The test effect: Behavioral change and potential biases due to (biomedical) testing in surveys

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WIDER Development Conference, 7 June, 2016

Motivation

(Rapid) biomedical testing in surveys:

- could change a respondent's health care seeking behavior,
- may bias impact estimates of a health care intervention.

"Test effect"

Disclosing previously unknown information about one's health status closes an information gap, raising awareness of true health.

Different from:

- Hawthorne and John Henry effect (e.g. Duflo et al., 2007),
- Question-behavior effect (e.g. Sherman, 1980),
- Survey effect (e.g. Zwane et al., 2011).

Behavioral change due to (biomedical) testing

- **HIV testing** (Thornton, 2008, 2012; Delavande and Kohler, 2012; Gong, 2015),
- **Water quality testing** (Jalan and Somanathan, 2008; Davis et al., 2011; Luoto et al., 2011; Hamoudi et al., 2012),
- **Malaria testing** (Tarozzi et al., 2015),
- **Blood pressure (BP) testing** (Hendriks et al., 2014),

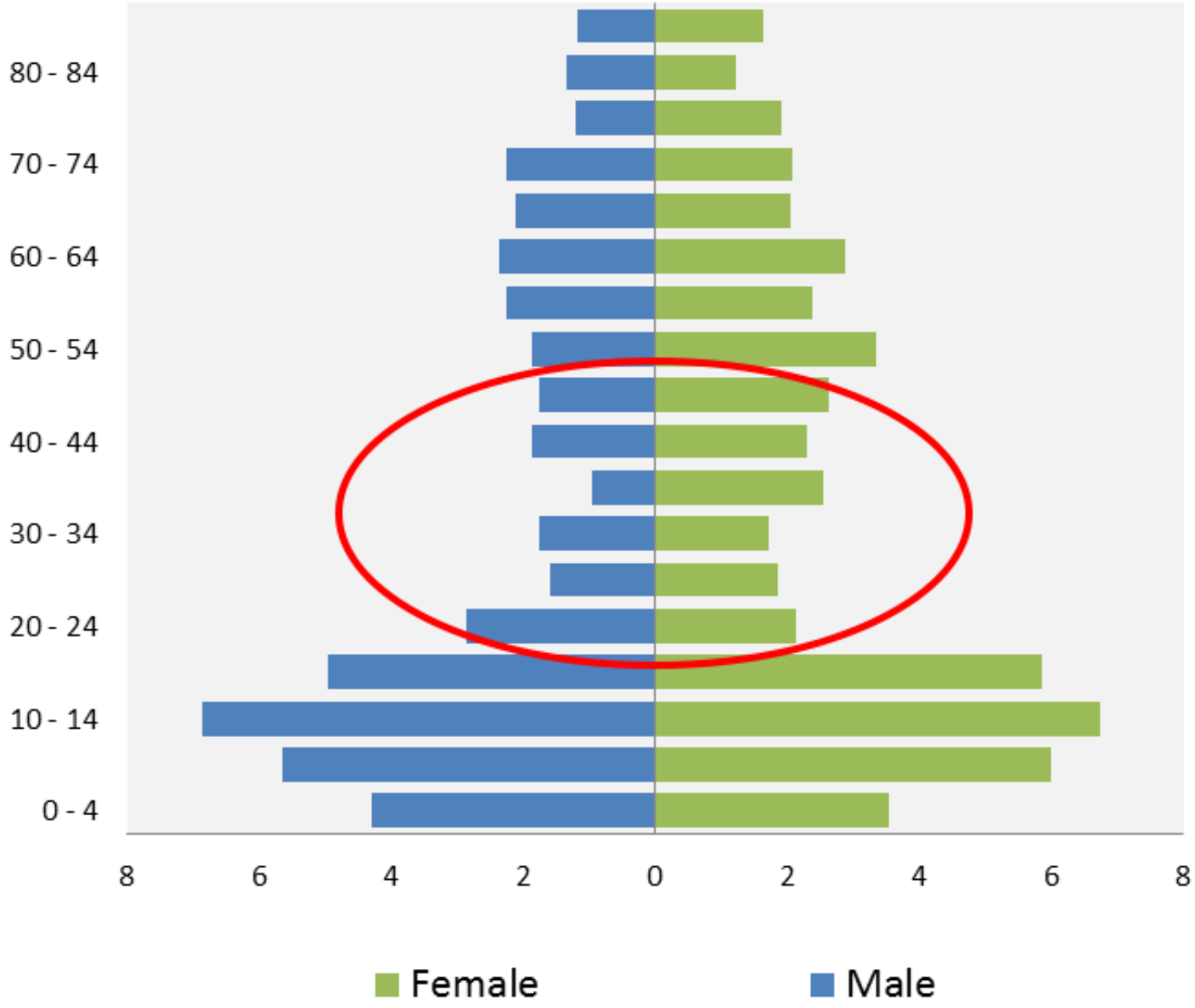
Preview

- BP test for random subsample during baseline survey of health insurance DiD impact evaluation (Kilimanjaro, Tanzania),
- Fixed effects panel estimation to identify test effect on:
  1. Health care use for hypertension (+12 pp for high BP cases),
  2. Health insurance uptake (no effect),
- And: health insurance ITT impact estimates not biased,
- Take away:
  - Randomly exclude (small) subsample from testing to disentangle test effect.

Research population

- Tanzania, Kilimanjaro region,
- 98% Chagga, 96% christian,
- Small scale coffee farmers and their households; active members of the Kilimanjaro Native Co-operative Union (KNCU),
  - approximately 2 in 5 households are "KNCU households" (10%–89%),
  - organized in primary societies,
- Median daily per capita consumption 2000 TZS ($\approx$ \$1.85),
- At baseline 11% of population had health insurance:
  - National Health Insurance Fund (NHIF): 9%,
  - Community Health Fund (CHF): 2%,
- Relatively few working age individuals.

Hourglass shaped age pyramid



KNCU Health Plan (1)

- Subsidized voluntary health insurance for KNCU coffee farmers and their households *(demand side intervention)*,
- Treatment in health facilities in close vicinity to target population (mostly faith based dispensaries), most of which had quality improvements in the scope of the KNCU Health Plan *(supply side intervention)*,
