Financial Conditions, Sleeplessness, and Cognition

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Motivation

Sleep is an important input for attention, memory, cognition (Banks and Dinges 2007, Lim and Dinges 2008, Goel et al 2009, Killgore 2010, Walker 2017)

Poverty is correlated with poor sleep quality (Grandner et al. 2010, Patel et al. 2010, Stranges et al. 2012).

Poor sleep quality in poverty could be the result of:

- Poor environmental conditions (noise, heat, bugs, overcrowding...)
- Physical discomfort (hunger, pain, illness)
- Psychological factors such as worry, rumination, problem solving, intrusive thoughts (Lemyre et al. 2020, Pillai and Drake 2015)

Questions

Do psychological factors induced by poverty have a direct causal impact on sleep quality?

Is sleep one mechanism causally linking poverty and cognition?

In this paper:

- We investigate using a regression discontinuity design around the date of a large unconditional cash transfer in Indonesia.
- We find increased sleep quality (not quantity) and cognition for transfer receiving household heads with no effect on other household members or in non-receiving households.

Literature

- Productivity/education/health impacts of sleep:
  - Developing: Bessone et al. 2021, Jagnani 2022, Giuntella et al. 2017
  - Developed: Gibson and Shrader 2018, Giuntella and Mazzonna 2019, Jin and Ziebarth 2020,...
- Poverty and cognition: Mani et al. 2013, Kaur et al. 2021, Duquennois 2022,...
- Cash transfers and well-being: Haushofer and Shapiro 2016,..., McGuire et al. 2022

Data

5th wave of the Indonesian Family Life Survey (IFLS5):

- Extensive household survey fielded 10/2014 - 08/2015.
- Part of a long running panel that started in 1993.
- Representative of 83% of the population. IFLS5: 15,185 households & 55,935 individuals.

Key variables:

- PROMIS questionnaire on sleep disturbance and sleep-related impairment
- Performance on ravens matrices, adaptive number series, mathematical questions, short and long word list recall
- Receipt of government transfers
- ... and a wealth of other variables

