Financial Conditions, Sleeplessness, and Cognition

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Abstract

In this paper, we provide the first evidence for the causal effect of financial conditions on sleep. Using a regression discontinuity research design, we find eligible household heads surveyed just after the rollout of a cash transfer program in Indonesia reported significantly better sleep quality, but not sleep quantity, compared to eligible household heads surveyed just before the rollout of the program. These effects are not observed for (i) other members of eligible households and (ii) household heads ineligible for the cash transfer program. We rule out nutrition, labor supply, and demand effects as explanations for our results. Lastly, we find suggestive evidence that eligible household heads tested just after the rollout of the cash transfer program performed better on cognitive exams.

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Sleep is an important input for attention, memory, and cognition (Killgore 2010; Lim and Dinges 2008). Yet, numerous studies show people get poor quality and quantity of sleep each night (Walker 2017). One determinant of poor sleep may be poverty. For instance, in the US, poor sleep quality is strongly associated with lower socioeconomic status (Grandner et al. 2010; Patel et al. 2010). In India, correlates of poverty like mental and physical distress (e.g., worries, stress, pain, or hunger) and environmental conditions (e.g., mosquitoes, heat, noise, or light) are important barriers to sleep (Bessone et al. 2021). However, we do not know whether this association between poverty and sleep is causal.

Preview of results. In this paper, we provide the first evidence for the causal effect of financial conditions on sleep. Using a regression discontinuity research design, we find eligible household heads surveyed just after the rollout of a cash transfer program in Indonesia reported significantly better sleep *quality*, but not sleep *quantity*, compared to eligible household heads surveyed just before the rollout of the program. Improvement in sleep quality is not driven by differences in characteristics of households surveyed on either side of the rollout: households surveyed before and after the roll-out of the cash transfer program were similar on numerous socioeconomic indicators. Our results are also not driven by seasonal confounders: we find no difference in sleep quality for household heads ineligible for the cash transfer program. Furthermore, we find no changes in reported physiological indicators (e.g., tiredness, loneliness, happiness, pain, depression) for eligible household heads which suggests that self-reported improvement in sleep quality is unlikely to be driven by demand effects. Lastly, we find suggestive evidence that the cash transfer program improved household heads' cognitive performance.

Context and data. To examine the causal effect of financial conditions on sleep, we exploit the rapid dissemination of an unconditional cash transfer program in Indonesia in 2014 at the same time as the rollout of a nationwide household survey that collected detailed sleep data for the past 7 days for every member of the household (Figure 1).

In late June 2013, and again in November 2014 and 2015, Indonesia reduced existing fuel subsidies and compensated poor and near-poor households for the subsequent rise in fuel, food,

and transport prices with a temporary unconditional cash transfer program, Bantuan Langsung Sementara Masyarakat (BLSM) (The World Bank 2017). BLSM added cash amounts to the 25-percent-poorest households' budget equal to about 11 percent of regular expenditures. Households could use their Kartu Perlindungan Sosial (KPS) or Kartu Keluarga Sejahtera (KKS) social protection cards – that they received via the national postal service after having been verified as poor or vulnerable by the national registry – to prove eligibility for BLSM. KPS/KKS holders could retrieve their BLSM transfers at the nearest post office.

Importantly, the dissemination of BLSM transfers in November 2014 coincided with the administration of the fifth survey wave of the Indonesian Family Life Survey (IFLS): IFLS 5 was fielded between September 2014 and April 2015. IFLS is a longitudinal data set that includes five waves of detailed household surveys conducted between 1993 and 2015. It covers 13 of the 27 provinces that existed in Indonesia in 1993, representative of 83% of the population. IFLS 5 was administered to 15,185 households composed of 55,935 individuals.

ILFS5 includes detailed measures of sleep quality for the past 7 days for every member of the household. That is, ILFS5 includes a sleep questionnaire that incorporates 10 items from the Patient Reported Outcomes Measurement Information System (PROMIS): 5 items each from the sleep disturbance and sleep-related impairment item banks, respectively. The PROMIS sleep items have been carefully developed and evaluated against other well-known sleep indices such as the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale (Yu et al. 2012; Buysse et al. 2010). ILFS5 also includes data on bedtime and wake-up time for the day prior to the survey for every member of the household.