- Funded by the Health Insurance Fund, and implemented by PharmAccess Foundation (Dutch NGO),
- Covers comprehensive primary and limited basic secondary health care services (including hypertension treatment).

KNCU Health Plan (2)

- Enrollment by household, not by individual,
- Annual premium of TZS 14,000 ($\approx$ \$13) per person (one week of baseline median per capita consumption),
- Co-premium TZS 12,000–4,500 per person (14%–62% subsidy), depending on household size,
- Door to door sales, up front annual payment in cash,
- Introduced in the fall of 2013 in the insurance treatment group ($\approx$ 7 months after baseline).

KNCU Health Plan has now joined with CHF to become the *improved* Community Health Fund (*i*CHF), now available to the full district populations (partnership with local government).

Experimental design & data collection

- Insurance intervention & control group chosen by matching KNCU primary societies (PSs) on observed characteristics (ins. intervention group: 5 PSs; ins. control group: 4 PSs),
- Baseline in Q1 of 2013 (by EDI Ltd.),
- Household questionnaire (CAPI, Swahili):
  - socio-economic questions,
  - health related questions [if consented],
- Random sample of 1000 KNCU households:
  - Insurance intervention: 500 HHs,
  - Insurance control: 500 HHs.
- Blood pressure (BP) measurements in randomly chosen 80% of households (stratified by subvillage) [if consented],
- Follow-up survey 2 years later, in March 2015,
- Ethical clearance received from NIMR & COSTECH.

Blood pressure measurements (baseline)

- All (consenting) adults in selected households ($\approx$3 per HH),
- BP measured 3 times by survey medical officer (white coat),
- Respondent was informed of the result:
  - Normal BP,
  - High BP $\rightarrow$ warned of cardiovascular risk (leaflet), and advised to seek medical care.

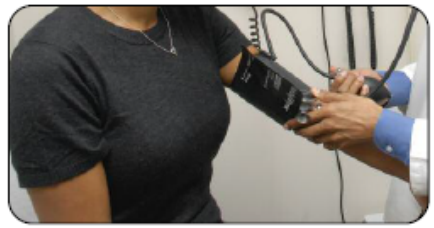
Leaflet (BP info)

SHINIKIZO LA DAMU

Moyo wako husukuma damu kupitia kwenye mishipa kwa kubana na kulegea. Kitendo hiki husababisha shinikizo kwenye mishipa ya damu. Shinikizo la damu hutofautiana kati ya mtu na mtu na ni moja ya mambo mbali mbali yanayohusiana na umri wako na mfumo wako wa maisha. Ni kawaida shinikizo lako la damu kubadilika siku nzima; linaweza kupanda kama una wasiwasi, msongo, au baada ya kufanya mazoezi na linaweza kushuka unapokuwa umepumzika au umelala.