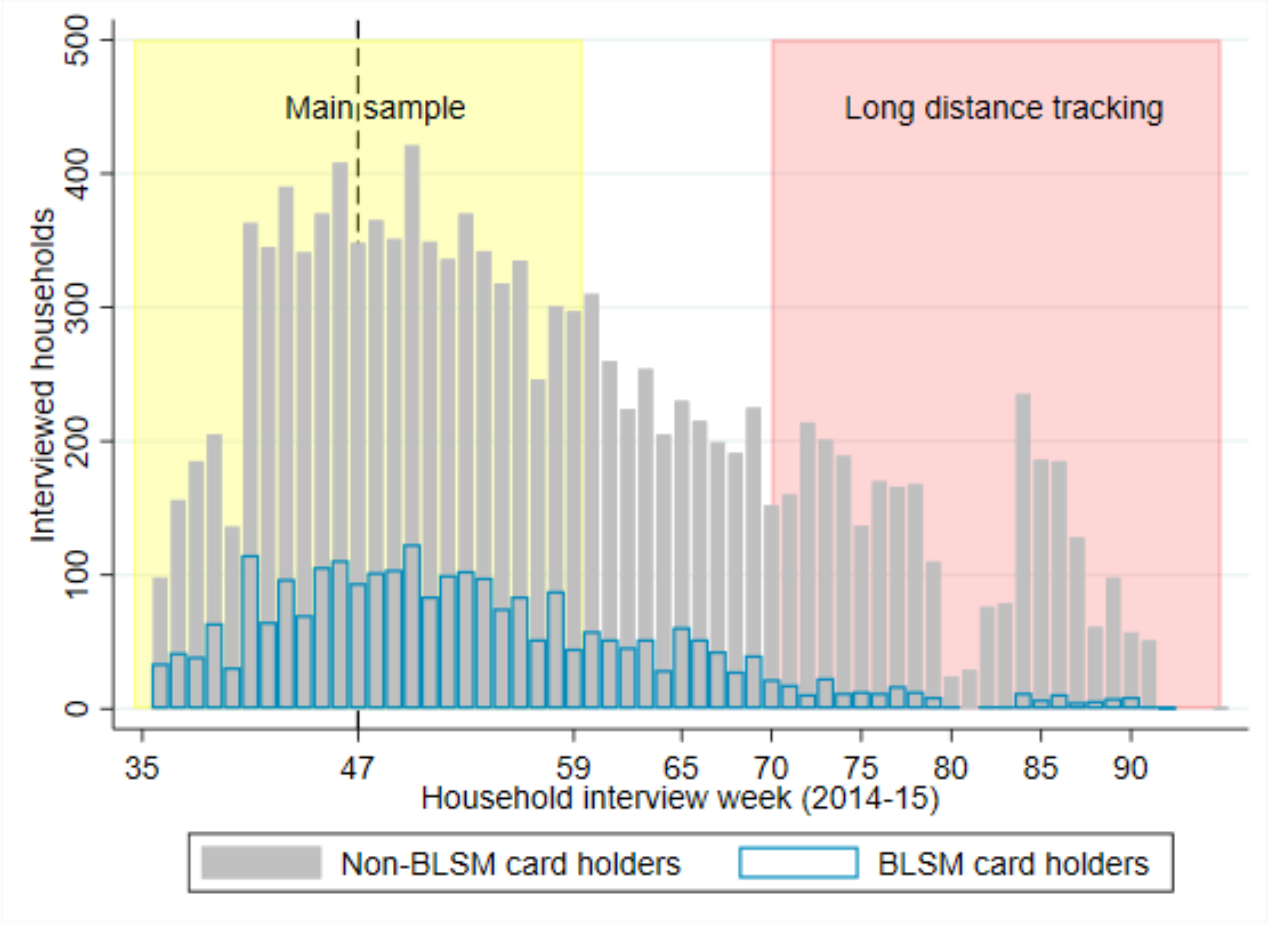
IFLS4: some cognition measures.

Indonesia's Bantuan Langsung Sementara Masyarakat (BLSM) transfers

- Unconditional cash transfers disbursed to poor and near-poor households in response to changes in fuel subsidies (irregularly since 2005)
- Targeting cards issued to poor and near-poor households as established by proxy means tests
- November 2014 transfer:
  - Nov 18th 2014: 30 percent increase in subsidized gasoline prices (added 2-3% to annual inflation, no significant impact on economic growth)
  - triggers transfers of 400,000 rupiahs (about 30 USD) per targeted household (about 31% of receiving households median monthly food expenditures)
  - distributed either via post offices or mobile money transfer

