics and family planning knowledge.[9-18] Because variables such as a woman's own education, her husband's education, occupation and household socio-economic status are themselves inter-correlated, bivariate estimates are vulnerable to confounding: a factor that appears significant in isolation may lose its explanatory power once other correlated variables are taken into account. Multivariable logistic regression, which yields adjusted odds ratios (AOR) with 95% confidence intervals, is widely used internationally to isolate the independent contribution of individual determinants of family planning knowledge and use - for example, an Ethiopian determinants study found that both a woman's own and her partner's educational attainment remained independently associated with contraceptive use after multivariable adjustment.[19] Yet this analytic step is rarely undertaken in Indian rural community-based KAP surveys, which typically stop at descriptive and chi-square-based reporting. The present study addresses this gap by re-analysing a rural Karnataka dataset originally reported descriptively, applying multivariable logistic regression to identify the independent, confounder-adjusted determinants of family planning knowledge among reproductive-age women attending rural immunization clinics.

2. OBJECTIVES

i. To determine the independent predictors of knowledge regarding family planning among reproductive-age women attending rural immunization clinics, using multivariable binary logistic regression

ii. To assess the level of knowledge (awareness and composite depth of knowledge) regarding family planning among the study population.

iii. To identify socio-demographic factors bivariately associated with knowledge of family planning.

3. METHODOLOGY

3.1 Study design

This was a community-based, cross-sectional analytical study, representing a pre-specified secondary statistical analysis of a parent descriptive Knowledge-Attitude-Practice (KAP) survey on family planning.

3.2 Study area and population

The study was conducted in the rural field-practice area of two Primary Health Centres, Adargunchi and Noolvi, attached to the Department of Community Medicine, J.G.M.M. Medical College, Hubballi, Karnataka. The study population comprised married women aged 18-49 years attending immunization sessions at these centres and their outreach areas.

3.3 Study period

Data was collected over two months, from 15 September 2023 to 15 November 2023.

3.4 Sample size calculation

The sample size was calculated using the formula $n = 4pq/d^2$, where $p = 94$ (prevalence of knowledge of family planning reported in a previous study), $q = 100 - p = 6$, and $d = 5$ (expected absolute error). This yielded $n = (4 \times 94 \times 6) / 5^2 = 90.24$, rounded up to a target sample size of 100.

3.5 Sampling method

A universal (consecutive) sampling method was used: all eligible women attending immunization sessions during the study period were enrolled until the target sample size of 100 was achieved.

3.6 Inclusion and exclusion criteria

Inclusion criteria: Married women aged 18-49 years attending immunization sessions at the study centres or their outreach areas, who provided written informed consent.

Exclusion criteria: Women who had undergone hysterectomy were excluded.

3.7 Data collection tool

Data was collected by direct interview using a pre-designed, pre-tested, structured questionnaire covering socio-demographic characteristics; knowledge and awareness of family planning methods; attitude towards family planning; history of past use of contraceptive methods; and history of side-effects experienced with contraceptive use. Each interview lasted approximately 30 minutes and was conducted in the participant's local language after obtaining written informed consent.

Minimizing bias: Several steps were taken during data collection to limit potential sources of information and selection bias. The questionnaire was pre-designed and pre-tested before the study period and refined for clarity and cultural appropriateness; it was then administered identically to every participant in a single structured interview format, limiting instrument-related variation in information bias. Conducting interviews in the participant's local language reduced the risk of comprehension-related misclassification of exposures and outcomes. Selection bias was limited by using universal (consecutive) sampling of all eligible women attending immunization sessions during the study period, rather than a method vulnerable to selective recruitment.

3.8 Data management and outcome definitions for this analysis

Data collection during the two-month study period yielded 121 completed questionnaires from women attending the study centres. At the point of data cleaning, prior to analysis, 20 questionnaires were excluded because of missing responses for one or more key study variables (most commonly per-capita household income, needed to derive the Modified B.G. Prasad socio-economic classification), and a further questionnaire was identified as a duplicate submission and excluded; missing records were excluded rather than imputed, and no eligible woman's reason for non-participation or refusal was separately recorded in the parent dataset. This yielded the analytic sample of 100 women, with complete data for every variable reported in this analysis, described here. “Knowledge regarding family planning” - the outcome of interest for objectives 2 and 3 - was operationalised as awareness of family planning (having heard of it; yes/no). To more fully characterise the level of knowledge (objective 1), a supplementary composite five-item knowledge score (range 0-5) was additionally constructed from: awareness of family planning; awareness of three or more contraceptive methods; awareness of emergency contraception; correct concept of family planning (spacing or limiting births); and awareness of at least one non-contraceptive benefit. Scores were graded as poor (0-1), average (2-3) or good (4-5). Socio-economic status was classified using the Modified B.G. Prasad classification, based on per-capita monthly family income.[20]

