Gender and Generational Effects of Family Planning and Health Interventions: Learning from a Quasi-Social Experiment in Matlab, 1977-1996

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Subsidizing family planning should increase contraceptive use, reduce fertility and affect indirectly life-cycle behavior and family outcomes:

- Women’s welfare gains by avoiding unwanted births (unmeasured)
- Spillover to women’s health gains (BMI gains)
- Women’s opportunity wages increase
- Women’s labor supply may change
- Household assets increase, portfolio changes, if children are substitutes for life cycle savings
- Child human capital, if a substitute for more children, should increase .

Randomized evaluations of long run consequences of family planning and maternal and child health programs are scarce: Why?

- Requires experimental assignment of treated
- Treatment is needed for a prolonged period
- Evaluation of treatment and control is costly
- Even with prospective panel design, attrition bias is a worry: migration and mortality
- What alternatives are there to evaluate the development consequences of these potentially important population policies?
- Instrumental variable methods inadequate?

Instrumental variable methods depend on variation in fertility (or child mortality) that is independent of parent preferences, family lifetime constraints, and family determined choices:

- **Twins first used as "natural" shock to fertility – but only 1-2 percent of births are twins (lack power), and twins are less well endowed than singleton births in terms of birth weight, health etc. (heterogeneous). (Rosenzweig & Wolpin, 1980)**

- **Sex composition of initial births may affect fertility, but it is not a valid instrument for fertility because sex also affects cost of children and affects family wealth. (Angrist & Evans,1998)**

Outline

- Description of the social experiment and data
- Pre-program evidence on independent program assignment (Joshi and Schultz, 2007)
- Post-program estimates of fertility cohort effects
- Post- program effects on women's health, wages and employment
- Post-program effects on household assets and portfolio, if some are substitutes for children
- Intergenerational investments in child schooling and health

Background information on Matlab:

- **Matlab, 60 km south-east of Dhaka, is the site of a field research station of the International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR,B).**

- **It was the site of four cholera vaccine trials between 1963 and 1968. It then became a research station to implement and evaluate best practices in public health.**

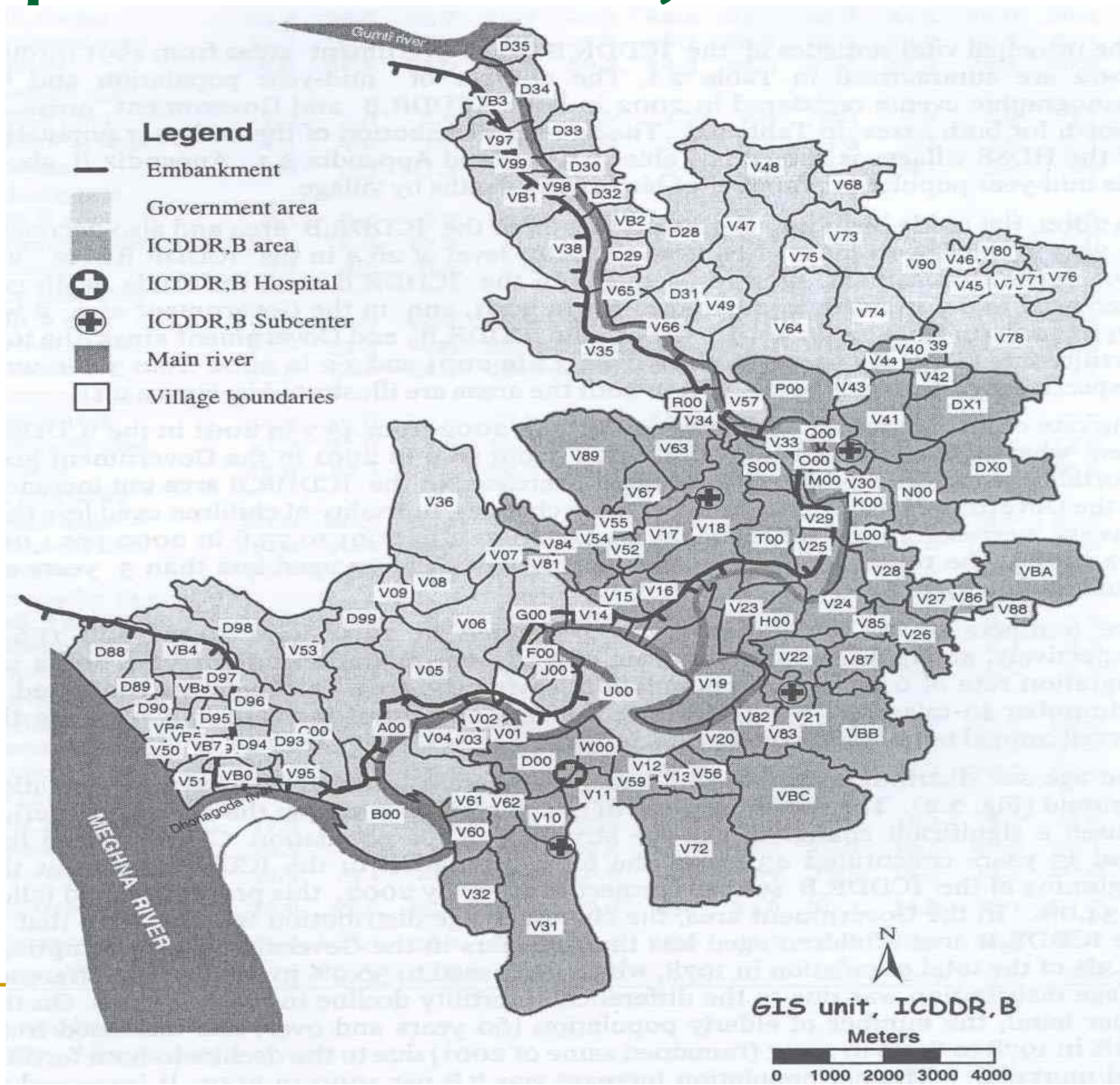
- **A Demographic Surveillance System (DSS) was established in 1966 to track births, marriages, deaths, divorces, internal migration in and out of the area, and movements within the area on a monthly basis for a population of about 180,000.**