Shinikizo la damu hupimwa kwa kifaa maalumu, kinachofungwa kwenye mkono wako kati ya beka na kiwiko. Shinikizo la damu huandikwa kwa namba mbili, ambazo huwakilisha mbano wa moyo (systole) na mlegeo wa moyo (diastole). Kwa mfano, 150/95 mmHg, inayotamkwa '150 kwa 95'. Shinikizo la damu la wastani ni 120/80 mmHg kwa watu wazima.

Mtu husemwa kuwa shinikizo la damu liko juu, kama shinikizo lake la damu ni 140/90 au zaidi, likiwa limepimwa nyakati tofauti, na wakati ukiwa umepumzika.



Hivyo kama shinikizo lako la damu liko juu unapopimwa mara moja, haimaanishi una matatizo ya 'shikizo la damu'. Kwa upande mwingine, kwa kawaida huwezi kujua kama shinikizo lako la damu liko juu, isipokuwa unapopimwa kutumia kifaa maalumu cha kupimia shinikizo la damu.

Sababu za shinikizo la damu kuwa juu mara nyingi hazijulikani. Tatizo hili hutokea zaidi katika baadhi ya familia kuliko katika familia nyingine. Kinachojulikana ni kuwa kadri umri wako unavyoongezeka, ndivyo uwezekano wa shinikizo lako la damu kuwa juu unavyoongezeka. Shinikizo la damu kuwa juu si ugonjwa, ila kama litaendelea kwa miaka kadhaa, linaweza kuwa kisababishi cha kupata ugonjwa wa moyo, kiharusi au ugonjwa wa figo.

Kuna mambo kadhaa unayoweza kubadili katika maisha yako ili kupunguza shinikizo lako la damu:

- **Acha uvutaji wa sigara au kiko kama wewe ni mvutaji**
  Uvutaji sigara, mbali na shinikizo la damu pia huathiri mishipa ya damu na moyo wako.

- **Punguza uzito kama una uzito wa kupindukia**

Kupunguza uzito wa ziada kunaweza kuchangia sana kurekebisha shinikizo lako la damu.

- **Jishughulishe zaidi wakati wa mchana**

Kazi za nguvu au mazoezi, kama vile kutembea au kendesha baiskeli mara kwa mara yanaweza kushusha shinikizo la damu mbali na faida nyingine za kiafya.

- **Punguza matumizi ya chumvi**

Kiasi cha chumvi unachokula kina athari kubwa kwenye shinikizo lako la damu. Ni vizuri kutumia chumvi kidogo katika chakula chako na tumia viungo kutia ladha chakula badala ya chumvi.

- **Kula mlo kamili na bora**

☞ Kula kwa wingi matunda, mbogamboga, mkate au ugali wa unga usiokobolewa, viazi mviringo na mchele.
☞ Tumia mafuta kwa kiasi katika mapishi, na ikiwezekana tumia mafuta ya zeituni au alizeti.
☞ Jitahidi kula angalau milo miwili ya samaki kwa juma.
☞ Punguza matumizi ya vyakula na vinywaji vyenye sukari.

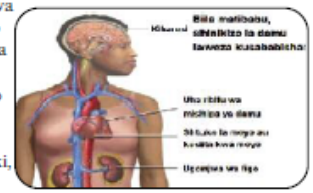
- **Epuka au punguza matumizi ya vilevi**

Ni vema zaidi kutokunywa zaidi ya vipimo 2 vya kilevi kwa siku kwa wanaume, na si zaidi ya kipimo kimoja cha kilevi kwa siku kwa wanawake. Mbali na kubadilisha mfumo wako wa maisha, ni muhimu kupata ushauri wa daktari unapokuwa na shinikizo la juu la damu; wakati mwingine atashauri kutumia dawa kushusha shinikizo lako la damu. Kama ni hivyo, mara nyingi dawa zitatumika maisha. Lakini kwa watu ambao wamefanya mabadiliko muhimu katika mfumo wao wa maisha (kwa mfano waliopunguza uzito, au walioacha kunywa pombe kupindukia) inawezekana wakatumia dawa kwa miaka michache tu.