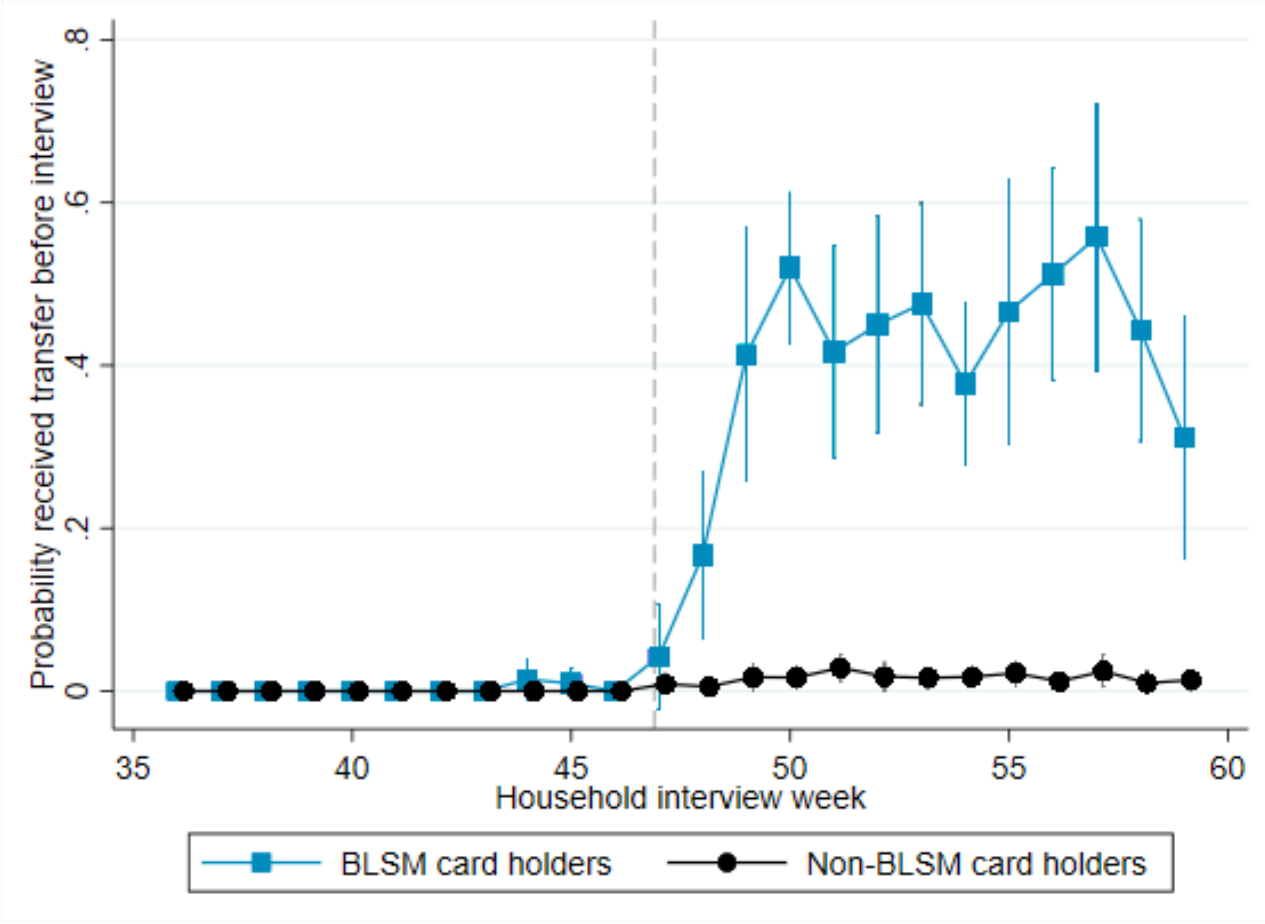
Survey timing

November 2014 BLSM disbursement timing coincided with IFLS5 survey roll out.



Survey timing

Transfer disbursment



Probability household reports receipt of cash transfer by week

Who is treated?

- BLSM cardholders:
  - Households that report having a PKPS BBM BLT/BLSM card: a strong predictor for eligibility and transfer receipt.
  - Will be contrasted to estimates on non-cardholding households.
- Financial providers/worriers: Household heads
  - *A person among the group of householders who is responsible for satisfying daily necessities of the household or a person who is regarded/assigned as the head of the household.*
  - Will be contrasted to estimates on other household members

Estimation

Regression discontinuity design around the week 47 roll out:

$$Y_{h,i} = \beta_0 + \beta_1 Post_{h,i} + \beta_2(Week_{h,i} - 47) + \beta_3(Week_{h,i} - 47) \times Post_{h,i} + \kappa_{h,i} + \epsilon_{h,i}.$$

- β_1: main coefficient of interest
- $Week_{h,i}$: interview week
- $Post_{h,i} = 1$ if $Week_{h,i} \geq 47$
- $\kappa_{h,i}$: kabupaten fixed effects
- age-decade, gender and education fixed effects may also be included when relevant