3.9 Ethical approval

The study protocol was approved by the Institutional Ethics Committee, J.G.M.M. Medical College (reference JGMMMCIEC/035/2023, dated 11 August 2023). Written informed consent was obtained from all participants after the study objectives and procedures were explained in the local language; confidentiality of responses and the right to voluntary withdrawal at any stage were assured.

3.10 Statistical analysis

Data were cleaned and analysed for the final sample of 100 women. Categorical variables were summarised as frequencies and percentages. Bivariate associations between awareness of family planning and each socio-demographic variable were assessed using the Pearson chi-square test, with Fisher's exact test substituted where expected cell frequencies fell below 5. Variables significant at $p<0.10$ on bivariate screening - women's own education, husband's education and occupation - were entered into a binary logistic regression model to obtain adjusted odds ratios (AOR) with 95% confidence intervals (CI) and Wald p-values. For both education variables, the illiterate category could not be retained in the multivariable model and primary-school

education was used as the reference category instead; this reflects, at minimum, the complete absence of variability in the illiterate stratum for women's own education (0 of 9 illiterate women were aware of family planning), which precludes stable maximum-likelihood estimation for that category. Overall model significance was assessed with the omnibus likelihood-ratio chi-square test, and model fit was further described using the −2 Log Likelihood, Cox and Snell pseudo-R^2 and Nagelkerke pseudo-R^2. A two-sided $p<0.05$ was considered statistically significant throughout.

Handling of quantitative variables: Age and the other count- or duration-based variables were initially recorded as numerical variables and categorised for descriptive and bivariate analysis. Age was grouped into 18-29 and older age groups; age at marriage was categorised as <18, 18-25 and >25 years, reflecting the legal minimum marriage age in India (18 years) and the distribution observed in this cohort; duration of marriage was categorised as ≤1, 2-4, 5-7 and >7 years; and number of pregnancies and living children were each categorised as 0, 1, 2 and ≥3, following conventional parity groupings used in reproductive health research. These groupings were used to facilitate clinically and demographically interpretable comparisons and to avoid excessively small analytical cells in the bivariate analysis. The same categorisations were used consistently in the descriptive (Table 1) and bivariate (Table 3) analyses. Per-capita monthly family income was likewise recorded as a continuous variable and categorised into the five Modified B.G. Prasad socio-economic strata using the pre-specified income cut-points for September 2023 CPI-IW.[20]

Handling of missing data: Records with missing responses for one or more study variables were excluded during data cleaning prior to analysis; no imputation was performed. The final analytic dataset of 100 women had complete data for every variable included in this analysis, so no missing-data category appears in Table 1, Table 2, Table 3 or Table 4.

4. RESULTS

4.1 Socio-demographic profile of study participants

Of the 100 women studied, 54% were aged over 30 years and 46% were 18-29 years old; 91% were Hindu and 9% Muslim. Nine percent of women were illiterate, while 27% had studied up to pre-university/diploma level and 10% were graduates; husbands showed a broadly similar, slightly less favourable pattern (12% illiterate, 28% pre-university/diploma, 15% graduate). The majority (82%) of women were housewives, 62% lived in joint families, and 71% had married between 18 and 25 years of age, although 24% had married before turning 18. Two-thirds (67%) had been married for more than seven years, 39% had experienced three or more pregnancies, and 46% had two living children. On the Modified B.G. Prasad classification, based on per-capita monthly family income, this was a predominantly lower socio-economic cohort: 45% of women belonged to class V (lower) and 36% to class IV (lower middle), with only 1% in class I (upper) (Table 1).

