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HEALTH SHOCKS AND LABOR SUPPLY RESPONSES: EVIDENCE FROM URBAN NORTH-CENTRAL OF NIGERIA

Ogebe, O. F., Weye, A. E. and Nnama, U. C.
Department of Agricultural Economics,
Federal University of Agriculture, PMB 2373, Makurdi, Benue State, Nigeria
Corresponding Author's E-mail: frankozoko@gmail.com **Tel.:** 07035945500

ABSTRACT
The study was conducted in three (3) States of the North-Central Nigeria to investigate households' labor supply to health shocks in urban north-central of Nigeria. A multi-stage sampling technique was employed to select 900 households from 18 Council Wards across the three (3) States of north-central of Nigeria covering a period of five (5) months (March to July, 2019). The study found that labor supply was an important response to illness as households increased their labor supply in response to illness shocks. The results showed that 14% of men and 21% of women employed in the study areas missed at least one day of work due to unanticipated illness. Also, women in the labor force missed work due to illness or caregiving duties in 6.2% of weeks and 3.2% of weeks for men. Men and women work more in order to increase their take-home pay and compensate for the lost income due to absence from work of another household members. The findings further showed that men were 7.8% points more likely to work in weeks in which another worker in the household is unexpectedly ill. The men worked an average of 0.385 more days (P = 0.13) and 4.9 more hours as the result of the illness of a fellow worker in the household. It was also disclosed that the overall labor supply response (P = 0.17) was driven by males in households with less assets and education. The regression estimates showed that males in wealthier households were less likely to increase labor supply when another worker in the household was unexpectedly ill. A one (1) standard deviation increase in assets was associated with 0.313 fewer days worked by man in response to an illness shock (P = 0.17) and fewer hours (P = 0.15) implying that wealthier households had fungible savings that they can access to smoothen consumption after short-run shocks. The study also found that total household earnings fell by ₦91.00 and ₦72.00 when men and women, respectively, missed work because of illness. The estimated labor hour's responses showed a larger drop of 32 hours for male illness and 18 hours for female. It was concluded that despite the increase in labor supply from other males in the household, total household income and labor supply decreased when a household member was unexpectedly ill. The study recommended health insurance policies by the government towards a reduction of illness burden for the households in the study area.

Keywords: Health shock, Households, Labor supply, Nigeria, Urban labor supply.

INTRODUCTION
Health shocks are common in the developing world and frequently severe enough to impair a worker's earning ability (Strauss and Thomas, 1998). While formal sector contracts may insure workers against income loss due to health shocks, casual wage workers and the self-employed are not typically insured against such shocks (Gutierrez, 2014). Furthermore, if the financial cost of treatment for illness is high and few households have full insurance against these costs, then these income shocks occur at the same time that a typical household's marginal utility of income has increased. Given that many households are constrained in the ability to borrow and save, households may compensate for lost income due to an unanticipated illness

of a worker by increasing the labor supply of other members. According to Heath *et al.* (2019), male household members work more when another member misses work for a week due to an unexpected illness shocks. Heath *et al.* (2019) also found that this pattern of compensatory behavior is consistent across workers in a variety of job types (self and wage employment, work at home and away from home).

Theories predicts that the household members most likely to increase labor supply in response to an income shocks are those with high gains (high salary), low opportunity cost of time at home while other member is ill, or both. Indeed, Heath *et al.* (2019) found that men who are the highest earners in their households work 7.5 hours more in response to illness than men who are not. The researchers also found that women who are the highest earners in their households do not work more in response to the illness of other workers, suggesting that their opportunity cost-presumably, the cost of caregiving is even higher. A study on the net effect of a worker's illness on household total labor supply and income found that labor supply decrease when a household member is unexpectedly ill and the effect of a male illness is much more costly as income decrease to as high as 56% compared to a woman illness with a decline in income of 22% (Asfaw and Von Braun, 2004). Health shocks thus appear costly for households particularly in developing countries which face greater welfare losses from shocks due to lack of social insurance (Chetty and Looney, 2006).