IFLS5 also includes several different measures of cognition, including performance on eight ravens matrices, performance on five mathematical questions, the ability to recall a list of ten words, and a six item block-adaptive number series test.

Furthermore, ILFS5 also collects detailed information on all government transfers. For instance, IFLS 5 includes data on the month of receipt, frequency, and amount of BLSM transfers. It also includes information on whether households have social protection cards required to claim BLSM transfers. Together, this data allows us to identify the precise period of BLSM transfers for eligible

households and verify the nonreceipt of BLSM transfers for ineligible households.

Research design. We find almost no households surveyed in ILFS5 prior to November 17 (week 47) reported receipt of BLSM transfers, followed by a sharp increase in receipt of BLSM transfers among eligible households surveyed after on or after week 47 (Figure 2). Successively greater numbers of eligible households surveyed in the following two weeks reported receipt of BLSM transfers. This trend stabilized by December 7. 81% of recipient households reported transfers of Rp 400,000 (roughly USD 30). The average BLSM transfer amount was Rp 379,686, representing roughly 30% of the median monthly food expenditures for recipient households. Reassuringly, as one might expect, ineligible households surveyed on or after week 47 did not report receipt of BLSM transfers.

To examine the causal effects of financial strain on sleep, we use a fuzzy regression discontinuity design that leverages the sharp increase in the likelihood of BLSM transfers on or after week 47. The underlying assumption of our research design is that households surveyed on or just after week 47 are, on average, similar to household surveyed just before week 47. Indeed, we find households surveyed on either side of the cutoff have similar socioeconomic characteristics (Table 1). Crucially, households surveyed just after the cutoff are no more likely to have a social protection card than household surveyed just before the cutoff.

Results. Figure 3 shows that eligible household heads surveyed just on or after week 47 reported significantly lower sleep impairment, compared to eligible household heads surveyed just before week 47. Table 2 presents the corresponding reduced form point estimate of 0.3 standard deviations. As one would expect, these effects are not observed for ineligible household heads, which suggests that our results are not driven by seasonal confounders. Furthermore, we find that reported improvement in sleep quality for eligible household heads, and the corresponding lack of effect for ineligible household heads, is observed for each of the ten items that together constitute the sleep impairment index (Table 3). In Table 4, we present instrumental variable estimates where receipt of BLSM transfer is instrumented with whether the household was surveyed before or after week 47. Importantly, these effects are on sleep quality, as we fail to find evidence for an effect on sleep

quantity for eligible household heads (Table 5).

We show the effects on sleep quality are concentrated among household heads, who are presumably responsible for household finances, with comparatively modest effects on other members of the household (Table 6). This is consistent with the limited cognition mechanism, discussed in the literature on poverty and cognition, that proposes that the poor are more preoccupied by economic decisions as they face more difficult trade-offs. Changes in financial circumstances would have a particularly important impact on the financial decision makers in the household. Our findings suggest that this decision making load impacts sleep quality, which may be an important mechanism behind existing findings on consequences for cognitive performance.

We rule out several alternative explanations for our results, including nutrition and labor supply. We fail to find evidence for an increase in food consumption in the past 7 days for eligible households surveyed just on or after week 47 compared to eligible household surveyed just before week 47 (Table 7). We also fail to find evidence for a change in hours worked in the past 7 days for household heads surveyed after the cutoff (Table 5). Lastly, we find no changes in reported physiological indicators (e.g., tiredness, loneliness, happiness, pain, depression) for eligible household heads which suggests that self-reported improvement in sleep quality is unlikely to be driven by demand effects (Table 8).

Finally, we find suggestive evidence that eligible household heads tested just on or after week 47 performed better on cognitive exams, compared to eligible household heads tested just before week 47 (Table 9). The point estimates range from 0 to 0.6 standard deviations across five separate cognitive measures. As before, these effects are not observed for ineligible household heads.