Table 1. Socio-demographic profile of study participants (N = 100)

Characteristic	n	%
Age (years)		
18-29	46	46.0%
>30	54	54.0%
Religion		
Hindu	91	91.0%
Muslim	9	9.0%
Women's education		
Illiterate	9	9.0%
Primary school	22	22.0%
High school	32	32.0%
Pre-university/Diploma	27	27.0%

Graduate and above	10	10.0%
Husband's education		
Illiterate	12	12.0%
Primary school	21	21.0%
High school	24	24.0%
Pre-university/Diploma	28	28.0%
Graduate and above	15	15.0%
Occupation		
Housewife	82	82.0%
Unskilled worker	18	18.0%
Type of family		
Joint	62	62.0%
Nuclear	38	38.0%
Age at marriage (years)		
<18	24	24.0%
18-25	71	71.0%
>25	5	5.0%
Duration of married life		
≤1 year	4	4.0%
2-4 years	15	15.0%
5-7 years	14	14.0%
>7 years	67	67.0%
Number of pregnancies		
0	2	2.0%
1	21	21.0%
2	38	38.0%
≥3	39	39.0%
Number of living children		
0	4	4.0%
1	24	24.0%
2	46	46.0%
≥3	26	26.0%
Socio-economic status (Modified B.G. Prasad)*		
Upper	1	1.0%

Upper middle	8	8.0%
Middle	10	10.0%
Lower middle	36	36.0%
Lower	45	45.0%

**Socio-economic status classified from per-capita monthly family income (complete for all 100 women in the analytic sample) using the Modified B.G. Prasad scale for September 2023 CPI-IW.[20]*

4.2 Level of knowledge regarding family planning

Just over half of the women (52%) reported having heard of family planning; 48% had not. Among the 52 aware women, health professionals were the leading source of information (76.9%), followed by family/relatives (13.5%), magazines (7.7%) and the internet (1.9%). Knowledge of specific contraceptive methods among aware women was comprehensive: oral contraceptive pills and injectables were each known to 92.3%, condoms to 86.5%, and intrauterine devices, female sterilisation and male sterilisation each to 84.6%. However, only 8% of all women had heard of emergency contraception. When asked about the underlying concept of family planning, 53% had "no idea," 34% correctly identified birth spacing, and only 3% recognised both spacing and limitation; similarly, 56% could not name any non-contraceptive benefit of family planning, while 43% cited "improvement of health." On the composite five-item knowledge score, only 42% of women achieved a "good" grade (score 4-5), 6% an "average" grade, and over half (52%) a "poor" grade (score 0-1) (Figure 1) - indicating that simple awareness substantially overstates the depth of usable knowledge in this population.

Table 2. Level of knowledge regarding family planning

Knowledge item	n	%
Aware of family planning (N = 100)		
Yes	52	52.0%
No	48	48.0%
Source of information (among n = 52 aware)		
Health professional	40	76.9%
Family / relative	7	13.5%
Magazine	4	7.7%
Internet	1	1.9%
Contraceptive methods known (among n = 52 aware)		
Oral contraceptive pills	48	92.3%
Injectables	48	92.3%
Condom	45	86.5%
Intrauterine devices	44	84.6%
Female sterilisation	44	84.6%
Male sterilisation	44	84.6%
Aware of emergency contraception (N = 100)		
Yes	8	8.0%
No	92	92.0%

Concept of family planning (N = 100)		
No idea	53	53.0%
Spacing of births	34	34.0%
Limitation of births	7	7.0%
Both spacing and limitation	3	3.0%
Stopping birth	3	3.0%
Awareness of non-contraceptive benefits (N = 100)		
No idea	56	56.0%
Improvement of health	43	43.0%
Prevention from STD	1	1.0%
Composite knowledge-depth grade (N = 100)		
Poor (score 0-1)	52	52.0%
Average (score 2-3)	6	6.0%
Good (score 4-5)	42	42.0%

STD = sexually transmitted disease. Percentages for items restricted to the 52 aware women are calculated out of 52.

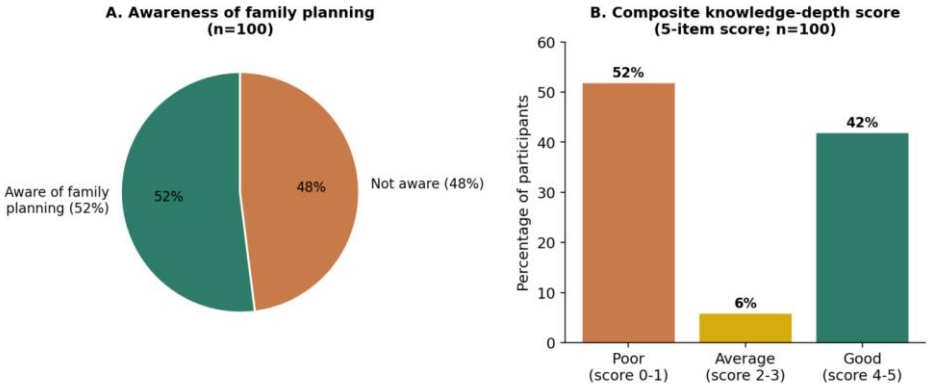


Figure 1. Awareness of family planning and composite knowledge-depth grading among study participants (N = 100).