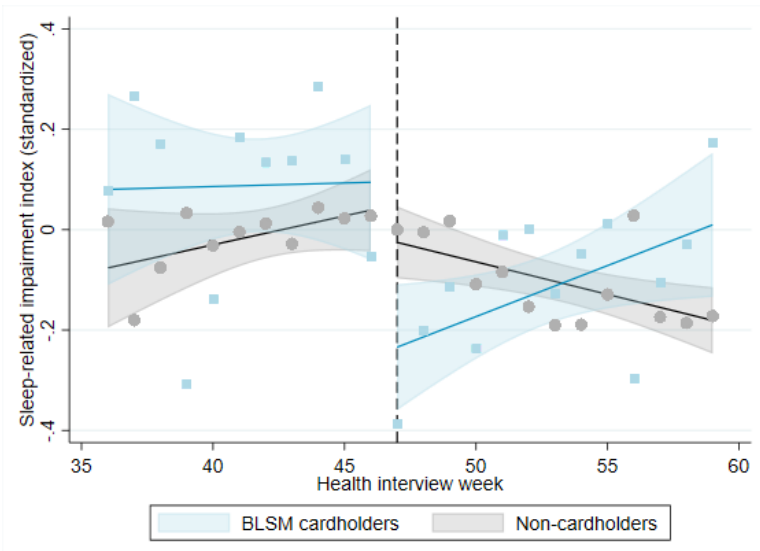
Identifying assumptions:

- Being surveyed shortly before or after week 47 is as good as randomly assigned.
- Check: there is no discontinuity in observable fixed household characteristics at the threshold Balance

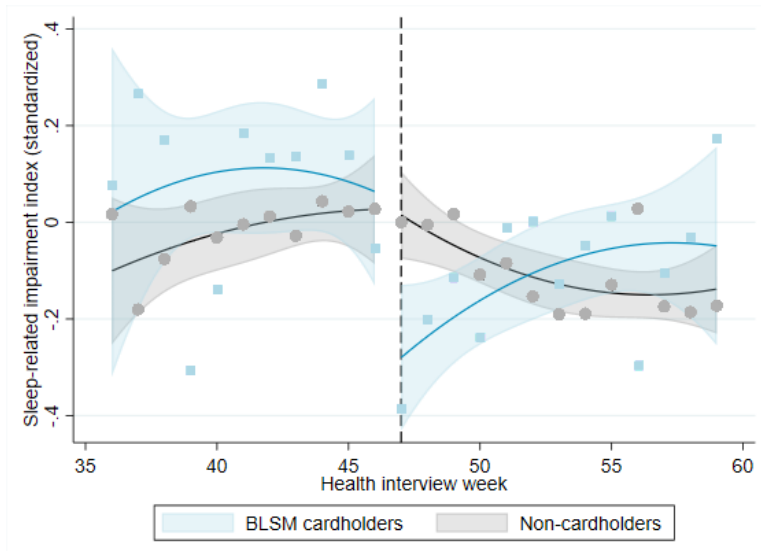
Impacts on sleep impairment of household heads

	Sleep-related impairment index (standardized)							
	BLSM cardholders				Non-cardholders			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	-0.330***	-0.279**	-0.317*	-0.351**	-0.0757	-0.0547	-0.0125	0.0320
	(0.109)	(0.111)	(0.164)	(0.165)	(0.0612)	(0.0631)	(0.0977)	(0.0973)
Specification	Linear	Linear	Quadratic	Quadratic	Linear	Linear	Quadratic	Quadratic
FE: Gender	No	Yes	No	Yes	No	Yes	No	Yes
FE: Age (decade)	No	Yes	No	Yes	No	Yes	No	Yes
FE: Kabupaten	No	Yes	No	Yes	No	Yes	No	Yes
N	1668	1668	1668	1668	6263	6263	6263	6263

Note: Standard errors are clustered at the enumeration area, with: * p<0.1, ** p<0.05 and ***p<0.01.