Aside from the direct cost of treatment, negative health shocks also decrease household income by reducing workers' productivity (Pitt and Rosenzweig, 1984; Thomas and Strauss, 1977; and Thomas *et al.*, 2006). Previous research has documented that households respond to health shocks by selling or consuming assets (Asfaw and Von Braun, 2004; and Islam and Maitra, 2012), borrowing (Islam and Maitra 2012; and Mohanan, 2013), or receiving transfers from other households (Asfaw and Von Braun, 2004; De Weerdt and Dercon, 2006; Genoni, 2012). Kochar (1999) found that households increase their labor supply in response to idiosyncratic shocks; this is supported by Rose (2001) who pointed out that households do so in response to aggregate shocks as well. Jayachandran (2006) further pointed out that households supply labor even when aggregate labor supply responses decrease the wage, suggesting that these households lack alternative ways to smooth risk. Labor supply has not previously been emphasized as an important mechanism by which households in developing countries respond to income losses due to health shocks.

The current research therefore, evaluated labor supply responses to health shocks as evidence from urban north-central of Nigeria. Specifically, the study estimates the average socio-economic status (SES) differences in the number of hours worked due to illness; estimate effects of a worker's unexpected illness on the labor supply of other household member; examine the heterogeneous effects by household-level socio-economic status, examine heterogeneous effects by absolute and relative earning potential within household; and estimate the net effects of illness on a worker on household-level labor outcomes.

MATERIALS AND METHODS

The Study Area

The study was conducted in north-central zone of Nigeria, commonly referred to as the Middle-belt. The north-central zone consists of six (6) States including the Federal Capital Territory (FCT), namely; Benue, Plateau, Nasarawa, Niger, Kwara, Kogi and Abuja (FCT). North-central of Nigeria lies between longitudes $3^0$and 4^0E and latitudes $7^0$30'and 11^0 20'N of the Greenwich Meridian (FAO, 2004). The area occupies a land mass of about 296, 898 Km^2 and a projected population of 29, 567, 406 million people (NPC, 2016). The average annual rainfall in the zone is estimated at 14000mm with high relative humidity and temperature of 15

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^{0}C. The major crops of the area are rice and ground-nut as the zone produces well over 40% of the national production. Other arable crops include sorghum, cowpea, soya-bean, yam and Irish potatoes. The zone also grows economic trees like mango, citrus, cashew and also a major oil palm producer of the nation.

Sampling Techniques

Both random and purposive sampling techniques were employed by the study. The purposive sampling procedure was adopted to select 9 Local Government Areas (LGAs) and three (3) from each State. Two (2) wards were randomly selected from each Local Government Area (LGA) making a total of 18 wards. From the available records obtained at the States, there were 2,160 households across the 18 sampled wards of the States. The study used simple random sampling technique to select 900 households (i.e., 18 wards across 50).

Method of Data Collection

The study was conducted in three States of north-central of Nigeria namely: Benue, Nasarawa and Plateau State from March to July, 2019. The States were selected because of their intense agricultural productivity. The population studied was urban households in north-central of Nigeria. The research adopted a case study design whereby descriptive and explanatory data were captured. Hence, both qualitative and quantitative data were collected.

Analytical Techniques

The research employed the multiple linear regression model (MLRM) to estimate the individual-level responses to other workers' illness, net effects of illness on households and household-level earnings (Heat *et al.,* 2019; and Honore, 1992). Whether a respondent worked at all that week, and days and hours worked, the labor supply outcome (Y_{ijst}) for respondent i in household j in city t was estimated using a fixed effect regression given as:

$Y_{ijct} = \alpha i + X_i + Female_{ijc} \times \lambda t + \mu s \times \lambda t + \beta_1 \times$ Other worker $ill_{ijct} + \beta_2 \times$ Other worker $ill_{ijct} \times female_{ijc} + \theta_1 \times$ Household members planning to $work_{jct} + \theta_2 \times$ Household members to $work_{jct} \times female_{ijc} + \varepsilon_{ijct}$ …(1)

where;

Y_{ijct} = Dependent variable

αi = time fixed effect allowed to vary by gender $female_{ijc}$ and by city μs to capture labor market fluctuation which may differentially affect workers of one gender or within one city.

Other worker ill_{ijct} = 1 if another adult in the household missed the entire week of work due to unexpected illness or caregiving during a week in which she or he had planned to work. β_2 tests whether female workers display differential response to the illness of another worker in addition to the sex of the worker responding.

The study conditioned on the household members planning to work in a given week (households planning to $work_{ijct}$), and allow its impact to vary by gender. The estimated β_1 and sum of β_1 and β_2 provide the causal effect of a health shock to another worker in the household on male and female respondents, respectively.