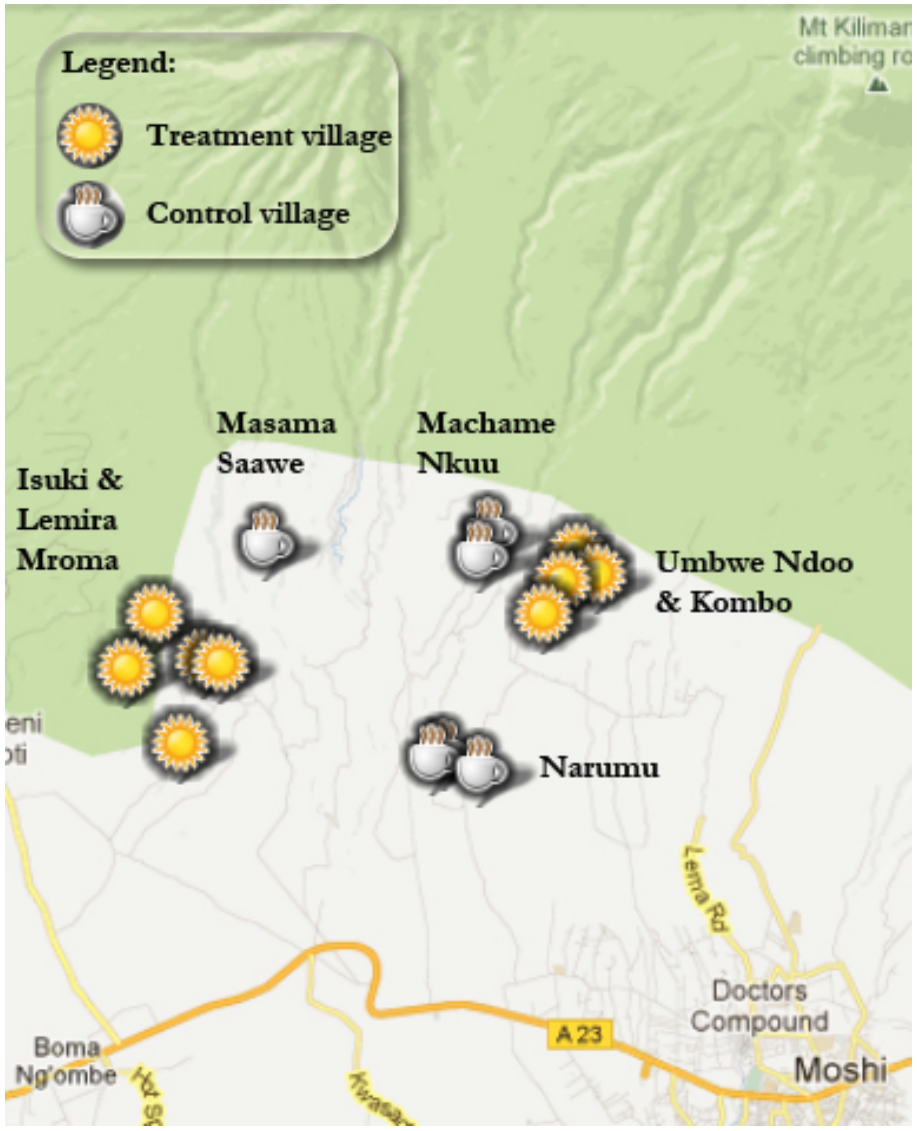
Unapoacha matumizi ya dawa, sharti upimwe shinikizo lako la damu mara kwa mara. Daktari

wako anaweza kukupa ushauri na matibabu stahili.

Kama ulipimwa shinikizo lako la damu katika utafiti huu na likakutwa liko juu, unashauriwa kwenda kliniki, hospitali au kituo cha afya kupata ushauri wa daktari ili upimwe tena shinikizo lako la damu.



Insurance intervention & control areas



Source: Community survey. Adapted from Google maps.