Contributions. This study contributes to the growing literature in economics on the relationship between economic conditions and cognitive function. Poverty has been shown to impact well-being in numerous way that have potential implications for cognitive function: poverty may cause stress and negative affective states (Haushofer and Fehr 2014), and is associated with several physical conditions like malnutrition (Schofield, 2014), poor sleep (Bessone et al. 2021; Jagnani 2021), and alcoholism (Schilbach 2019), all of which carry potential implications for cognitive function.

Several recent studies have also focused directly on the causal relationship between poverty and cognitive function (Mullainathan and Shafir 2013; Mani et al. 2013; Kaur et al. 2021; Shah, Shafir and Mullainathan 2015; Carvalho, Meier and Wang 2016; Schilbach, Schofield and Mullainathan 2016; Bartos et al. 2018; Ong, Theseira and Ng 2019; Fehr, Fink and Jack 2020; Lichand and Mani 2019; Duquennois 2021). While, these studies often are able to rule out some mechanisms, such as nutritional changes, they do not always provide empirical evidence on the exact mechanisms by which observed cognitive impacts take hold. Understanding the mechanisms underlying these causal effects is a crucial step toward the design of effective policies. This paper attempts to bridge this gap in the literature by documenting a causal link between financial strain, cognition, and one such mechanism: poor sleep.

Next steps. In April'22, we will launch an online experiment that will prime individuals on their finances to causally isolate poor sleep as one mechanism linking financial concerns to cognition.

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Tables and Figures

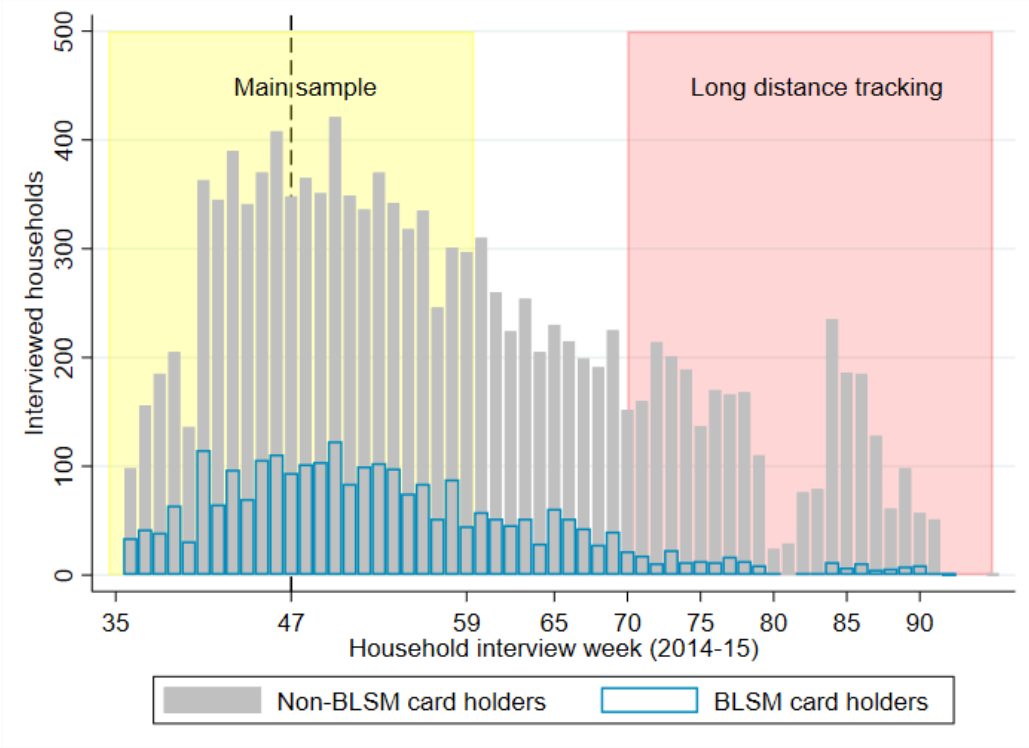


Figure 1. Survey timing

Notes: The histogram shows the number of BLSM card holding (in blue) and non-BLSM cardholding households (in grey) interviewed each week during the survey period. The main survey was administered between October 2014 and April 2015, followed by long distance tracking. Weeks are numbered relative to the 1st week of 2014. The dashed line marks week 47, the beginning of transfer disbursement. Our main sample, highlighted in yellow, runs from weeks 35 and 59 , spanning from 12 weeks before to 12 weeks after the late November BLSM transfer.