To estimate the net effect of a household member's illness on the household (inclusive of the compensatory behavior of other workers), the study examined the effect of a household-level illness shock (worker ill_{jt}, i.e., a worker missing a week of work due to unexpected illness in a given week-household-level outcome (Y_{jt}), namely, total labor supply and earnings. The study included household (γj) fixed effects and time fixed effect interacted with city ($\lambda t \times \mu c$):

$Yjct = \gamma_j + \lambda t \times \mu c + \delta_1 \times$ Worker $ill_{jct} + \delta_2 \times$ Worker $ill_{jct} \times$ female $ill_{jct} + \theta_1 \times$ household members planning to $work_{jct} + \theta_2 \times$ household members planning to $work_{jct} + \varepsilon_{jct}$ …(2)

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where;
δ_1 = net effect of an illness shock to a male worker after the household has undertaken compensatory behavior
δ_2 = the sum δ_1 and δ_2 provides the overall effect of the illness of a female worker on the household.

For estimation the household-level earnings, the hours worked was investigated and earnings calculated under the assumption that respondents earn their usual pay each hour worked unless they indicate a change in the payment terms under which they were employed. Self-employed income was calculated in the weekly by summing the respondents' income he receives over the week for work done. Wage employment income was calculated by multiplying days worked by the respondent's usual daily wage rate.

RESULTS AND DISCUSSION

Working-age Adults and Number of Hours Worked Due to Illness

Table 1 presents statistics of the working-age adults and Number of Hours Worked Due to Illness in the study areas. The results of descriptive statistics showed that the respondents are relatively young with average ages of 35 and 37 years for men and women, respectively. The respondents are well educated by developing country standards: the average male has 12.2 years of education and the average female has 8.4 years of education. The typical household extends beyond a nuclear family; the average male is in a household with 5.71 total working-age adults and the average female is in a household with 6.22 working-age adults. Both male and female labor supply is high: 75% of men and 70% of women reported being employed and 65% of men and 56% of women worked in the past week in which both women and men worked approximately the same number of total hours (50 hours for men and 48 hours for women). Women earned less than men with average weekly earnings of ₦7, 100.45, compared to men with average earnings of ₦10, 500.72.

Table 1 also showed that health shocks that cause respondents to miss work on days/weeks in which they were planning to work are relatively common. Women who missed work due to an unexpected illness or caregiving duties in 6.2% of weeks; the figure for men was 3.2% of weeks. For men, all the reported days missed due to illness were for their own illness, whereas for women, 4.2% of weeks involved their own illness and 2.0% of weeks involved caregiving. The results also showed that 14% of men and 21% of women employed ever missed at least a week of work due to unanticipated illness or caregiving.

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Table 1: Average Socio-economic Status Difference in Number of Hours Worked due to Illness

Variables	Males	Females
Age (years)	35.22	36.56
Education (years)	12.18	8.36
Marital status	0.456	0.516
Number of children	1.66	2.29
Total adult of 18-65 in household	5.71	6.22
Employed/self-employed	0.749	0.699
Illness outcome on households		
Missed days of work due to own unexpected illness last week	0.025	0.042
Missed days of work due to care- taking illness last week	0.000	0.020
Missed days of work to unexpected illness (own or care)	0.032	0.062
Ever missed a week of work due to unexpected illness	0.136	0.162
Ever missed work a week of work due to care- taking	0.000	0.046
Ever missed a work do to unexpected illness (own or care)	0.142	0.213
Worked in the past week (%)	0.643	0.556
Days of work	5.27	5.50
Hours of work	49.47	48.32
Earnings (₦)	10,500	7,100

Note: Employment = 1 for stable work done for pay; and Ill the past week = 1 for missing work for entire week in the respondent planned to work.
Source: Survey data, 2020

Individual-level Responses to Other Workers' Illness

Table 2 showed the regression estimates of a worker's response to illness of another worker during a given week. The result shows that a male worker was 7.8% points more likely to work in a week in which another household member was unexpectedly ill. This effect was large, relatively to the overall probability of 0.64 that a man who was employed actually worked in a given week as indicated earlier in Table 1. They also worked an average of 0.385 more days (P = 0.13) and 4.9 more hours as the results of the illness of a fellow worker in their household.