Sample

- Baseline (85% consented: BP test: 86%; No BP test: 85%):
  - Normal BP: 64%,
  - High BP: 34%,
  - No test result (but assigned to BP test): 2%,
- Follow-up:
  - 83% still in HH (BP test: 83%; No BP test: 85%). Attrition selective (more likely younger, male, healthier, better educated), but balanced between test treatment/control.
  - Consented: 85% (BP test: 86%; No BP test: 82%),
- Panel: 1,536 (BP test: 1,243; No BP test: 293).

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Test treatment/control balance (baseline means)

	BP test (N=1243)	No BP test (N=293)	p-value
Main			
Insurance intervention area	0.48	0.54	0.186
Self-reported HT	0.23	0.26	0.189
BP check - past 12 months	0.34	0.37	0.467
Consult for HT - past 12 months	0.16	0.19	0.229
Any health insurance	0.15	0.13	0.367
Socio-economic characteristics			
Age (years)	54.8	57.7	0.016*
Female	0.61	0.59	0.476
Married	0.69	0.70	0.686
Worked - past 12 months	0.21	0.17	0.073^{+}
Educ: None	0.09	0.13	0.094^{+}
Educ: Less than primary school	0.31	0.32	0.827
Educ: Primary school	0.54	0.49	0.163
Educ: More than primary school	0.06	0.06	0.853
Self-reported illness/ injury			
Chronic illness	0.41	0.46	0.157
Acute illness / injury - past 12 months	0.50	0.52	0.553
Hospitalization - past 12 months	0.07	0.08	0.546
Household characteristics			
Annual consumption - PC (TZS/1,000)	860	872	0.742
Financial health shock - past 12 months	0.37	0.39	0.632

Means are weighted and p-values clustered at the household level. BP=blood pressure; HT= hypertension; PC=per capita. $^{+}$ $p<0.10$, * $p<0.05$.

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Insurance intervention/control balance (baseline means)

	Ins. area (N=797)	Not Ins. area (N=739)	p-value
Main			
BP test	0.79	0.82	0.188
High BP	0.25	0.37	<.001***
Self-reported HT	0.22	0.25	0.154
BP check - past 12 months	0.33	0.37	0.060^{+}
Consult for HT - past 12 months	0.17	0.17	0.685
Any health insurance	0.15	0.14	0.743
Socio-economic characteristics			
Age (years)	54.9	55.8	0.307
Female	0.60	0.61	0.712
Married	0.70	0.69	0.666
Worked - past 12 months	0.20	0.20	0.808
Educ: None	0.11	0.09	0.176
Educ: Less than primary school	0.31	0.32	0.711
Educ: Primary school	0.54	0.52	0.438
Educ: More than primary school	0.04	0.07	0.003**
Self-reported illness/ injury			
Chronic illness	0.41	0.44	0.252
Acute illness / injury - past 12 months	0.49	0.51	0.463
Hospitalization - past 12 months	0.08	0.07	0.337
Household characteristics			
Annual consumption - PC (TZS / 1,000)	851	873	0.382
Financial health shock - past 12 months	0.39	0.36	0.432