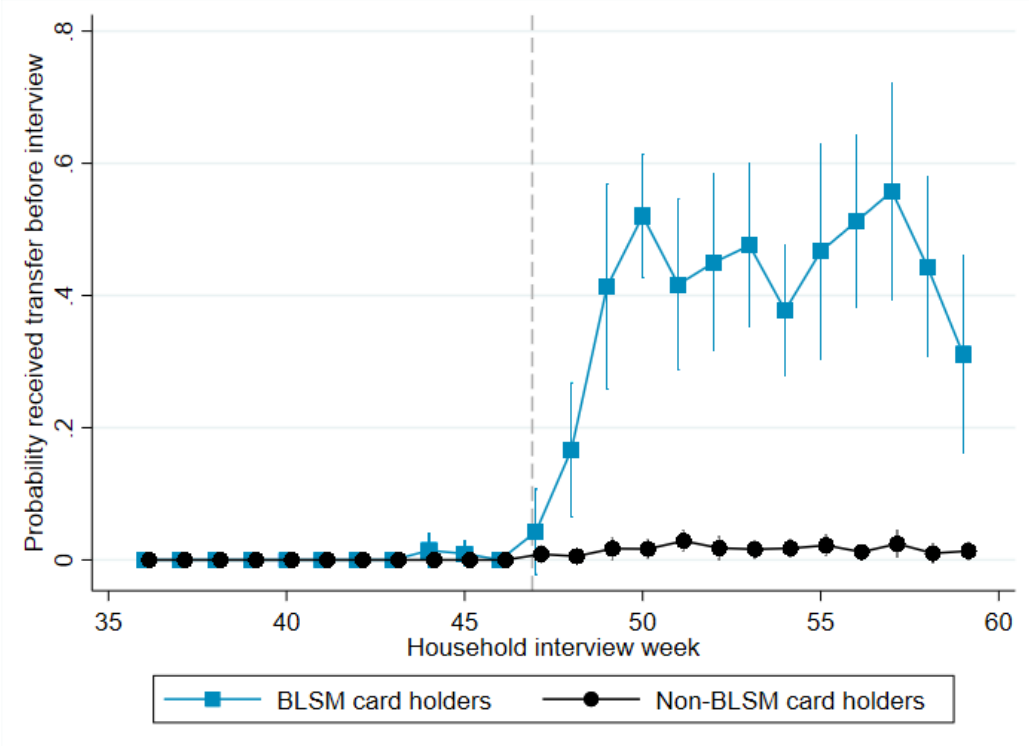
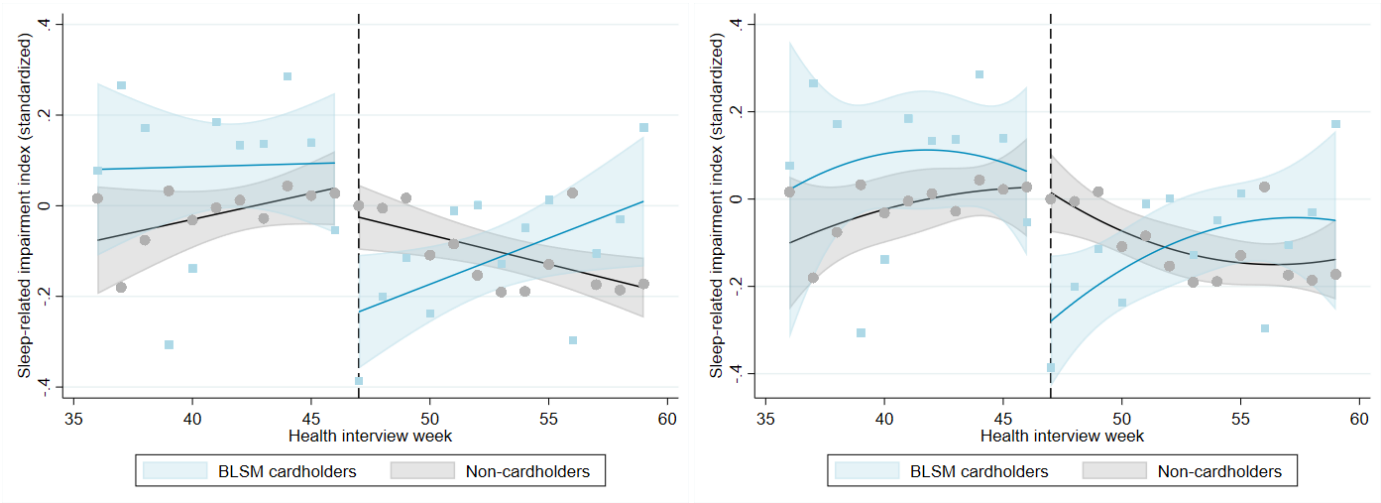