Table 2: Effects of a Worker's Unexpected Illness on the Labor Supply of Other Household Members

Dependent variable	1 (Work)	Days worked	Hours worked
Overall effects:			
Other worker ill (ijct)	0.013	0.130	1.618
	(0.027)	(0.164)	(1.483)
R^2	0.774		
Effects by gender of respondent:			
Other worker ill (ijct)	0.078**	0.385*	4.915*
	(0.036)	(0.237)	(2.332)
Other worker ill x Female	-0.131**	-0.496	-5.718
	(0.052)	(0.327)	(3.494)
Mean dependent variable	0.807	4.279	37.660
R^2	0.771		

Note: Other worker ill = 1 if another household member missed work for an entire week in which he/she was planning to work. All specifications include individual fixed effects: ***P< .01, **P<0.05 * P<0.1
Source: Survey data, 2020.

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By contrast, as presented in Table 2, women's labor supply responses are on average close to zero. This estimated net zero on women does not rule out countervailing effects that mask compensatory labor supply of women. In general, some women could work more when a household is ill, while others work less in order to care for that household member or take other duties around the home. Indeed, women were the only ones who reported missing work due to caregiving in the study areas as shown earlier in Table 1. This agrees with the findings of Heath *et al.* (2019) who reported that women in urban Ghana is 0.8% points more likely to report caretaking in a week when fellow worker is unexpectedly ill.

Heterogeneous Effects by Household-level Socio-economic Status

Table 3 examines whether workers in a poorer households display greater increases in labor supply than workers in wealthier households. The ordinary least square (OLS) following Honore (1992) was adopted.

Table 3: Heterogeneous Effects by Household-level Socio-economic Status

Dependent variable	**1(Work)**	**Days Worked**	**Hours Worked**	**1(Worked)**	**Days worked**	**Hours Worked**
Other worker ill	0.075	0.294	3.354	0.226**	1.696**	12.939*
	(0.032)	(0.259)	(2.216)	(0.112)	(0.804)	(6.748)
Other worker ill x Female	-0.131***	-0.380	-4.357	-0.172	-1.203	-4.761
	(0.047)	(0.327)	(3.101)	(0.179)	(1.177)	(8.893)
HH Assets x Other worker ill	-0.030	-0.313	-2.871			
	(0.033)	(0.225)	(1.974)			
HH Assets x Other worker ill x Female	0.004	0.303	2.876			
	(0.049)	(0.260)	(2.528)			
HH Average Education x other worker ill				-0.014	-0.134*	-0.842
				(0.011)	(0.077)	(0.625)
HH Average Education x other worker ill x Female				0.003	0.064	-0.260
				(0.020)	(0.129)	(0.982)
Net effect on Male 1 std. below mean	0.108	0.63	6.452	0.121	0.715	6.769
P-value	0.029	0.029	0.014	0.006	0.034	0.032
Net effect on Male 1 std. above mean	0.045	-0.013	0.519	0.045	0.006	2.312
P-value	0.299	0.972	0.885	0.281	0.968	0.445
Net effect on Female 1 std. below mean	-0.028	-0.078	-1.010	-0.031	-0.022	0.100
P-value	0.506	0.738	0.648	0.434	0.926	0.964
Net effect on Female 1 std. above mean	0.081	-0.093	-0.990	-0.092	-0.394	-5.735
P-value	0.126	0.761	0.718	0.279	0.412	0.258
Mean dependent variable	0.807	4.279	37.660	0.807	4.279	37.660
R^2	0.614			0.601		

Note: Other worker ill = 1 if another household member missed work for an entire week in which he/she was planning to work. All specifications include individual fixed effect. Assets are measured by possession of household valuables including bed, wall clock, radio, sewing machine, fan, etc. Regressions include week-of-interview dummies interacted with gender, city, and controls for the number of household members planning to work interacted with gender. Standard errors in brackets clustered at the household level: ***P<0.01, **P< 0.05 *P<0.1.

Source: Survey data, 2020.

The results of OLS estimates in Table 3 showed that males in wealthier households are less likely to increase labor supply when another worker in their household is unexpectedly ill.