A Maternal Child Health and Family Planning Program began in 1977 in half of Matlab (70 out of 141 villages)

In October 1977 an experimental Maternal and Child Health and Family Planning (MCH-FP) program was established for home delivery of services:

- **The initial total population of 180,000 was divided into a "treatment area" and a "comparison area" of roughly the same size.**
- **The comparison area continued to receive only the regular family planning and health services based in government clinics.**

Map from ICDDR,B Bulletin :



Time-line of the programs implemented in the "Treatment Area"

1977—1982

- Community Health Workers (CHWs) visited married women in the treatment villages every 2 weeks and assisted them in adopting contraception and provided follow-up services.
- CHWs were married women from the village who were relatively well educated and were themselves contraceptive users.
- They offered women a choice of pills, condoms, foam tablets or injectable contraceptives (depo-medroxy-progesterone acetate) or provided information on clinical methods, such as the IUD or tubectomy.

Expanded Prenatal Care and Preventive Health Care for Children

1982—1999: Additional services were added to villages in the treatment area over time, first in blocks A &C in 1982-1985, and then throughout treatment areas:

- **Tetanus inoculation of pregnant women and then of all married women to prevent neonatal tetanus**
- **Measles immunizations for children under age 5**
- **Oral rehydration therapy for diarrhoea**
- **Encouraged pre-natal and post-natal care**
- **Other EPI child vaccinations**

Data:

- **Matlab Health and Socioeconomic Survey (MHSS) 1996**
  - **A random survey of 4364 households in 141 villages in Matlab carried out with NIH funding**
  - **Collected by RAND, the Harvard School of Public Health, the University of Pennsylvania, the University of Colorado at Boulder, Brown University, Mitra and Associates and ICDDR,B.**
- **Using individual ID numbers, the 1996 survey data can be matched with previously collected census data from 1974 and 1982 at the village level.**

It is hypothesized that parents coordinate their fertility with life cycle investment in child quality and saving of physical capital. Are these forms of "social wealth" substitutes?

- **Limited consensus on how to identify the causal effect of policy-induced decline in fertility or child mortality on child schooling, parental savings and time allocation.**
- **Most research assumes child mortality and fertility are exogenous, when in reality they appear to be endogenously related to parent schooling and changing household economic conditions, as well as to access to program services.**

Parent returns to children may decline, returns to child human capital and life cycle savings may rise, but there are no measures of variation in these returns.

- **The demographic transition is attributed to culture, change in health or contraceptive technology, industrialization or increasing returns to schooling or globalized technical change, but empirical evidence on causation is weak.**
- **What can we learn from the Matlab Social Experiment after 19 years of family adjustment driven by an exogenous policy facilitating reduction in fertility and mortality?**

Differences between outcomes in treatment and control villages measured in 1974, 1982 and 1996

- **Simple differences (before-after) would be unbiased if pre-program differences were insignificant according to the 1974 Census**
- **Controls for woman's age are critical for obtaining informative predictions from the data**
- **Different mechanisms to explain large differences in women's BMI and wages between the two regions in 1996 are then assessed**

Interdependent outcome variables that require study because they respond over time to outside shocks :

- Women's fertility (children ever born) and children alive (contributing to pop. growth)
- Body Mass Index (BMI) as indicator of women's health
- Women's wage and time allocation
- Under five mortality
- Child schooling by sex
- Household assets by type per adult (15+)

Are differences between treatment and control villages due to program effects?

- **The treatment and control populations may differ in characteristics that are associated with fertility and well-being <u>before</u> the program was launched in 1977**
  - **Such differences would bias inter-village comparisons and compromise the evaluation of program effects.**
  - **1974 Census provides pre-program assessments of fertility and education and the 1982 Census, the amount of land owned, all of which did not differ significantly between treatment and control villages.**
  - **The program might have affected the probability of migration to or from the registration areas, causing migration to differ between treatment and control villages from 1977 to 1996. There was no evidence of such selection bias in the 1996 survey.**

Difference in difference estimate of village level surviving fertility

- $Y_{jt} \sim C/W_{jt} = \beta_0 + \beta_1 P_j + \beta_2 T_t + \beta_3 P_j{*}T_t + e_{jt}$

  j= 1,2,…, 141 villages

  - t= 1974 and 1982, or 1996
  - C/W_{jt} is child-woman ratio in village j at time t
  - P_j is 1 if village j is in the treatment area
  - T_t is 1 if census is for a period after program started
  - e_{jt} is an independent error
- β_3 is the estimate of the program effect in a post-program year, controlling for village fixed effects and time year effects
- If error is positively serially correlated, restricting the comparison to a single before-after cross section reduces bias

Pre-program differences:

- **Pre-program differences in child-woman ratios at the village level (number of surviving children aged 0—4 per woman aged 15—49 in a village) between treatment and control villages.**
  - **Pre-program differences are statistically insignificant in 1974, GLS weighted to adjust for heteroskedasticity.**
  - **Difference in differences (over time and between areas) by 1982 suggest 17% declines in children per woman in treatment vs. control villages, and that difference remained at 16% lower in 1996.**
  - **By 1996 the number of children per woman had declined by 39 % in comparison villages, as it had in much of Bangladesh.**

Reduced form specification estimated at the individual level for women in 1996

- $Y_i = \alpha_0 + \alpha_1 P_i + \alpha_2 Z_i + \alpha_3 P_i * Z_i + \alpha_4 B_i + \alpha_5 X_i + u_i$
  - $B_i = 1$ indicates resident in a comparison village adjacent to treatment village (Boundary Village)
  - X_i are additional controls for individual characteristics and the infrastructure of the village of residence
  - Z_i are individual characteristics that may affect the family outcome Y_i, as well as influence the responsiveness to the program, when $P_i = 1$, i. e. heterogeneous response to the program implies that α_3 could be non zero, and difference in difference estimates could then be biased
  - and u_i is an error, but observations weighted by the inverse of the probability of being sampled