4.3 Bivariate associations of knowledge with socio-demographic factors

On bivariate analysis, women's own education level was significantly associated with awareness of family planning (χ^2=16.587, df=4, p=0.002), rising from 0% among illiterate women to 74.1% among those with pre-university/diploma education, with a modest decline to 60.0% among graduates. Husband's education showed a comparable association (χ^2=11.740, df=4, p=0.019): only 25.0% of women whose husbands were illiterate were aware of family planning, rising to 75.0% among women whose husbands had pre-university/diploma education, before falling back to 33.3% among women whose husbands were graduates.

Occupation was also significantly associated (χ^2=5.160, df=1, p=0.023), with housewives more often aware (57.3%) than unskilled workers (27.8%). Age group, religion, type of family, age at marriage, duration of marriage, parity, number of living children and socio-economic status were not significantly associated with awareness (all p>0.05) (Table 3).

Table 3. Bivariate association of socio-demographic factors with knowledge of family planning (chi-square test)

Factor	Not aware n (%)	Aware n (%)	Total	χ^2	df	p-value
Age group						
18-29	20 (43.5)	26 (56.5)	46	0.698	1	0.404
>30	28 (51.9)	26 (48.1)	54			
Religion						
Hindu	42 (46.2)	49 (53.8)	91	1.000	1	0.305
Muslim	6 (66.7)	3 (33.3)	9			
Women's education						
Illiterate	9 (100.0)	0 (0.0)	9	**16.587**	4	**0.002***
Primary school	12 (54.5)	10 (45.5)	22			
High school	16 (50.0)	16 (50.0)	32			
PU/Diploma	7 (25.9)	20 (74.1)	27			
Graduate and above	4 (40.0)	6 (60.0)	10			
Husband's education						
Illiterate	9 (75.0)	3 (25.0)	12	**11.740**	4	**0.019***
Primary school	11 (52.4)	10 (47.6)	21			
High school	11 (45.8)	13 (54.2)	24			
PU/Diploma	7 (25.0)	21 (75.0)	28			
Graduate and above	10 (66.7)	5 (33.3)	15			
Occupation						
Housewife	35 (42.7)	47 (57.3)	82	**5.160**	1	**0.023***
Unskilled worker	13 (72.2)	5 (27.8)	18			
Type of family						
Joint	29 (46.8)	33 (53.2)	62	0.098	1	0.754
Nuclear	19 (50.0)	19 (50.0)	38			
Age at marriage						
<18 years	16 (66.7)	8 (33.3)	24	4.424	2	0.125
18-25 years	30 (42.3)	41 (57.7)	71			
>25 years	2 (40.0)	3 (60.0)	5			
Duration of marriage						

≤1 year	2 (50.0)	2 (50.0)	4	2.701	3	0.449
2-4 years	7 (46.7)	8 (53.3)	15			
5-7 years	4 (28.6)	10 (71.4)	14			
>7 years	35 (52.2)	32 (47.8)	67			
Number of pregnancies						
0	2 (100.0)	0 (0.0)	2	2.057	3	0.632
1	9 (42.9)	12 (57.1)	21			
2	18 (47.4)	20 (52.6)	38			
≥3	19 (48.7)	20 (51.3)	39			
Living children						
0	4 (100.0)	0 (0.0)	4	5.138	3	0.156
1	9 (37.5)	15 (62.5)	24			
2	22 (47.8)	24 (52.2)	46			
≥3	13 (50.0)	13 (50.0)	26			
Socio-economic status						
Upper	0 (0.0)	1 (100.0)	1	1.943	4	0.819†
Upper middle	3 (37.5)	5 (62.5)	8			
Middle	6 (60.0)	4 (40.0)	10			
Lower middle	18 (50.0)	18 (50.0)	36			
Lower	21 (46.7)	24 (53.3)	45			

**Statistically significant at p<0.05. PU = pre-university. df = degrees of freedom. Associations between categorical variables were assessed using the Pearson chi-square test; Fisher's exact test was used where the assumptions of the chi-square test were not met, particularly where expected cell frequencies were below 5. †For socio-economic status, more than one-fifth of cells had an expected count below 5 (minimum expected count 0.48); the p-value shown is therefore the Fisher-Freeman-Halton exact test (the chi-square statistic and df are reported alongside for reference only).*