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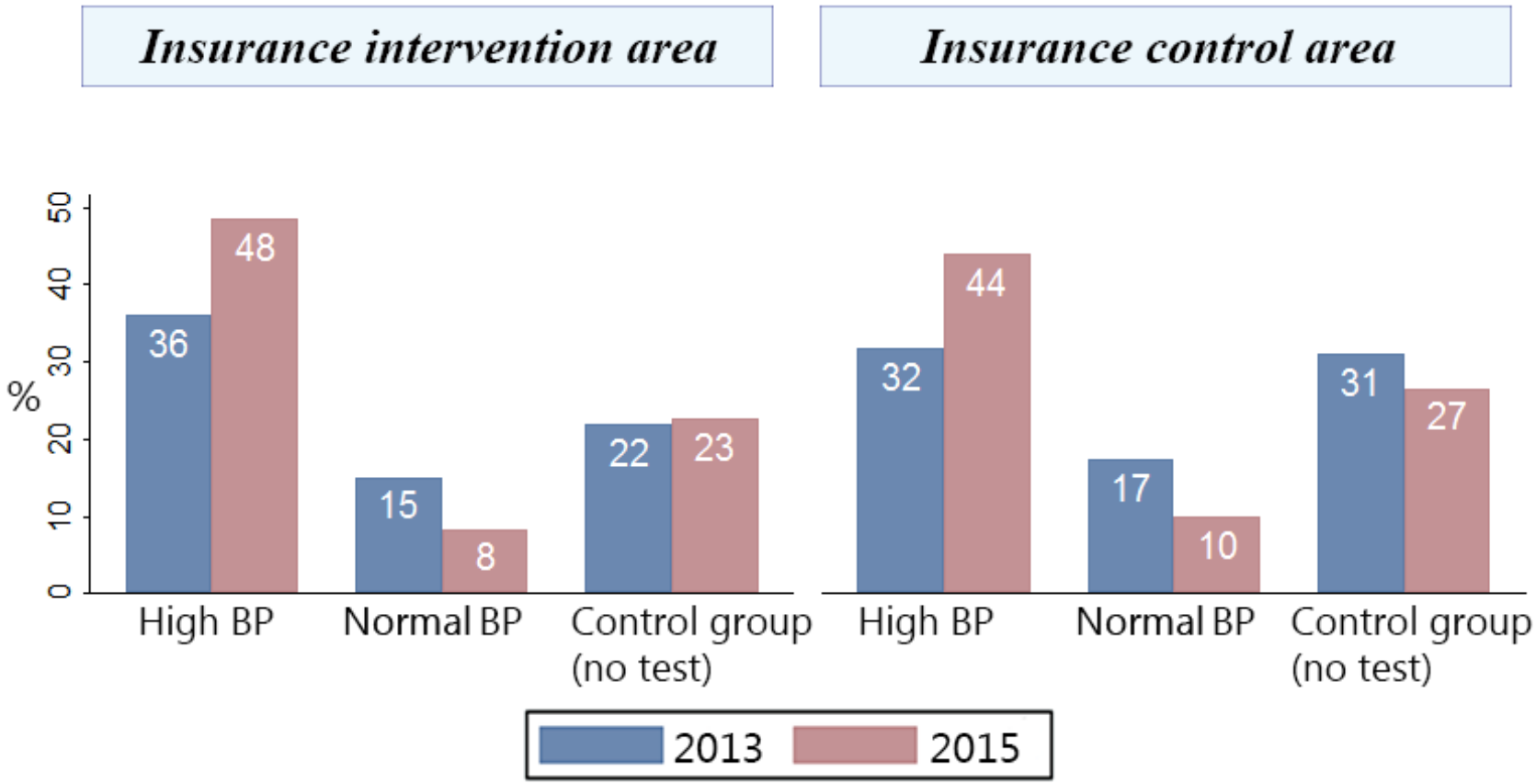