Estimation strategy: Control variables Z and X must not be household choices

- **The program effect to vary freely across 11 five-year age groups of women: under 25, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64 and 65+.**
- **The treatment effect may spillover into boundary villages for three age-groups of women: Under 30, 30-54, and 55+.**
- **Other controls X: muslim; husband's schooling; women's schooling; married female-head of household; unmarried female head; woman's husband absent but she is not head of household; dummy variables indicating missing observations, and infrastructure controls for five forms of community infrastructure.**
- **We examine heterogeneity in response to the program by adding interactions Z*P: muslim X treatment area and women's schooling X treatment area. Other interactions were not significant.**

Age Specific Effects of the Program:

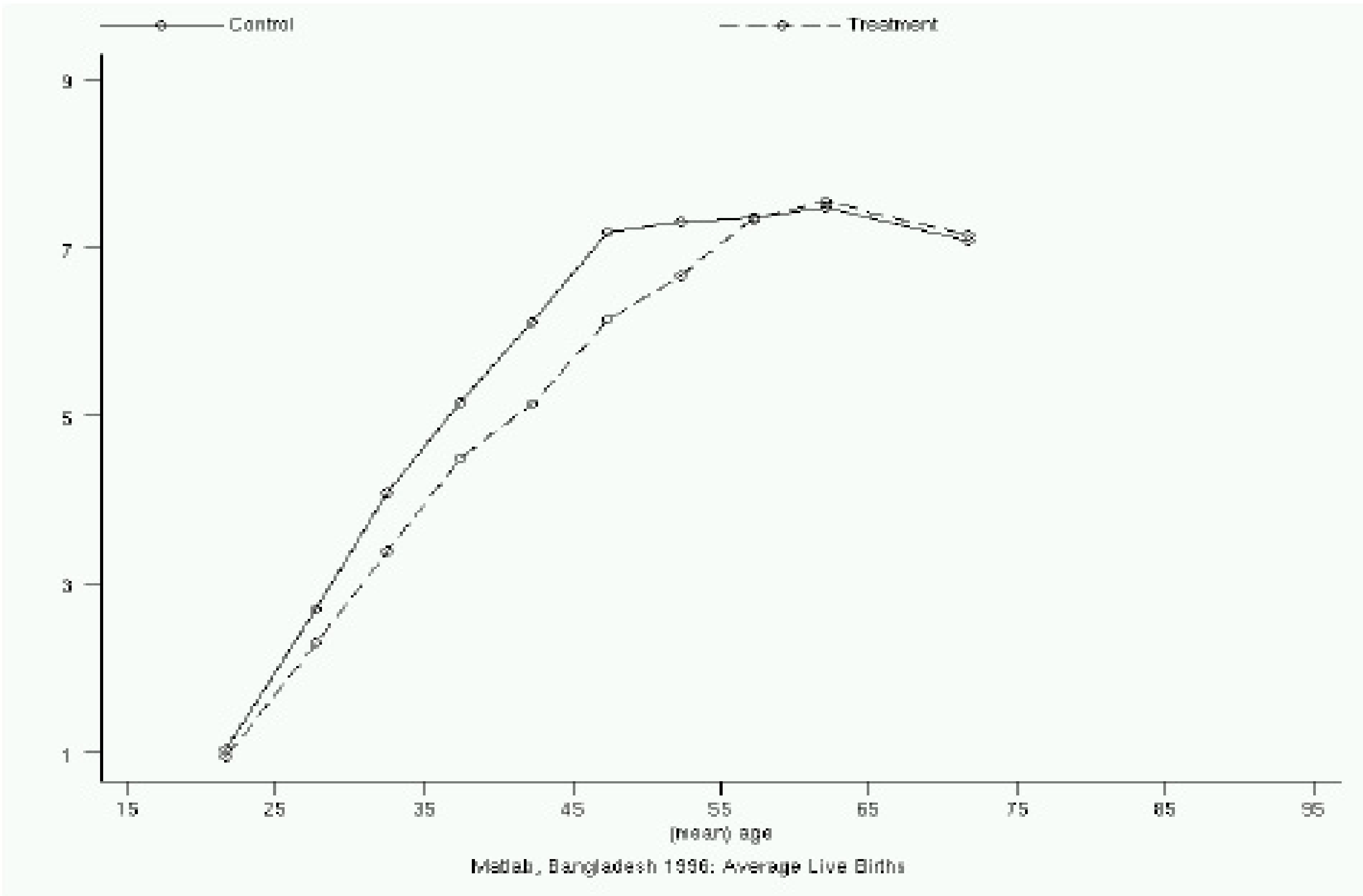


Figure 1: Number of Children Ever Born per Ever Married Woman by Five Year Age Groups in Matlab Health and Socioeconomic Survey 1996, by resident in Treatment and Control Villages

Sample Statistics of Potential Program Effects by Woman : Unconditional Difference between Control and Treatment Areas as of 1996

Variable	Control Areas -- Mean (standard deviation)	Treatment Areas -- Mean (standard deviation)	Difference (standard error)
Number of children ever born (not by age of woman as in Fig.1)	5.229 (2.967)	4.736 (2.801)	-0.496 (0.078)***
Fraction of children who died by fifth birthday	0.149 (0.187)	0.126 (0.178)	-0.023 (0.005)***
Woman's weight	40.937 (6.257)	41.944 (6.875)	1.007 (0.192)***
Woman's Body Mass Index	18.372 (2.393)	18.957 (2.687)	0.585 (0.074)***

Differences in Woman's Earnings and Assets

Variable	Mean (std. dev.)	Mean (std. dev.)	Difference (std. err.)
Woman's primary occupational earnings (taka/month)	697.7 (6651.)	1374. (9575.)	676.0 (225.3)***
Total household assets (1000 taka)	145.9 (277.3	209.2 (419.5)	63.90 (9.672)***
Value of farmland	44.236 (101.4)	58.40 (129.5)	14.15 (3.166)***
Value of homestead	80.16 (228.6)	114.8 (314.2	35.22 (7.46)***
Ponds, orchards and other agricultural assets	8.439 (21.43)	17.11 (51.16)	8.690 (1.068)***
Drinking water tubewell in Bari	0.553 (0.497)	0.626 (0.484)	0.072 (0.013)***
Clean water in Bari	0.428 (0.495)	0.529 (0.499)	0.101 (0.014)***