4.4 Independent predictors of knowledge: multivariable logistic regression

Women's own education, husband's education and occupation - the three variables significant at p<0.10 on bivariate screening - were entered into the multivariable model. The overall model was statistically significant (omnibus likelihood-ratio χ^2=20.436, df=7, p=0.005; −2 Log Likelihood=118.033; Cox and Snell pseudo-R^2=0.185; Nagelkerke pseudo-R^2=0.247), indicating that the included predictors, taken together, improved prediction of awareness meaningfully beyond an intercept-only model, although a substantial share of the variance in awareness remained unexplained.

After adjustment, only pre-university/diploma-level education in the woman herself remained an independent predictor of awareness, with approximately fourfold higher odds relative to primary-school-educated women (AOR=4.03, 95% CI 1.12-14.48, p=0.033). High-school (AOR=1.92, 95% CI 0.64-5.75, p=0.245) and graduate-level (AOR=5.31, 95% CI 0.82-34.32, p=0.080) education in the woman herself showed a similar direction of effect but did not reach statistical significance, the latter despite a numerically larger point estimate than the PU/Diploma category - a reflection of the small graduate subgroup (n=10) and correspondingly wide confidence interval rather than evidence of a weaker true effect. Husband's education, although significantly associated with awareness on bivariate analysis, was not independently associated with awareness after adjustment for the woman's own education and occupation: high-school (AOR=1.48, 95% CI 0.48-4.58, p=0.500), PU/Diploma (AOR=2.67, 95% CI 0.77-9.24, p=0.120) and graduate-level (AOR=0.32, 95% CI 0.06-1.58, p=0.161) husband's education

were all non-significant. Occupation likewise lost independent significance after adjustment (unskilled worker vs housewife: AOR=0.47, 95% CI 0.13-1.64, p=0.236) (Table 4, Figure 2).

Table 4. Multivariable binary logistic regression for independent predictors of knowledge of family planning

Predictor (reference category)	AOR	95% CI	p-value
Husband's education (ref: Primary school)			
High school	1.48	0.48 - 4.58	0.500
PU/Diploma	2.67	0.77 - 9.24	0.120
Graduate and above	0.32	0.06 - 1.58	0.161
Women's education (ref: Primary school)			
High school	1.92	0.64 - 5.75	0.245
PU/Diploma	**4.03**	1.12 - 14.48	**0.033***
Graduate and above	5.31	0.82 - 34.32	0.080
Occupation (ref: Housewife)			
Unskilled worker	0.47	0.13 - 1.64	0.236

*AOR = adjusted odds ratio; CI = confidence interval; PU = pre-university/diploma. *Statistically significant at p<0.05. The illiterate category was not retained in the model for either education variable (see Section 3.10). Model: omnibus likelihood-ratio $\chi^2(7)=20.436$, p=0.005; −2 Log Likelihood=118.033; Cox and Snell pseudo-R^2=0.185; Nagelkerke pseudo-R^2=0.247.*