Figure 2. Probability household reports receipt of cash transfer by week

Notes: For households interviewed in each week, this figure plots the probability a household reports receipt of a BLSM transfer in the months of October, November or December 2014 for BLSM card-holding households (in blue) and non-BLSM card-holding households (in black). 95% confidence intervals are plotted alongside point estimates. The dashed line marks week 47, the beginning of transfer disbursement.



(a) Linear specification **(b) Quadratic specification**

Figure 3. Cash transfer impacts on sleep impairment of household heads

Note: Plotted estimates do not include controls or fixed effects, as estimated linearly in columns 1 and 3 and quadratically in columns 5 and 7 of table 2. Figures display 95% confidence intervals with standard errors clustered at the enumeration area.

Table 1: Balance of household and individual characteristics

	$\hat{\beta}_1$	Mean [St. Dev.]	Observations
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]	
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: All reported $\hat{\beta}_1$ coefficients are for a linear specification that includes kabupaten fixed effects. The dependent variable mean and standard deviation are also reported. 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.

Table 2: Cash transfer impacts on sleep impairment of household heads, by BLSM card holding status

	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)
(Week-47)	0.00141	-0.000440	-0.0287	-0.00298	0.0115	0.00823	-0.000364	-0.0203
	(0.0147)	(0.0152)	(0.0648)	(0.0639)	(0.00880)	(0.00850)	(0.0346)	(0.0338)
(Week-47)× Post	0.0189	0.0218	0.0748	0.0719	-0.0245**	-0.0236**	-0.0345	-0.0147
	(0.0178)	(0.0190)	(0.0719)	(0.0717)	(0.0101)	(0.00967)	(0.0388)	(0.0388)
$(\text{Week-47})^2$			-0.00274	-0.000213			-0.00109	-0.00263
			(0.00594)	(0.00580)			(0.00288)	(0.00285)
$(\text{Week-47})^2\times$ Post			0.000499	-0.00398			0.00293	0.00432
			(0.00644)	(0.00638)			(0.00322)	(0.00322)
Constant	0.0958	0.0739	0.0375	0.0591	0.0504	-0.116	0.0273	-0.196
	(0.0905)	(0.212)	(0.148)	(0.231)	(0.0490)	(0.0899)	(0.0860)	(0.132)
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 reported in parenthesis, clustered at the enumeration area, with the following significance indicators: * $p<0.1$, ** $p<0.05$ and ***$p<0.01$.