Differences in Child Schooling and Body Mass Index in 1996

Variable	Control Area Mean (std. dev.)	Treatment Area Mean (std. dev.)	Difference (std. err.)
Boy’s schooling Z Score (average age 9-14)	-0.122 (0.904)	0.100 (0.990)	0.221 (0.050)***
Girl’s schooling Z Score (average age 9-14)	-0.107 (0.897)	0.065 (1.042)	0.172 (0.053)***
Boy’s BMI Z Score (age 0-14)	-1.475 (1.116)	-1.375 (1.098)	0.100 (0.053)*
Girl’s BMI Z Score (age 0-14)	-1.417 (1.028)	-1.307 (0.880)	0.110 (0.046)**

Including controls the association between the program in the village and life cycle family outcomes are robust:

- Fertility: One fewer child by age 35-54
- Under five mortality reduced by 30%
- Women's BMI greater than 18: a rise of 6 percent
- Wage of women aged 25-54: increased by 40%
- Female-headed households have 25% more assets per adult and composition of assets adjusts to having less child labor
- Boys complete more years of schooling, BMI increases for girls aged 1-11

Questions that remain unanswered

1) Is the increase in women's Body Mass Index a indicator improvement of women's health caused by family planning or by general development?
2) Is the rise in women's wages biased by the changing characteristics of the women who are working for pay?
3) Is the increase in female wages concentrated in certain population groups thereby reducing or increasing inequality?
4) How important are geographical spillovers?