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A one standard deviation increase in asset is associated with 0.313 fewer days worked by a man in response to an illness shock (P = 0.17) and 2.871 fewer hours (P = 0.15). A possible explanation could be that wealthier households have fungible savings that they can access to smooth consumption after short-run shocks, because wealthy households tend to be better integrated into risk sharing networks. This agrees with the findings of Fafchamps (1992) and De Weerdt (2004) that heterogeneity is entirely driven by men and that there was no evidence that heterogeneity effect by wealth underlie the net zero effect of illness of a household member on women's labor supply. The result shows that the same broad pattern occurs when using the average education of adult in the household as an alternate measure of socio-economic status.

Heterogeneity Effects by Absolute and Relative Earnings Potential within Household

Table 4 provides further analysis to test whether members with greater absolute earning potential (proxied by households with highest earnings or highest usual hours of work) drive response to illness shocks. The result in Table 4 showed that a male worker who is the highest earner in the household works 0.78 days and 7.7 more hours in response to illness of another worker compared to another male.

Table 4: Heterogeneity Effects by Absolute and Relative Earnings Potential within Household

Dependent variable	**1(Work)**	**Days Worked**	**Hours worked**	**1(Worked)**	**Days Worked**	**Hours Worked**
Other worker ill	0.075	0.078	1.557	0.068	0.225	2.533
	(0.042)	(0.291)	(2.495)	(0.048)	(0.288)	(6.748)
Other worker ill x Female	-0.058	0.039	-2.362	-0.172	-1.203	-4.761
	(0.066)	(0.337)	(3.127)	(0.179)	(1.177)	(8.893)
Highest earnings in household	0.083	0.780	7.649*			
x Other worker ill	(0.062)	(0.463)	(4.347)			
Highest earnings in household	-2.202*	-1.389*	-7.254			
x Other worker ill x Female	(0.104)	(0.719)	(7.377)			
Highest usual hours of work				0.054	0.489	6.032
in household x Other worker				(0.068)	(0.512)	(0.625)
ill						
Highest usual hours of work				-0.024	-0.103	-6.212
in household x Other worker				(0.113)	(0.657)	(7.469)
ill x Female						
Net effect on Male	0.135	0.838	9.106	0.122	0.713	8.505
worker/Highest Earn/Hours						
P-value	0.007	0.007	0.006	0.009	0.069	0.068
Net effect on Female	-0.124	-0.511	-0.780	-0.024	0.134	-1.079
worker/Highest Earn/Hours						
P-value	0.081	0.259	0.785	0.706	0.607	0.950
Mean dependent variable	0.807	4.279	37.660	0.807	4.279	37.660
R^2	0.611			0.611		

Note: Other worker ill = 1 if another household member missed work for an entire week in which he/she was planning to work. All specifications include individual fixed effect, week of interview dummies interacted with city, and controls for the numbers of household member planning to work. Standard errors in brackets clustered at the household level: ***P<0.01, **P< 0.05 *P<0.1.

Source: Survey data, 2020.

According to the results of Table 4, there is no differential effect for women who are the highest wage earners or have the highest usual hours of work in their households. It appears

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that even (relatively) high-earning women have caregiving and other duties around the home that prevent them from increasing their labor supply when another worker is ill.

Net Effects of Illness of a Worker on Household-level Labor Outcomes

The study examined the overall effects of a member's illness-related absence on household level income and labor supply, including both the direct effects of the missed work and compensatory responses of other household members. The result of regression estimates shows R^2 of 0.789 indicating that 79% of the dependent variable was explained by the independent variables.