Table 3: Sleep questionnaire item responses for household heads

	BLSM card holders	Non-cardholders
	$\hat{\beta}_1$	$\hat{\beta}_1$
Panel a: Response to the specific question: In the past 7 days ... (1. Not at all 2. A little bit 3. Somewhat 4. Quite a bit 5. Very much)		
*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)
Panel b: 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 reported $\hat{\beta}_1$ coefficients are for a linear specification that includes gender, age decade and kabupaten fixed effects. Estimates in the first column are for BLSM card-holding household heads and in the second column are for non-BLSM card-holding household heads. The dependent variable is the response to the specific question in panel a. Panel b presents the aggregate score on all questions, the aggregate score on the italicized sleep disturbance questions and the aggregate score on the bold sleep-related impairment questions, our main outcome variable. Standard errors are reported in parenthesis, clustered at the enumeration area, with the following significance indicators: * $p<0.1$, ** $p<0.05$ and *** $p<0.01$.

Table 4: Sleep impacts for BLSM recipient household heads (IV estimates)

	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: The first column reports the $Post$ coefficients for the first stage regression on transfer receipts. Columns 2 and 3 replicate the estimates presented in columns 1 and 2 of table 2. Columns 4 and 5 present instrumental variable fuzzy regression discontinuity estimates for the impact of transfer receipts on the SRI of BLSM card-holding household heads. 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.

Table 5: Time use patterns 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 reported $\hat{\beta}_1$ coefficients are for a linear specification that includes gender, age decade and kabupaten fixed effects. 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.

Table 6: Cash transfer impacts on sleep impairment for BLSM card-holding sub-groups

	Sleep related impairment (standardized)			
	$\hat{\beta}_1$	Observations	Household head share	Female share
Panel a: All individuals				
All	-0.09	4580	0.36	0.52
	(0.07)			
Men	-0.19*	2167	0.60	0.00
	(0.10)			
Women	-0.00	2413	0.13	1.00
	(0.09)			
40 and under	-0.04	2614	0.20	0.52
	(0.09)			
41-65	-0.17	1679	0.56	0.51
	(0.12)			
Over 65	-0.07	280	0.53	0.57
	(0.25)			
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: All reported $\hat{\beta}_1$ coefficients are for a linear specification that includes gender, age decade and kabupaten fixed effects. The share of the sub-group that identifies as the household head is also reported alongside the share of females. 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.

Table 7: 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 reported $\hat{\beta}_1$ coefficients are for a linear specification that includes fixed effects for the number of working age individuals in a household, whether the household is female headed, the total number of household members and kabupaten. The dependent variable mean and standard deviation are also reported. 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.

Table 8: Depression and affect for BLSM card-holding household heads

	$\hat{\beta}_1$	IFLS4 controls	Observations
Depression index	-0.10		1666
	(0.11)		
Depression index	0.02	Included	1480
	(0.11)		
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. Standard errors are reported in parenthesis, clustered at the enumeration area, with the following significance indicators: * $p<0.1$, ** $p<0.05$ and ***$p<0.01$.

Table 9: Cognition indicators for household heads

		BLSM cardholders		Non-cardholders	
	IFLS4 controls	$\hat{\beta}_1$	Observations	$\hat{\beta}_1$	Observations
Ravens matrices		0.03	1646	0.03	6235
		(0.10)		(0.05)	
Ravens matrices	Included	0.19	249	-0.02	1075
		(0.20)		(0.09)	
Math questions		0.01	1322	0.12*	5071
		(0.10)		(0.07)	
Math questions	Included	0.66***	211	0.08	932
		(0.24)		(0.12)	
Number series		-0.05	1665	0.02	6253
		(0.09)		(0.05)	
Rapid word recall		0.21**	1666	0.05	6265
		(0.10)		(0.06)	
Rapid word recall	Included	0.15	1454	0.03	5081
		(0.10)		(0.06)	
Delayed word recall		0.25***	1666	0.03	6265
		(0.08)		(0.06)	
Delayed word recall	Included	0.17**	1454	0.05	5081
		(0.08)		(0.05)	

Note: All regressions include age decade, gender, kabupaten and education category fixed effects. Indicated regressions include a control for the previous performance of the individual when they were surveyed in the IFLS4 wave. Standard errors are reported in parenthesis, clustered at the enumeration area, with the following significance indicators: * $p<0.1$, ** $p<0.05$ and *** $p<0.01$.