Figure 2
Distribution of Women by BMI

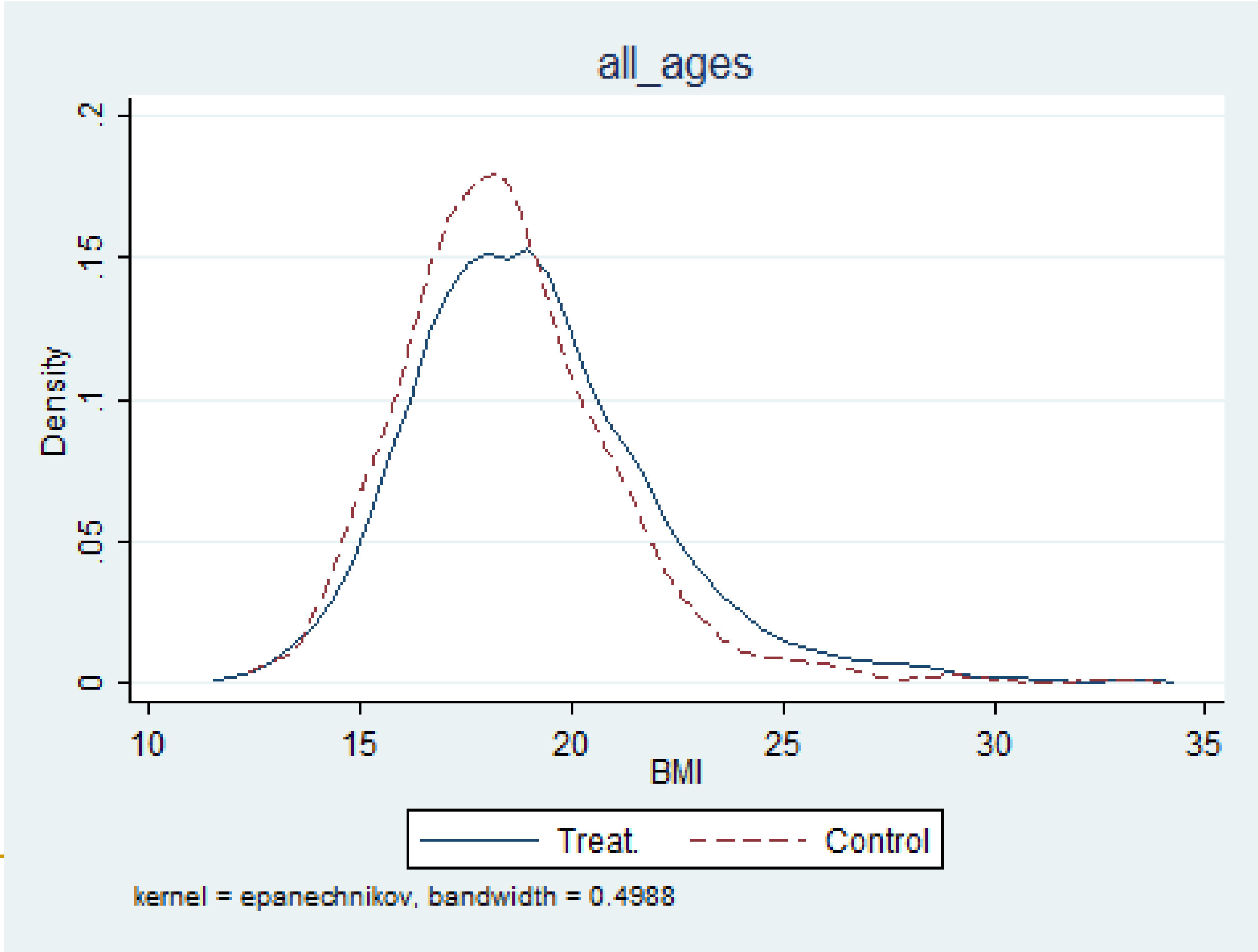


Figure 3
Women by BMI within Age Groups