(a) Linear specification



(b) Quadratic specification

Impacts on sleep impairment for BLSM card-holding sub-groups

	Sleep RI (standardized)			
	$\hat{\beta}_1$	Obs.	Head share	Female share
Panel b: Household heads				
Household heads	-0.28**	1666	1.00	0.19
	(0.11)			
Male household heads	-0.28**	1357	1.00	0.00
	(0.12)			
Female household heads	-0.20	306	1.00	1.00
	(0.32)			
Household heads 40 and under	-0.36*	527	1.00	0.13
	(0.20)			
Household heads 41-65	-0.33**	946	1.00	0.18
	(0.14)			
Household heads over 65	-0.05	187	1.00	0.37
	(0.37)			
Male household heads 41-65	-0.34**	773	1.00	0.00
	(0.16)			
Female household heads 41-65	-0.40	163	1.00	1.00
	(0.40)			
Panel c: Non-household heads				
Non-household heads	0.03	2912	0.00	0.70
	(0.08)			
Male non-household heads	-0.00	808	0.00	0.00
	(0.15)			
Female non-household heads	0.04	2104	0.00	1.00
	(0.10)			
Non-household heads 40 and under	0.06	2085	0.00	0.62
	(0.09)			
Non-household heads 41-65	-0.00	732	0.00	0.93
	(0.16)			
Non-household heads over 65	0.25	85	0.00	0.80
	(0.43)			

Note: $\hat{\beta}_1$ coefficients are for a linear specification that includes gender, age decade and kabupaten fixed effects. Standard errors are clustered at the enumeration area, with: * $p<0.1$, ** $p<0.05$ and ***$p<0.01$.

Cognition impacts Figures

		Heads BLSM cardholders		Heads Non-cardholders		Non-head BLSM cardholders	
	IFLS4 controls	$\hat{\beta}_1$	Obs.	$\hat{\beta}_1$	Obs.	$\hat{\beta}_1$	Obs.
Ravens matrices		0.03	1646	0.03	6235	-0.02	2906
		(0.10)		(0.05)		(0.06)	
Ravens matrices	Yes	0.19	249	-0.02	1075	-0.20	805
		(0.20)		(0.09)		(0.13)	
Math questions		0.01	1322	0.12*	5071	0.00	2712
		(0.10)		(0.07)		(0.07)	
Math questions	Yes	0.66***	211	0.08	932	-0.03	699
		(0.24)		(0.12)		(0.14)	
Number series		-0.05	1665	0.02	6253	-0.02	2912
		(0.09)		(0.05)		(0.06)	
Rapid word recall		0.21**	1666	0.05	6265	0.08	2913
		(0.10)		(0.06)		(0.08)	
Rapid word recall	Yes	0.15	1454	0.03	5081	0.11	1826
		(0.10)		(0.06)		(0.08)	
Delayed word recall		0.25***	1666	0.03	6265	0.11	2913
		(0.08)		(0.06)		(0.08)	
Delayed word recall	Yes	0.17**	1454	0.05	5081	0.11	1826
		(0.08)		(0.05)		(0.09)	

Note: All regressions include age decade, gender, kabupaten and education category fixed effects. Standard errors are clustered at the enumeration area, with: * $p<0.1$, ** $p<0.05$ and *** $p<0.01$.

Alternate explanations

We find no clear discontinuities in:

- Sleep timing, quantity or work time Sleep Quantity
- Nutrition Nutrition
- Depression & affect Depression and affect

Next Steps

Want to identify the role of sleeplessness in estimates of poverty's impacts on cognition.

We will be piloting a 2x2 intervention on prolific:

- Survey subjects in the evening and following morning
- Treatment will be designed to induce financial worry
- Collect measurements of sleep, cognition and memory

	Morning Survey	Morning Survey + Treatment
Evening survey	Control	T_M
Evening survey + Treatment	T_E	T_{EM}

Resources permitting we may also consider running an RCT.

Conclusions

- Provide the first causal evidence of the impacts of financial conditions on sleep quality.
  - likely mechanism is psychological factors ("worry") associated with financial conditions
  - Household heads also experience cognitive improvements
  - No impacts on other household members or ineligible household heads
  - No change in sleep or work hours, nutrition, depression
- (In progress) Sleep quality is a causal channel linking poverty and cognition

Thank you!