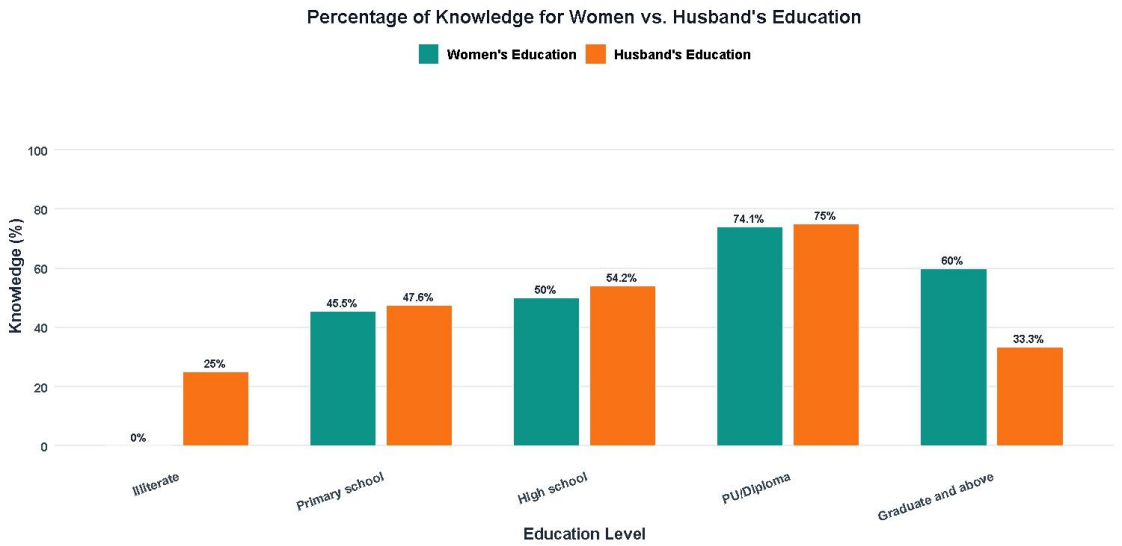


Figure 2. Unadjusted percentage of women aware of family planning, by women's own education and husband's education.

5. DISCUSSION

Against the three objectives set out in Section 2, the principal findings of this study were as follows. First, both awareness and depth of family planning knowledge were low in this cohort: only 52% of women were aware of family planning, and only 42%

achieved a "good" composite knowledge score. Second, on bivariate screening, women's own education, husband's education and occupation were each significantly associated with awareness, while age, religion, family type, age at marriage, duration of marriage, parity, number of living children and socio-economic status were not. Third, after mutual adjustment in the multivariable model, only pre-university/diploma-level education in the woman herself remained an independent predictor of awareness; husband's education and occupation, despite their bivariate significance, did not retain independent significance once the woman's own education was accounted for. These headline findings are discussed below in relation to the wider determinant's literature.

In this rural Karnataka cohort, only 52% of women attending immunization clinics were aware of family planning, and only 42% demonstrated "good" depth of knowledge on a composite five-item score - figures well below the near-universal 99% method-awareness reported for currently married Indian women in NFHS-5.[9] This gap most likely reflects the specific, under-served rural catchment studied here rather than a national trend, but it is not an isolated finding. A study of married Muslim women in Gulariya Municipality, Nepal, reported 94.5% knowledge of family planning methods,[10] and a Nigerian study among women of childbearing age in Potiskum town found 88.6% awareness of modern methods;[11] both figures are substantially higher than the 52% observed here. Similarly, in rural Jaipur, Rajasthan, 88.3% of married women had some knowledge of family planning.[12] The present cohort's low knowledge is, however, closely mirrored by another Karnataka study of breastfeeding mothers in Bellary, which found only 46% had adequate knowledge of family planning methods and, as in the present study, identified a lack of awareness as the principal barrier, with decisions frequently made by husbands or elders rather than by the women themselves.[15] A more recent observational study among pregnant tribal women in Mysore, Southern India, similarly documented low knowledge, with only 39.3% having heard of any temporary contraceptive method.[16] Taken together, these comparisons suggest that low family planning knowledge, considerably below national averages, may recur in specific rural, tribal or otherwise under-served Indian sub-populations rather than characterising rural India as a whole.

Even among the health professionals surveyed in a Kashmir-valley study - arguably a best-case scenario for knowledge - only 90.4% could correctly identify different family planning methods,[14] underscoring that comprehensive, working knowledge, as opposed to simple awareness, is difficult to achieve even in relatively literate populations. The present study's composite knowledge score captured an analogous pattern: although 85-92% of the women who were aware of family planning could correctly name specific methods (condoms, oral pills, injectables, intrauterine devices and sterilisation), only 8% had ever heard of emergency contraception and only 44% could identify a non-contraceptive health benefit. This awareness-depth gap parallels the wider knowledge-practice gap documented nationally, where 99% method-awareness in NFHS-5 translates into only 58% current contraceptive use,[9] and echoes findings from urban Lucknow slums, where a 55.3% unmet need for family planning among young married women was attributed in part to inadequate knowledge and negligent attitudes rather than to non-availability of services.[13]

Women's own education carried the clearest and most consistent signal among the determinants examined. On bivariate analysis, awareness rose from none of the 9 illiterate women through to 74.1% of pre-university/diploma-educated women, and this association survived adjustment for husband's education and occupation: women with pre-university/diploma-level schooling had approximately four times the odds of awareness of primary-educated women (AOR=4.03, 95% CI 1.12-14.48, p=0.033). Several plausible mechanisms could underlie this association, although none can be directly confirmed by a cross-sectional design of this kind. Greater schooling may improve a woman's general health literacy and her ability to process and retain health information conveyed during immunization or antenatal contacts; it may also increase her confidence in communicating with health workers, or her autonomy to seek out reproductive health information independently of her husband or in-laws. The graduate-education estimate (AOR=5.31, 95% CI 0.82-34.32, p=0.080) pointed in the same direction with an even larger magnitude, but its wide confidence interval - a consequence of the small number of graduate women (n=10) in this sample - means this apparent additional gain above the pre-university/diploma level should be interpreted cautiously and would benefit from confirmation in a larger sample rather than being read as evidence that graduate-level schooling confers no further benefit.