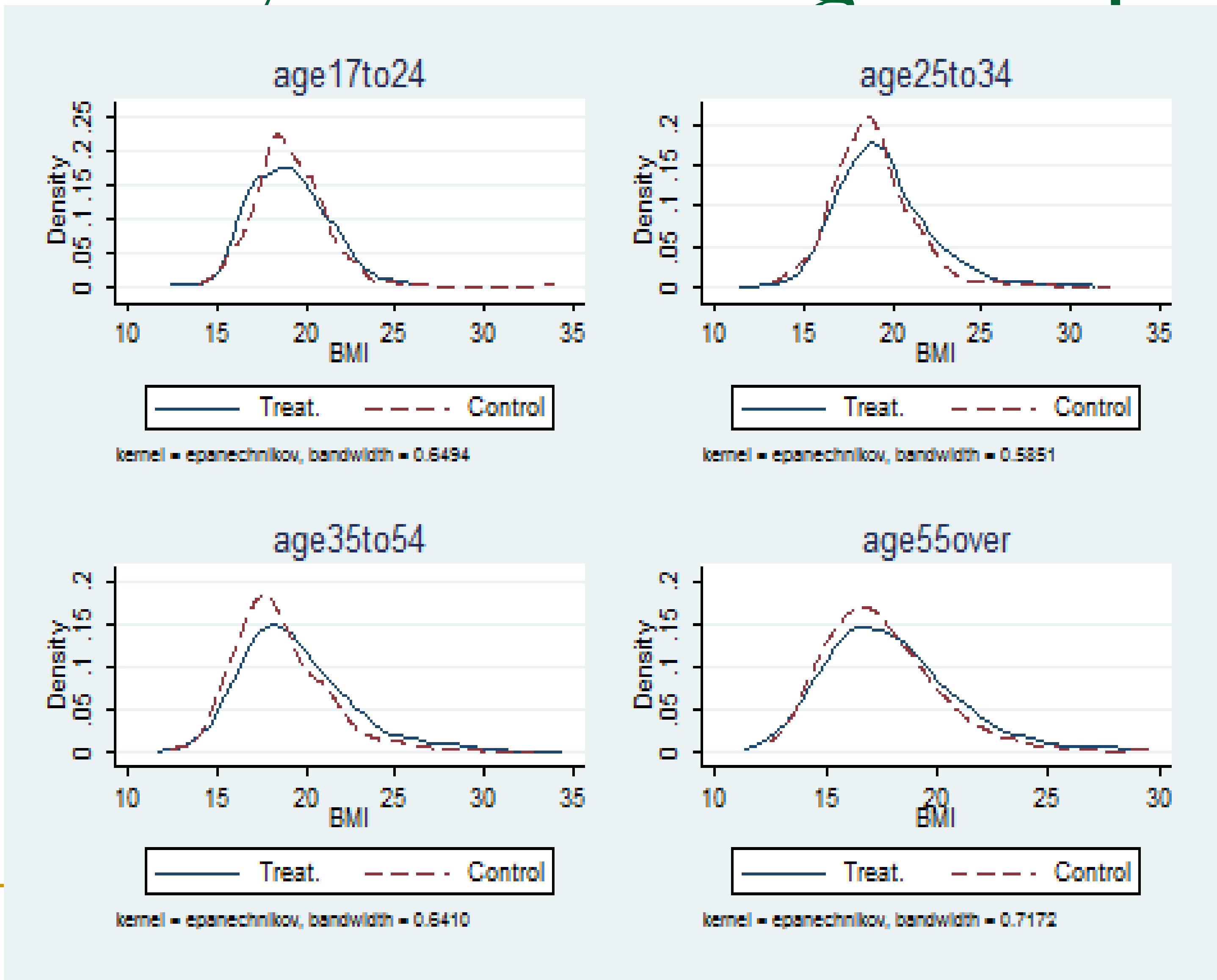


Figure 4
Histogram of BMI for all women

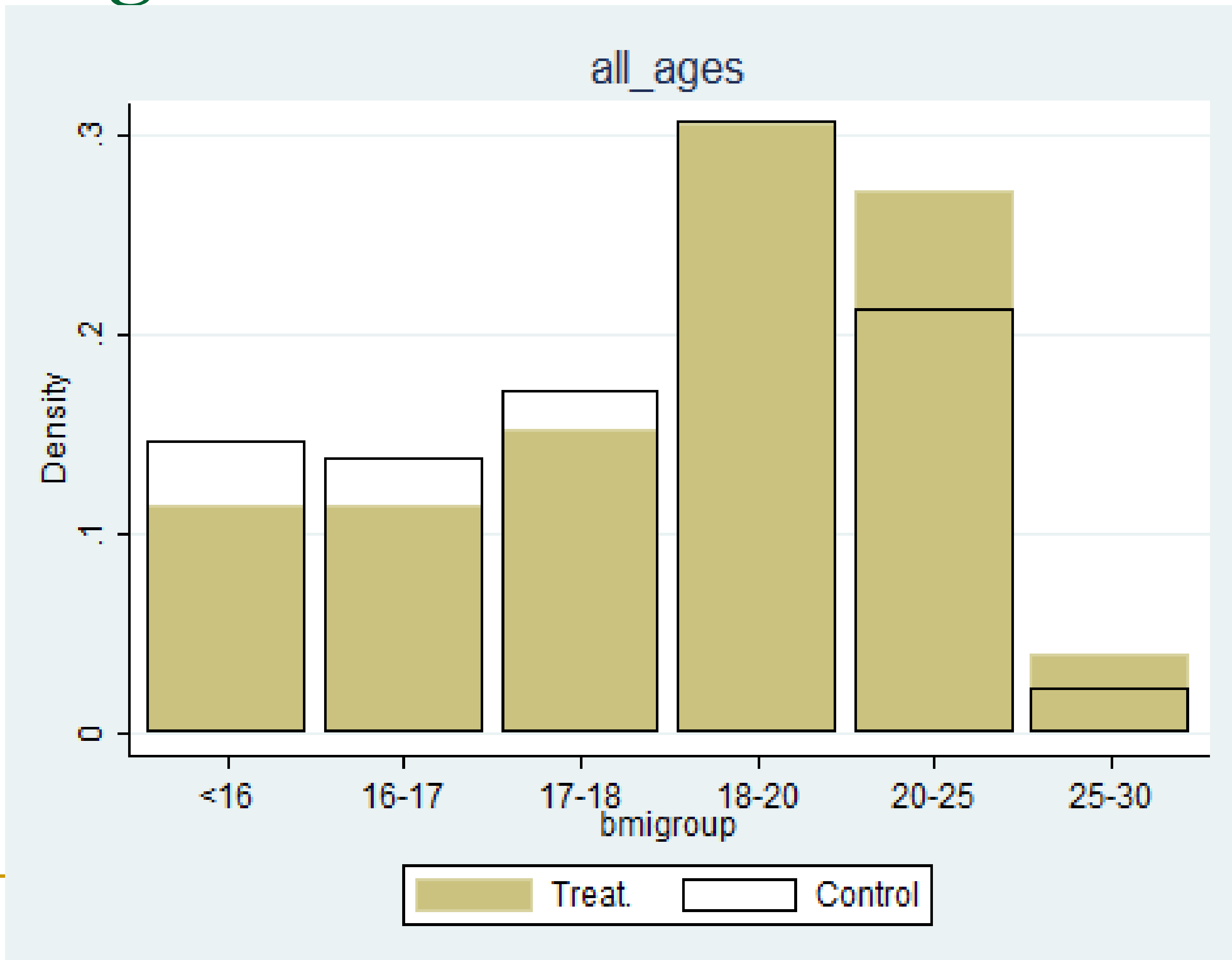