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Appendix

Balance around transfer date

Back

	$\hat{\beta}_1$	Mean [St. Dev.]	Obs.
Panel a: All households			
Reports having BLSM card	0.02	0.21	9302
	(0.02)	[0.41]	
Total houshold members	-0.13	3.85	9302
	(0.11)	[1.77]	
Working age houshold members	-0.06	2.46	9302
	(0.08)	[1.24]	
Total number of household members under 16	-0.01	1.20	9302
	(0.06)	[1.07]	
Total number of household members over 70	-0.06**	0.19	9302
	(0.03)	[0.47]	
Female headed	0.00	0.18	9302
	(0.02)	[0.39]	
Household land	-0.08	0.26	9298
	(0.06)	[1.64]	
Panel b: All individuals			
Age	-1.02	39.86	22950
	(0.74)	[16.67]	
Over 70	-0.02*	0.06	22950
	(0.01)	[0.24]	
Married and/or cohabitating	-0.02	0.71	22954
	(0.01)	[0.46]	
IFLS4 rapid word recall	0.09	4.79	14463
	(0.10)	[1.85]	
IFLS4 delayed word recall	0.18	3.78	14463
	(0.11)	[2.06]	

	$\hat{\beta}_1$	Mean [St. Dev.]	Obs.
Panel c: All household heads			
Age	-0.41	46.95	8699
	(0.96)	[14.56]	
Over 70	-0.02	0.08	8699
	(0.02)	[0.27]	
Married and/or cohabitating	0.00	0.82	8700
	(0.02)	[0.39]	
IFLS4 rapid word recall	0.00	4.64	6538
	(0.12)	[1.86]	
IFLS4 delayed word recall	0.06	3.61	6538
	(0.13)	[2.02]	
Panel d: BLSM card holding household heads			
Age	-0.54	48.80	1809
	(1.52)	[13.70]	
Over 70	-0.02*	0.10	1809
	(0.03)	[0.30]	
Married and/or cohabitating	0.02	0.82	1809
	(0.04)	[0.38]	
IFLS4 rapid word recall	-0.02	4.29	1456
	(0.18)	[1.77]	
IFLS4 delayed word recall	0.37*	3.33	1456
	(0.21)	[1.95]	

Note: $\hat{\beta}_1$ coefficients are for a linear specification that includes kabupaten fixed effects. Standard errors are clustered at the enumeration area, with: * $p<0.1$, ** $p<0.05$ and ***$p<0.01$.

Robustness to sample window selection

Back

	Sleep-related impairment index (standardized)							
	35 - 59	36-58	37-57	38-56	39-55	40-54	41-53	42-52
	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Post	-0.279**	-0.269**	-0.268**	-0.307**	-0.392***	-0.280**	-0.249*	-0.275*
	(0.111)	(0.111)	(0.118)	(0.121)	(0.122)	(0.133)	(0.139)	(0.144)
FE: Gender	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: Age (decade)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: Kabupaten	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1668	1628	1525	1443	1324	1207	1096	907

Note: Standard errors are reported in parenthesis, clustered at the enumeration area, with the following significance indicators: * $p<0.1$, ** $p<0.05$ and ***$p<0.01$.