Husband's education and occupation present a more instructive pattern, because both were significantly associated with awareness in isolation but lost significance once women's own education was accounted for. This is not a contradiction between the bivariate and multivariable results; rather, it is the expected behaviour of correlated predictors in a regression model. A woman's own educational attainment and her husband's educational attainment are seldom independent in this setting - spouses of similar schooling levels tend to marry one another, and occupation (housewife versus unskilled worker) is itself patterned by education. Once the woman's own education entered the model, much of the apparent explanatory power that husband's

education and occupation carried on their own appears to have been shared variance with, rather than an independent contribution beyond, the woman's own schooling. This form of attenuation after adjustment is a routine and expected finding in multivariable analysis and should not be read as evidence that a husband's education or a woman's occupation are irrelevant to family planning knowledge in any absolute sense, only that their bivariate associations in this dataset are substantially, though not necessarily completely, explained by their correlation with the woman's own education. The direction and near-significance of the husband's PU/Diploma-education estimate (AOR=2.67, 95% CI 0.77-9.24, p=0.120) is consistent with a real but comparatively weaker independent contribution that this sample was not adequately powered to detect with precision, and larger studies would be needed to establish this more definitively.

One further pattern deserves cautious comment. For husband's education specifically, the adjusted odds ratio dipped at the graduate level (AOR=0.32, 95% CI 0.06-1.58, p=0.161) after rising through the primary, high-school and PU/Diploma categories - a non-monotonic, "inverted-U" shape that mirrored the bivariate finding (33.3% awareness among women with graduate husbands, versus 75.0% among those with PU/Diploma-educated husbands). This pattern did not reach statistical significance and involved a comparatively small subgroup (15 graduate husbands, 5 of whose wives were aware), so sampling variation and residual confounding are more parsimonious explanations than any biologically or socially meaningful reversal of the usual education gradient. This finding should be treated as hypothesis-generating rather than confirmatory, and would benefit from replication in a larger, adequately powered sample before being interpreted further.

This household-level interpretation is broadly consistent with, though more nuanced than, the wider determinants literature. In the Butajira district of Ethiopia, a logistic-regression-based determinants study found that both a woman's own and her partner's educational attainment remained independently associated with contraceptive use after mutual adjustment.[19] The present findings differ in one respect: only the woman's own education retained independent significance here, while her husband's education did not. Differences in sample size (100 versus the larger Ethiopian cohort), in the specific outcome measured (awareness versus contraceptive use), and in the degree of correlation between spousal education levels in this catchment could all plausibly account for this difference, and the comparison should be read as illustrative rather than as a direct replication test. The general principle that family planning knowledge and use are shaped at the household, not purely the individual, level nonetheless remains applicable, since husband's education showed a real, if statistically imprecise, association in the present data, and prior work from Bellary, Karnataka, similarly found that husbands and elders were the principal decision-makers for family planning in a comparable rural population.[15]

Finally, age, religion, family type, age at marriage, duration of marriage, parity, number of living children and socio-economic status showed no statistically significant association with awareness in this study, either on bivariate screening or in the final model, which did not retain them. No statistically significant association was observed between socio-economic status and awareness (χ^2=1.943, df=4, Fisher-Freeman-Halton exact p=0.819), despite this being a predominantly lower and lower-middle socio-economic cohort (81% of women in Modified B.G. Prasad classes IV-V combined) once per-capita income was classified against the September 2023 CPI-IW-linked scale. This null finding is broadly consistent with the parent survey's own bivariate finding [9,15] and suggests that, within the relatively narrow and low income band captured in this rural catchment, socio-economic gradient did not further differentiate awareness once education-related factors were accounted for. More broadly, the absence of statistical significance for these variables indicates that this study did not detect an association at the sample size available, not that no such association exists in the wider population.