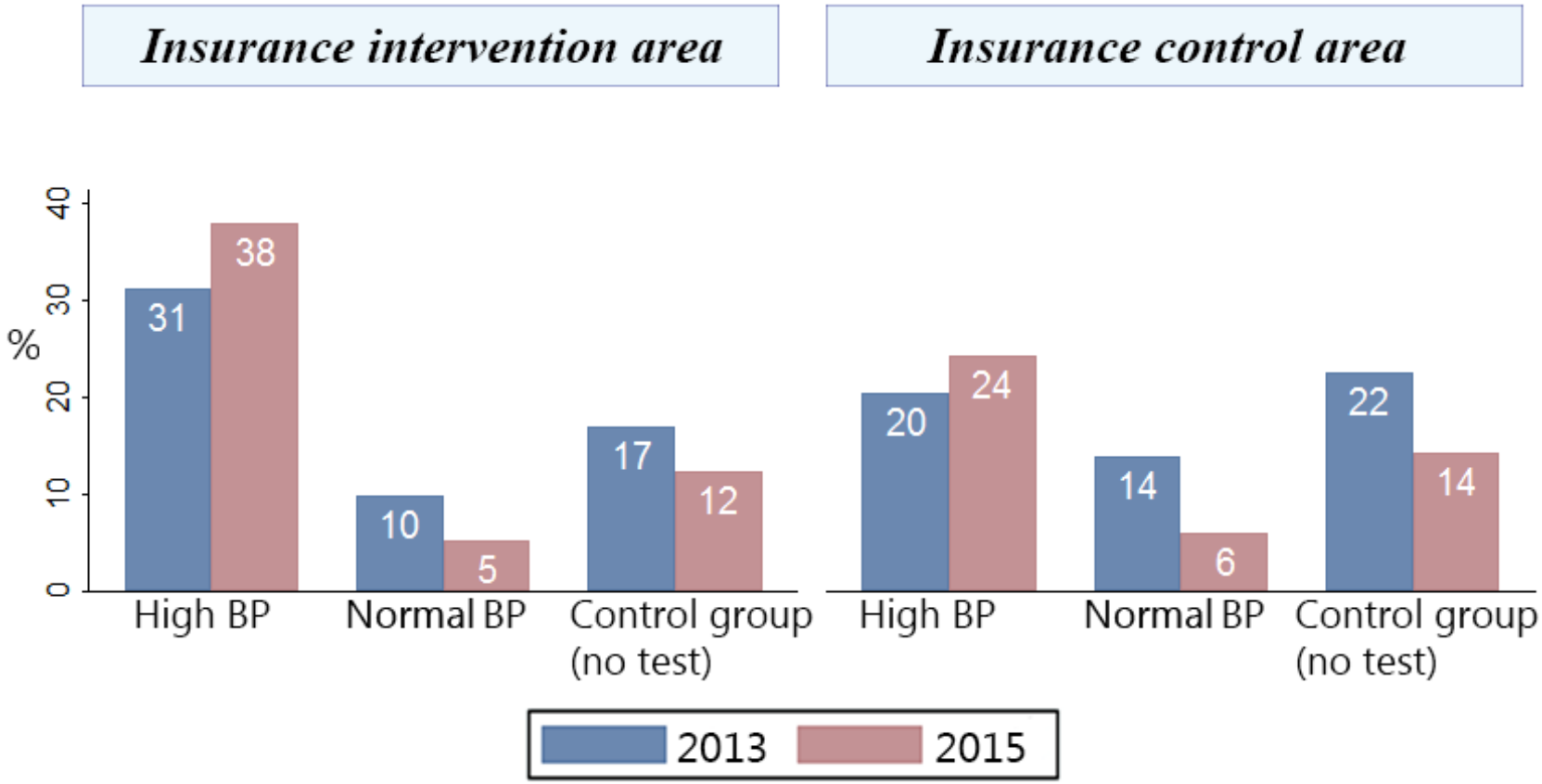
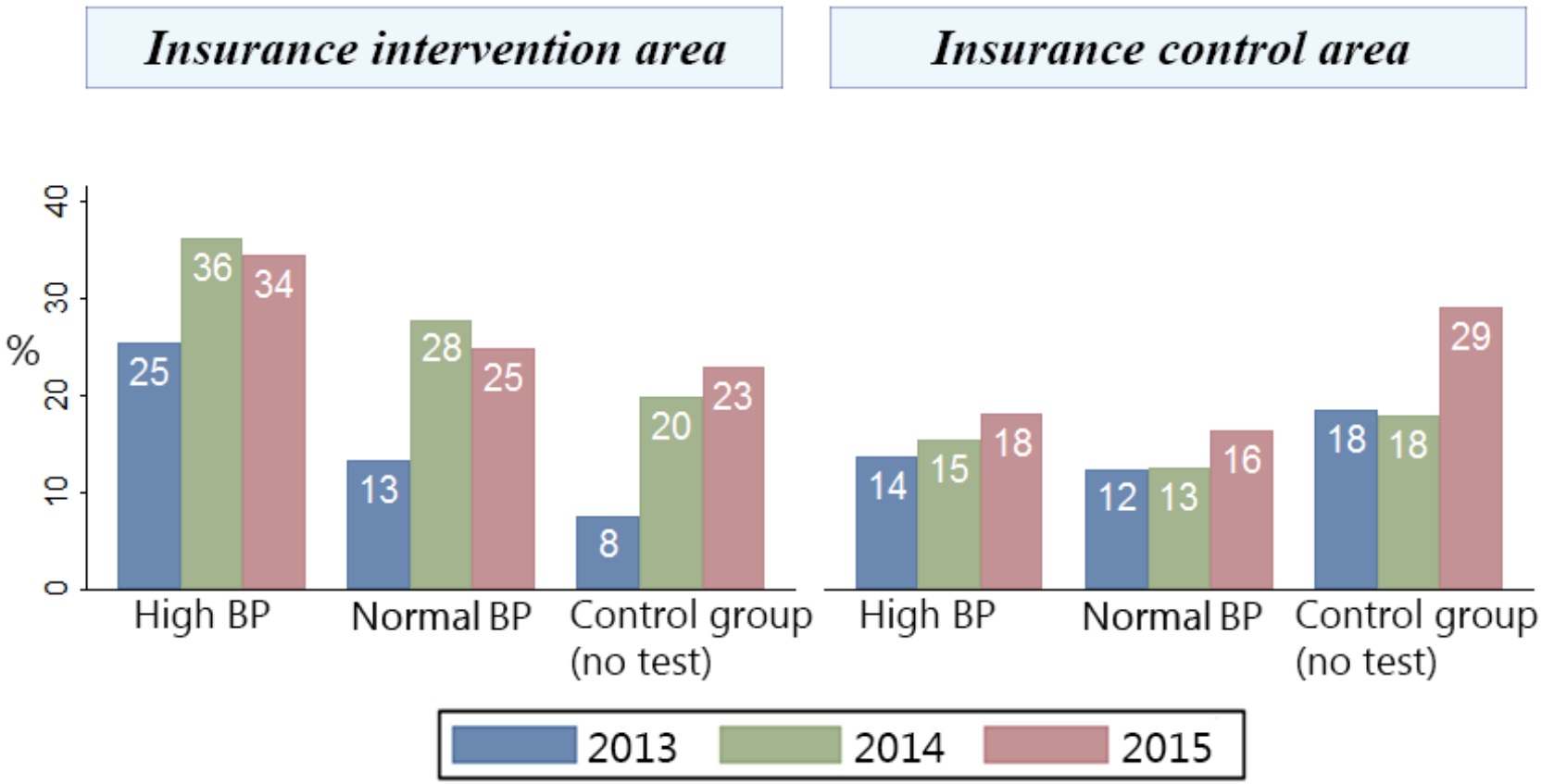
Self-reported hypertension