Itemized sleep questions for household heads

Back

In the past 7 days ...	BLSM card holders	Non-cardholders
(1. Not at all 2. A little bit 3. Somewhat 4. Quite a bit 5. Very much)	$\hat{\beta}_1$	$\hat{\beta}_1$
*I had trouble sleeping**	-0.31**	0.07
	(0.13)	(0.07)
*My quality of sleep was (reversed)**	-0.07**	-0.02
	(0.08)	(0.05)
My quality of sleep was refreshing (reversed)	-0.03**	0.02
	(0.11)	(0.05)
I was satisfied with my sleep (reversed)	-0.10**	0.03
	(0.11)	(0.06)
I had difficulty falling asleep	-0.27*	0.06
	(0.15)	(0.07)
I had a hard time concentrating because of poor sleep	-0.39***	-0.02
	(0.13)	(0.07)
I had problems during the day because of poor sleep	-0.27**	-0.02
	(0.12)	(0.07)
I had a hard time getting things done because I was sleepy	-0.13**	-0.09
	(0.12)	(0.07)
I felt tired	-0.23**	-0.06
	(0.14)	(0.08)
I felt irritable because of poor sleep	-0.27**	-0.06
	(0.14)	(0.07)
Aggregated indices		
Full sleep index	-2.06**	-0.09
	(0.81)	(0.42)
Sleep disturbance index	-0.78**	0.16
	(0.39)	(0.18)
Sleep-related impairment index	-1.29**	-0.25
	(0.51)	(0.29)

Note: Question response options are as listed in the table except for question 1 (1. Never 2.Rarely 3.Sometimes 4.Often 5.Always) and question 2 (1. Very poor 2.Poor 3.Fair 4.Good 5.Very good). All regressions include age decade, gender and kabupaten fixed effects. Standard errors are clustered at the enumeration area with * p<0.1, ** p<0.05 and ***p<0.01.

IV estimates of impact on sleep impairment of household heads

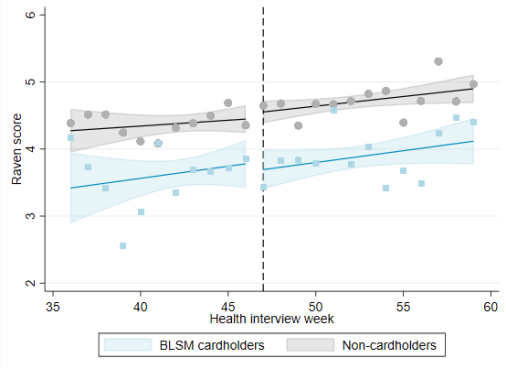
Back

	Got transfer	Sleep-related impairment index (standardized)			
	First stage	Reduced Form		IV	
	(1)	(2)	(3)	(4)	(5)
Post	0.275***	-0.330***	-0.279**		
	(0.0429)	(0.109)	(0.111)		
Got transfer				-1.209***	-1.254**
				(0.415)	(0.541)
FE: Gender	No	No	Yes	No	Yes
FE: Age (decade)	No	No	Yes	No	Yes
FE: Kabupaten (county)	No	No	Yes	No	Yes
N	1668	1668	1668	1668	1668

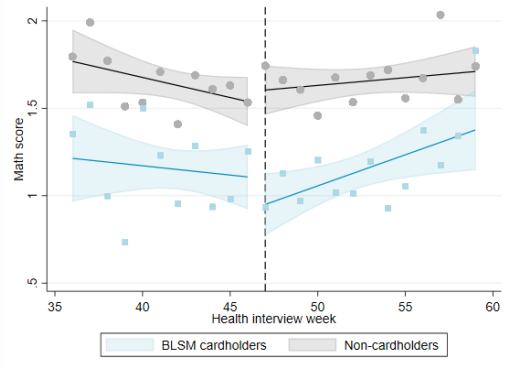
Note: Standard errors are clustered at the enumeration area, with: * p<0.1, ** p<0.05 and ***p<0.01.