Table 5: Net Effects of Illness of a Worker on Household-level Labor Outcomes

		Households (HH)				
Sample of households	**All**	**2 + Earners**	**0 male earners**	**1 + male earners**	**2 + male Earners**	**HH in which woman is the highest earner**
A. Dependent Variable = Total household income:						
Worker ill	-90.935***	-99.275**	-16.763	-89.743***	-134.102***	7.885
	(24.649)	(38.754)	(42.176)	(28.818)	(43.898)	(28.938)
Worker ill x Female ill	11.625	51.445	-98.06	54.586	130.164**	-104.956*
	(36.528)	(41.083)	(76.562)	(35.321)	(57.475)	(53.902)
R^2	0.789	0.777	0.757	0.732	0.752	0.738
Mean dependent variable	202.60	259.80	126.90	248.80	307.80	183.90
Overall effect of Female illness	-72.320	-48.260	115.724	-35.160	-0.987	-97.664
P-value	0.004	0.024	0.018	0.109	0.980	0.019
Expected male earnings loss	120.200	92.06		105.50	77.06	42.33
Fraction of loss compensated	0.241	-0.039		0.150	-0.702	1.195
Expected female earnings loss	49.040	50.07	40.06	57.40	67.50	53.68
Fraction of expected loss compensated	-0.434	0.116	-1.867	0.379	0.988	-0.801
B. Dependent Variable = Total Household Labor Hour						
Worker ill	-31.569***	-38.751***	-13.503	-29.440***	-42.567***	-12.719
	(5.563)	(7.894)	(11.580)	(5.776)	(9.843)	(9.688)
Worker ill x Female ill	12.082*	21.880**	-5.375	13.971*	32.348***	-4.767
	(6.813)	(9.082)	(12.888)	(8.052)	(10.896)	(8.543)
R^2	0.797	0.751	0.744	0.783	0.719	0.815
Mean dependent variable	67.03	95.70	40.00	83.54	112.60	72.24
Overall effect of Female illness	-18.482	-16.870	-18.780	-15.470	-10.240	-17.394
P-value	0.000	0.000	0.000	0.004	0.302	0.001

Note: Other worker ill = 1 if another household member missed work for an entire week in which he/she was planning to work. Expected earnings loss is calculated by taking the average usual income of individuals who are unexpectedly ill. All specifications include individual fixed effect, week of interview dummies interacted with city, and controls for the numbers of household member planning to work. Standard errors in brackets clustered at the household level: ***P<0.01, **P<0.05 *P<0.1.

Source: Survey data, 2020.

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The results in Table 5 showed that across all households, the average income loss of males who are sick was ₦120. The coefficient of -91 on worker ill *jct* indicates that (120-91)/120 = 24% of the expected income loss from males is compensated. Across all households, total household earnings fall by ₦91 when a man misses work because of illness and by ₦72 when a woman does so. The estimated hour's responses showed a larger drop of 32 hours from male illness, versus 18 hours after a female illness. In households with two or more earners, a man's illness results an income decrease of ₦98, and a woman's illness decreases income by ₦45, though the difference is not statistically significant (P = 0.024). The differential reduction in hours after a female illness is also larger meaning a 22 hours smaller decrease after a woman's illness.

The results of Table 5 further showed evidence of compensation on households with male earners. For households with at least one male earner, a male illness results in an income loss of ₦99, while female sickness results in a loss of ₦48. The result indicated that while the loss in male income is even larger than the expected loss due to the sick male's income (plausibly due to caregivers' missed work as well), 38% of the expected income loss from a woman's illness is compensated through labor supply response. In households with two or more earners, a male illness remains very costly, at ₦134, while a woman's illness only results in a net loss of ₦1.00: 99% of the expected loss is compensated. Meanwhile, a man's illness leads to 43 fewer labor hours, while a woman's leads to only 10 fewer (P = 0.30). By contrast, a woman's illness is quite costly in households without male earners; a female illness leads to an income loss of ₦116 (P = 0.018).

Similar effects occur in households (Table 5) in which a woman is the highest earner. In these households, a male illness has insignificant effect on household income, while a woman's illness leads to an average loss of ₦98. Also, woman's earnings are not substantially higher in these households compared to households with two or more male earners; the difference in total effect appears due to compensation. On a similar note, the hour's response is 19 fewer total hours in households with no male earners, and 17 hours in households in which a female is the highest earner suggesting that the costliness of female illness is due to the value of those uncompensated hours rather than total hours.

CONCLUSION AND RECOMMENDATIONS

The study concluded that men increased their labor supply in response to the unexpected illness of a worker in their household. In particular, men were 8.8% points more likely to work and work 0.39 more days and 4.7 more hours during weeks in which another adult in the household unexpectedly misses work for the entire week due to illness. The characteristics of the worker's primary job do not strongly affect labor market response. This suggests that a dichotomy between rigid wage work and flexible self-employment may not be salient in urban labor markets in developing country context.

Labor supply responses are particularly strong in low socio-economic status households suggesting that as income rise, households have better access to alternative income smoothing mechanism, which reduce the pressure on household members to work extra hours to cover income loss. The study recommended as follows:

1. Provision of health insurance policies towards a reduction of illness burden for the households so as to take into account the risk of work overload for women.
2. Also, for poor households that lack smoothing mechanisms (e.g., assets), flexible labor options are an important coping mechanism for dealing with unanticipated illness shocks.

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