Consulted a health care provider for hypertension (past yr)



Insured by any health insurance



Individual fixed effects model

$$y_{kit} = \beta_k(M_i \times T_t) + \eta_k(M_i \times D_i \times T_t) + \theta_k(D_i \times T_t) + \gamma_k T_t + \delta_{ki} + \epsilon_{kit},$$

- y_{kit} is the kth outcome of individual i at time t,
- M_i is the BP test assignment dummy,
- T_t is the time dummy,
- D_i is the insurance intervention area dummy,
- δ_{ki} is the individual fixed effect,
- ϵ_{kit} is the error term.

β_k, η_k capture test effect; η_k captures bias in health insurance ITT.

Additionally split $M_i = N_i + H_i$.

Results (1)

	Self-reported HT	Consult for HT: 12m	Insured
BP measurement	0.064	0.056	0.018
	(0.047)	(0.043)	(0.044)
BP measurement × Ins. area	-0.079	-0.021	-0.002
	(0.064)	(0.061)	(0.064)
Ins. area	0.055	0.034	0.128*
	(0.056)	(0.054)	(0.055)
Constant	-0.048	-0.082*	-0.006
	(0.041)	(0.038)	(0.039)
Observations	3064	3056	3072

Individual FE estimates. Standard errors in parentheses. Reported variables are interacted with the time dummy. BP=blood pressure; HT=hypertension; Ins.=Insurance intervention; * $p < .05$

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Results (2)

	Self-reported HT	Consult for HT: 12m	Insured
Normal BP	-0.029	0.001	0.008
	(0.048)	(0.043)	(0.046)
High BP	0.169**	0.121*	0.024
	(0.056)	(0.051)	(0.046)
Normal BP × Ins. area	-0.044	-0.000	0.016
	(0.065)	(0.061)	(0.067)
High BP × Ins. area	-0.053	-0.006	-0.037
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Results (3)

- Difference by prior beliefs?
  - No heterogeneity by baseline self-reported HT,
- Results robust to:
  - sub-village level clustering of standard errors,
  - age-group reweighting.
- Effect is present around the high BP cutoff point.

Conclusion

- Measuring high blood pressure during the baseline survey
  1. increased health care use for hypertension,
  2. but did not increase health insurance uptake,
- BP measurements did not bias the health insurance impact estimates. Potential explanations:
  - Household level insurance reduces self-selection,
  - Insurance offered 7 months after baseline.
- Take away:
  - Randomly exclude (small) subsample from testing to disentangle test effect.