Figure 5
Histogram of BMI of women by age

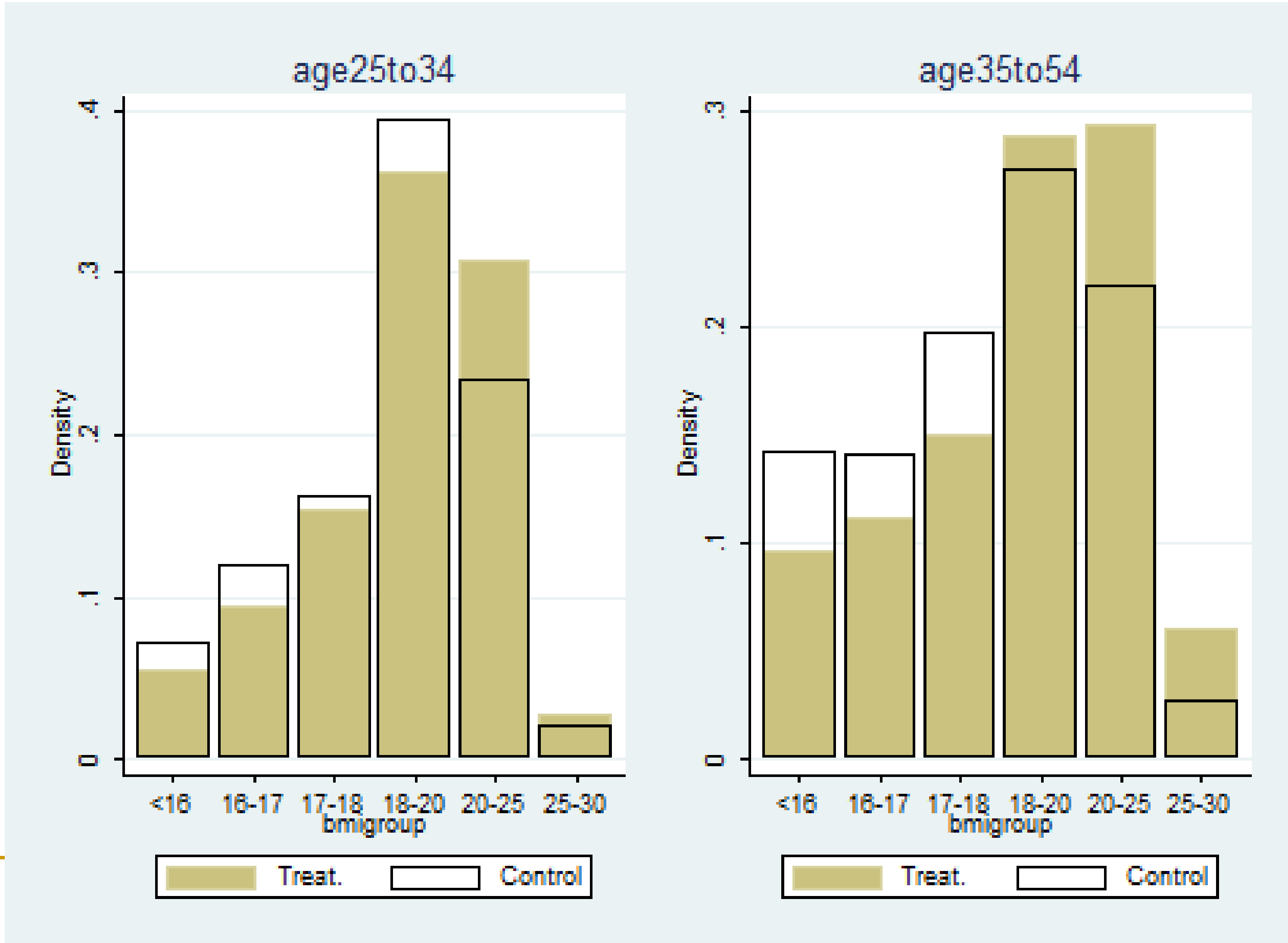
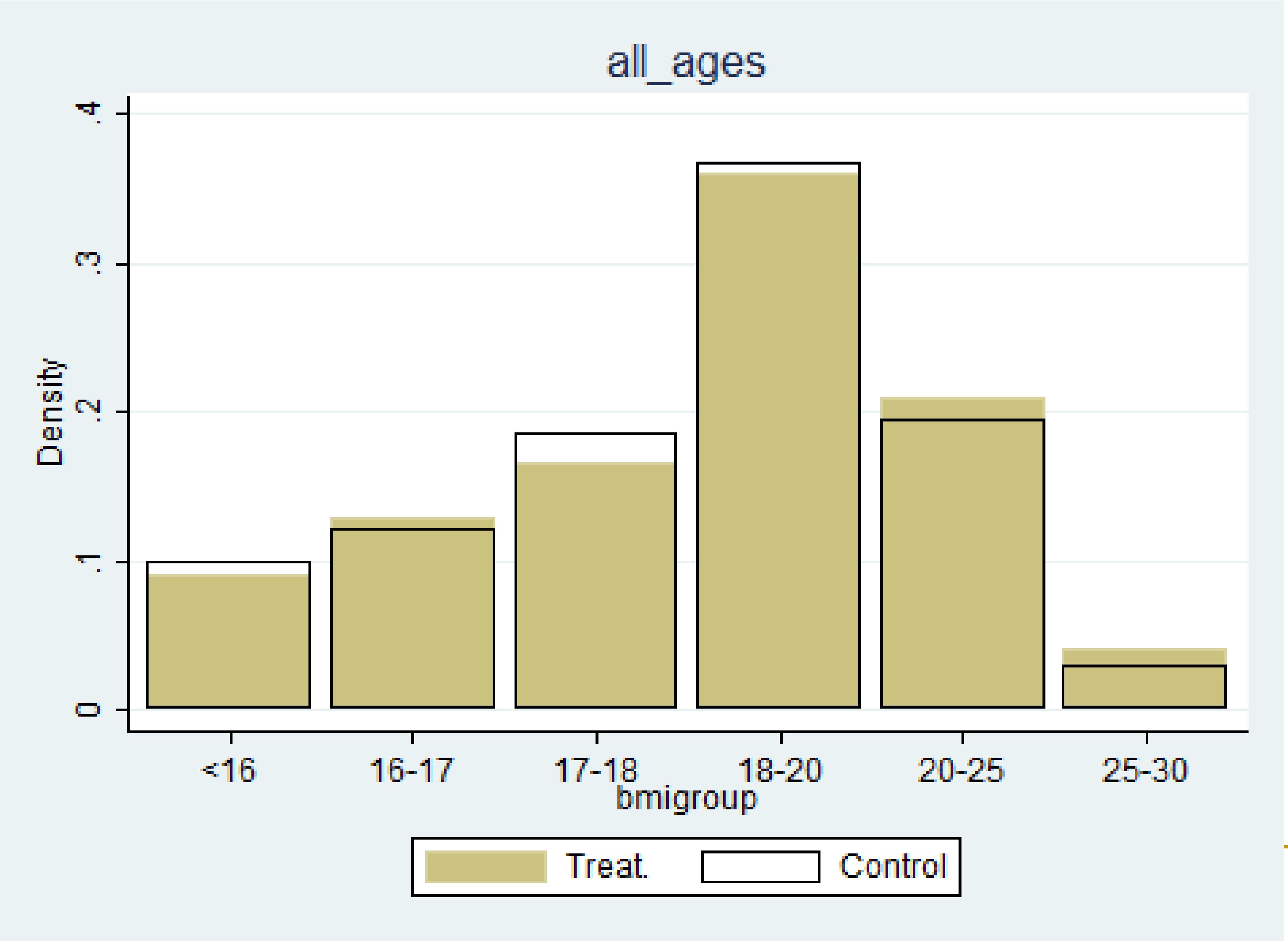