6. PUBLIC HEALTH IMPLICATIONS

• Programmatic emphasis should shift from generic mass-awareness messaging towards structured, in-depth family planning education - covering correct method use, emergency contraception and non-contraceptive benefits - rather than assuming that "having heard of" family planning equates to functional knowledge.

• Because a woman's own pre-university/diploma-level education was the sole independent predictor of awareness after adjustment, family planning health education should engage women directly rather than relying on a husband's schooling as a proxy channel for household knowledge, with specific outreach to women with less than pre-university/diploma-level schooling.

• Husbands should nonetheless continue to be engaged in couple-based counselling during antenatal and immunization contacts: although husband's education did not remain independently significant after adjustment, family planning decisions in this and

comparable settings are frequently made jointly or by husbands and elders, so excluding male partners from health education risks overlooking an influential household decisionmaker.

• ANM/ASHA-led health education delivered during immunization sessions is a logical, low-cost delivery channel, since health professionals were already the dominant information source (76.9%) for this cohort and immunization clinics reach virtually all mothers.

• Emergency contraception knowledge is a specific, near-absent gap (8% awareness) that should be explicitly incorporated into family planning information-education-communication (IEC) material for this population.

7. STRENGTHS AND LIMITATIONS

• The small sample size (n=100), drawn from two Primary Health Centres in a single district, limits statistical power - reflected in wide confidence intervals for several estimates (e.g., graduate-level education in the woman herself, 95% CI 0.82-34.32) - and constrains generalisability beyond this specific rural Hubballi catchment.

• The cross-sectional design precludes causal inference; all associations should be interpreted as such rather than as evidence of causality.

• Knowledge was self-reported and is therefore subject to recall bias and social-desirability bias.

• The illiterate category could not be modelled for either education variable because of sparse or zero-variability cells, most notably the complete absence of awareness among illiterate women; the reported associations therefore describe gradients from primary-school education upward and should not be extrapolated to the illiterate stratum.

• Because age and religion were not entered into the final multivariable model (having not met the $p<0.10$ bivariate screening threshold), residual confounding by these factors, though judged unlikely given their non-significant bivariate associations, cannot be formally excluded.

• The composite knowledge-depth score's constituent items were administered only to women who first reported awareness of family planning (a questionnaire skip pattern), so the score is best interpreted as a depth-of-knowledge indicator among aware women rather than a fully independent scale.

• Residual and unmeasured confounding - for example, media exposure, exposure to government health campaigns, or women's decision-making autonomy - cannot be excluded.

• Household income, from which socio-economic status was derived using the Modified B.G. Prasad classification, was self-reported and is therefore subject to the recall and under- or over-reporting bias common to income data in survey research, even though per-capita income was completely recorded for all 100 women in the analytic sample and socio-economic status was not significantly associated with awareness in either the bivariate or multivariable analysis.

• Generalisability: because this was a single-district sample recruited from two Primary Health Centres (Adargunchi and Noolvi) rather than a district- or state-representative sample, findings are most directly generalisable to women attending similar rural immunization clinics in other Primary Health Centre catchments of Hubballi taluk and comparable rural North Karnataka settings with a broadly similar socio-demographic and socio-economic profile (predominantly Modified B.G. Prasad classes IV-V in this cohort). Extrapolation to urban populations, tribal populations, or rural catchments with markedly different literacy, income or health-infrastructure profiles should be made cautiously and would benefit from confirmation in a larger, multi-site sample.

8. CONCLUSION

In this rural Karnataka cohort of reproductive-age women attending immunization clinics, only about half of the women were aware of family planning, and fewer than half demonstrated good depth of knowledge on a composite score, despite comprehensive method-specific knowledge among those who were aware. Multivariable logistic regression identified pre-university/diploma-level education in the woman herself as the sole independent, modifiable determinant of family planning awareness; husband's education and occupation, although significantly associated with awareness in unadjusted analysis, did not retain independent significance once the woman's own education was accounted for, most plausibly because their bivariate associations were substantially explained by their correlation with it. Age, religion, family type and socio-economic status did

not independently predict awareness. These findings argue for family planning health education efforts in similar rural Indian settings to engage women directly rather than assuming that a husband's schooling adequately captures household-level knowledge, to deliver information that goes beyond simple awareness (including emergency contraception and non-contraceptive benefits), and to continue leveraging the immunization-clinic platform and trusted health-professional messengers already reaching this population - while continuing to involve husbands as engaged household partners in counselling, given their documented role in family planning decision-making in comparable settings.

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10. Conflicts of Interest

The authors declare no conflicts of interest.

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