Cognition

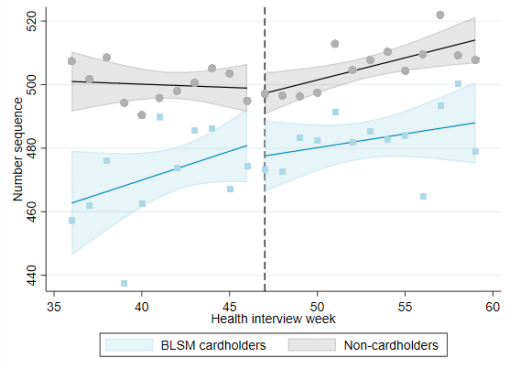
Back



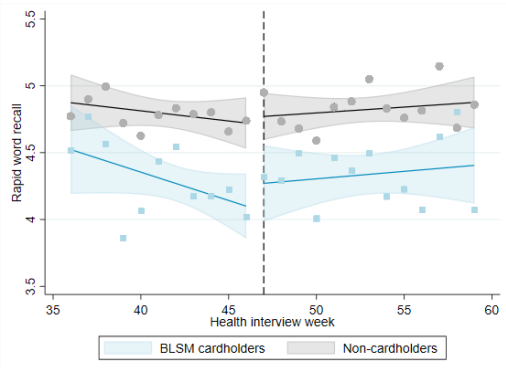
(a) Raven score



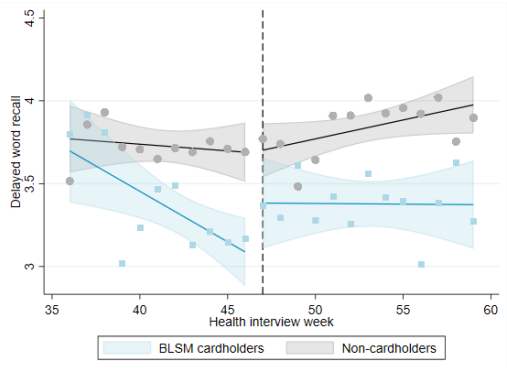
(b) Math score



(c) Number sequences



(d) Rapid word recall



(e) Delayed word recall

Cognitive indicators for household heads

Sleep Quantity

Back

Sleep times for BLSM card holding household heads

	$\hat{\beta}_1$	Observations
Time awake yesterday	0.24	1656
	(0.22)	
Rise time yesterday	-0.01	1667
	(0.18)	
Bed time yesterday	0.24	1663
	(0.17)	
Work hours last week	1.66	1778
	(2.29)	

Note: All regressions include age decade, gender and kabupaten fixed effects. Standard errors are clustered at the enumeration area with * p<0.1, ** p<0.05 and ***p<0.01.

Depression and affect for BLSM card-holding household heads

Back

	$\hat{\beta}_1$	IFLS4 controls	Obs.
Panel a: 10 item CES-D (standardized)			
Depression index	-0.10		1666
	(0.11)		
Depression index	0.02	Included	1480
	(0.11)		
Panel b: Blood pressure			
High blood pressure	0.06		1745
	(0.04)		
Panel c: Yesterday, did you feel [...]?			
Felt frustrated	-0.07		1677
	(0.08)		
Felt sad	0.07		1677
	(0.11)		
Felt enthusiastic	-0.12		1677
	(0.15)		
Felt lonely	0.25**		1677
	(0.11)		
Felt content	-0.11		1677
	(0.13)		
Felt worried	-0.04		1677
	(0.12)		
Felt bored	0.07		1677
	(0.09)		
Felt happy	0.03		1677
	(0.13)		
Felt angry	0.01		1677
	(0.09)		
Felt tired	-0.01		1677
	(0.13)		
Felt stressed	0.05		1677
	(0.09)		
Felt pain	-0.04		1677
	(0.12)		

Note: All regressions include age decade, gender and kabupaten fixed effects. Affect scores also control for the order of administered questions. Affect response options are 1. Not at all; 2. A little; 3. Somewhat; 4. Quite a bit; 5. Very. Standard errors are clustered at the enumeration area, with: * $p<0.1$, ** $p<0.05$ and ***$p<0.01$.

Nutrition

Back

Food consumption for BLSM card-holding households

	$\hat{\beta}_1$	Mean [Sd.]	Observations
Log household food consumption (in past week)	-0.08	5.68	1921
	(0.06)	[0.64]	
Received Raskin rice (in past year)	0.01	0.83	1921
	(0.04)	[0.37]	

Note: All regressions include household member, female headed, working age member and kabupaten fixed effects. Standard errors are clustered at the enumeration area, with * p<0.1, ** p<0.05 and ***p<0.01.