Figure 6
Histogram of BMI for all men



Wage Function Adjustment for Selection of Sample of Wage Workers:

- Log monthly wage is a function of schooling, age and access by adult women to family planning provided by program:

  $W = \alpha_1 S + \alpha_2 X + \alpha_3 P + \alpha_4 P*S \qquad + \mu_1$

  hypothesis 2 : $\alpha_4 > 0$

  Wage observed only if labor supply to the wage market positive of $L > 0$:

- $L = \beta_1 S + \beta_2 X + \beta_3 P \qquad + \beta_4 T \qquad + \mu_2$

  hypothesis 1 : $\beta_4 < 0$

Earnings and Participation in Paid Job: Joint Sample Selection Model Age 15-24

Log Monthly Earnings	Males	Females
Program	.154 (1.38)	.0948(.37)
Schooling	**.149 (5.74)**	.0693(1.16)
Participation in paid job		
Program	-.0876(1.40)	-.0774(.98)
Schooling	-.0495(.05)	.0231(1.24)
Landed HH	**-.192(3.31)**	**-.132(2.32)**
Land value	**-.0016(1.78)**	-.00061(.65)

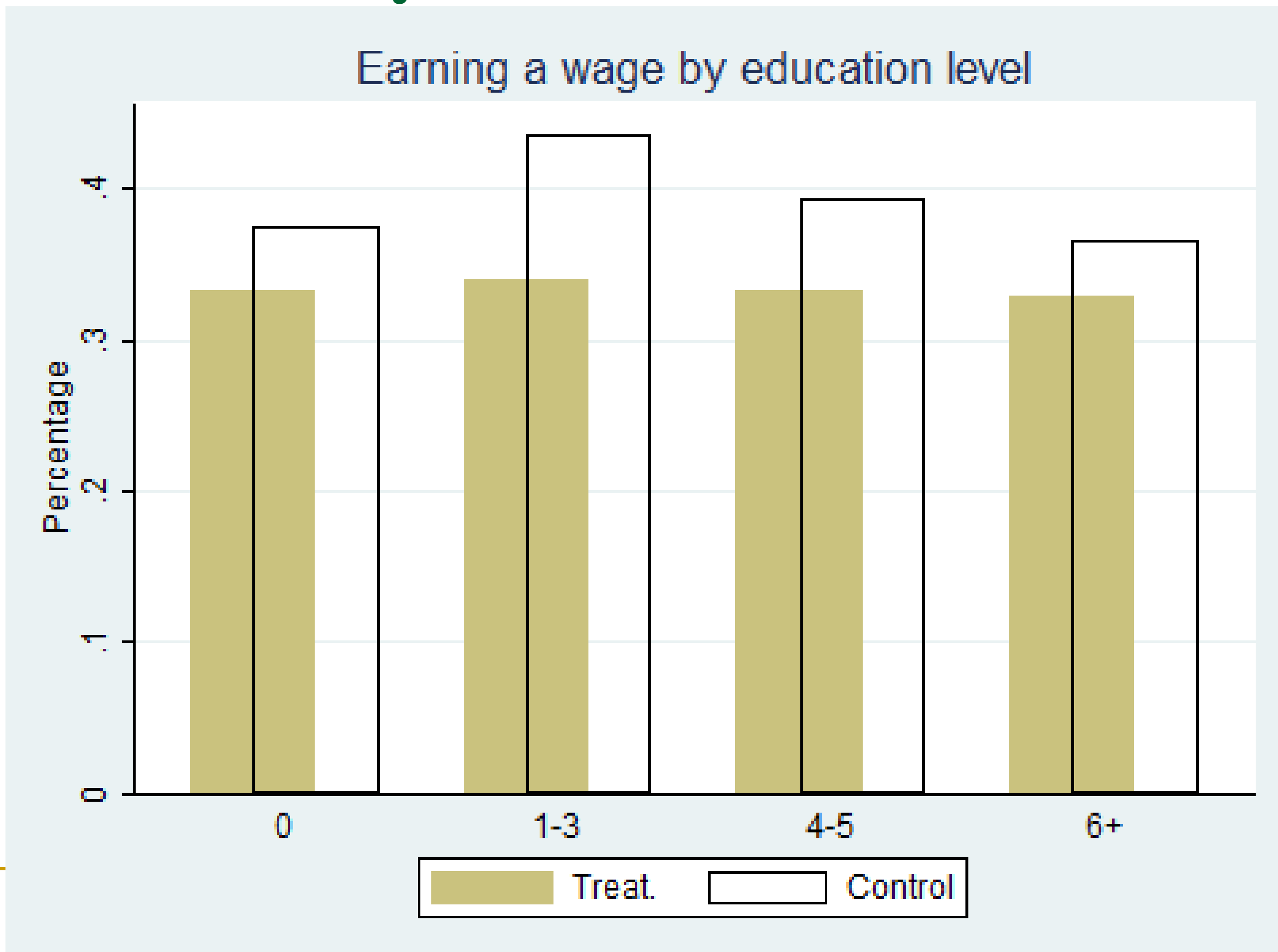
Earnings and Participation in Paid Job: Joint Sample Selection Model Age 25-54

Log Monthly Earnings :	Males	Females
Program	-.0291(.61)	**.343(4.67)**
Schooling	**.0602(9.76)**	**.134(9.39)**
Participation in Paid Job:		
Program	-.0471(1.21	**-.129(3.25)**
Schooling	.0066(1.15)	.0101(1.21)
Landed HH	**-.294(6.88)**	-.0738(1.50)
Value Land	-.0059(1.13)	-.0006(1.16)

Figure 7: Program Association with Wages of Women by Education

Figure 8: Program Association with Wages of Men by Education

Figure 9 : Proportion of Women in Paid Work by Education



Spillovers from Program to Behavior in Control Villages

- Fertility of women under age 35 residing in control villages adjacent to treatment villages have 0.34 fewer children than women in other control villages, about 1/3 of the impact associated with residing in a treatment village
- There is no evidence of geographic spillovers of the program on infant or child mortality or on the use of preventive health inputs by mothers or children
- Knowledge and effective use of contraception may slowly diffuse geographically, presumably through informal social networks, but changes in knowledge and adoption of new practices of health care may depend on personal transfer of information through an outreach program

Program – Comparison Differences in Household Assets per adult in 1996 Survey

Household asset category per adult	Percent of household assets	Treatment-control difference	T test of signifi-cance
Total assets	100	.25	4.71
Farmland	42	.081	1.64
Orchards	3.9	.66	5.94
Housing	41	.44	5.40
Savings and Jewelry	2.9	.56	3.38
Consumer durables	2.4	.33	5.07
Livestock	2.0	-.23	4.60
Non-farm	5.6	.12	.41

Intergenerational effects of program on children: reduced form estimates (Joshi & Schultz, 2007, revised 2010)

- Several different human capital outcomes:
  - **Years of completed schooling normalized as Z-scores by age and sex. Boys gain significantly and more than girls.**
  - **Under five mortality: both sexes gain**
  - **Body Mass Index and height are expressed as Z-scores by age and sex. Only the BMI of girls aged 1-11 improves as they do for mothers in treatment villages.**

Conclusions:

- Pre-program village differences in number of children surviving, adult and child education were not significantly different between treatment and control areas three years before the program started according to the 1974 Census, nor is landownership different according to the 1982 Census.
- Significant differences are associated with program treatment by 1996:
  - Fertility declines by about 1 child more in the treatment area as compared to the control areas, where total fertility declined from 6 to 3.5 children per woman during 1973-1996.
  - Women in treatment areas report greater BMI, 40% higher monthly earnings, 25% more household assets and allocate more time to housework than those in control areas
  - Household assets that complement child labor have declined in treatment villages (i.e. livestock and boats) while liquid assets, orchards, housing, consumer durables, and investments in wells (Bari) have increased.

Inter-generational and gender impacts of the program

- **Under five mortality is 25% lower in treatment areas than in control areas.**
- **The educational Z score of boys aged 9—14 and 15—29 are larger (half a standard deviation) and girls report significantly higher BMI at ages 1-14 as do their mothers than their counterparts in control areas.**
- **In sum, the unusual outreach design of the Matlab Family Planning Program, with frequent home delivery of services, is likely responsible for the health and economic benefits estimated: gains in women's human capital in the form of health (BMI), labor market productivity, women's schooling and increases in most categories of household assets. However, there no impact on female paid labor supply outside the household.**
- **The magnitude of program effects may be related to Purdah restrictions on female mobility, which may limit women's access to family planning supplies and child health services in Matlab.**

- Thank you.