Supplementary appendix 2

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Wong EB, Olivier S, Gunda R, Koole O, et al. Convergence of infectious and non-communicable disease epidemics in rural South Africa: a population-based multimorbidity study

Supplementary Appendix to Manuscript Entitled

Convergence of infectious and non-communicable disease epidemics in rural South Africa: a population-based multimorbidity study

Table of Contents

Vukuzazi Team: Staff who significantly contributed to the implementation and conduct of Vukuzazi.

* Denotes team members who were closely involved with the design, implementation and oversight of Vukuzazi.

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Supplemental Methods

Additional Methodological Details

Eligibility and Recruitment. Eligibility criteria included age of at least 15 years on the day of recruitment and ongoing residency in the southern part of the AHRI demographic surveillance area. Eligible individuals were enumerated from the surveillance database on a weekly basis to ensure that most up-to-date data were used to reduce non-contact resulting from migration and death. A resident member of a household was defined as an individual who had slept the majority of nights in the preceding 4 months in the homestead occupied by the household. Study field workers visited households to explain the Vukuzazi survey, provide a written description of the study, and invite eligible household members to participate. Survey field workers provided registered invitation cards to potential participants in person or by proxy (issued to a household informant for other eligible household residents who were not home at the time of the recruiter's visit). Individuals in possession of registered invitation cards were eligible to attend the health camp on any subsequent date.

Informed consent. Upon presentation to the health camp, potential participants received additional written and verbal explanation of survey procedures, underwent assessment of capacity, individual informed consent and enrollment into the survey. All participants completed a formal written informed consent process that included consent for disease testing and return of results, storage and future use of biobanked specimens, permission for genetic testing in the future, and permission to be re-contacted for additional sub-studies and longitudinal follow-up. Adolescent participants who were younger than 18 years of age additionally required written assent for participation from their parent or guardian.

Demographic data. Demographic information about Vukuzazi participants and non-participants (including marital status, employment status, level of education attained, location of residence and household access to running water) were obtained from the most recent demographic survey. Membership in the labour force and employment status were defined using the strict definition of unemployment as defined by Statistics South Africa.(1)

Health questionnaire: At the Vukuzazi health camp, a study nurse administered a personal health history questionnaire that included personal history of HIV (including date and result of most recent HIV test and personal history of antiretroviral therapy), personal history of tuberculosis (including date of most recent TB treatment, current TB treatment status and ascertainment of the presence and duration of the four cardinal symptoms of TB (cough, fever, night sweats and weight loss) as designated in WHO TB Prevalence Survey methodology,(2) personal history of diabetes (whether the condition had been

diagnosed and whether the participant was actively receiving antidiabetes therapy), and personal history of hypertension (whether the condition had been diagnosed and whether the participant was actively receiving antihyptertensive therapy).

Blood pressure measurement. Systolic and diastolic blood pressure were measured using automated devices (Welch Allyn) three times at 15 minute intervals when participants were comfortably seated and had been sitting with their legs uncrossed and feet on the ground for at least 15 minutes prior to the first measurement, according to the WHO STEPS protocol.(3) Small adult, adult, large adult and extra-large adult blood pressure cuffs were selected based on measured arm circumference (22-26cm, 27-34cm, 35-44cm, 45-52cm respectively). The average of the second and third systolic and diastolic measurements was used to define blood pressure for the analysis.

Statistical approaches. Inverse probability weights, to account for study non-participation, were calculated as the inverse probability of participation in the study, using a logistic regression model including all eligible individuals in the catchment area, with covariates for age groups (in 10 year bands) and sex. The inverse of the predicted probability from the regression model was used as the weight. Unweighted frequencies of multimorbidity categories in 1 year age bands were used to visualize the spectrum of health and across the adult lifespan. Since all resident individuals in the surveyed area of the PIPSA were eligible for the study, sampling weights were not applied in the calculation of population prevalence estimates. Continuous surface maps of disease and multimorbidity prevalence were generated using kernel interpolation method with a moving two-dimensional Gaussian kernel of a 3-km search radius which has been extensively validated in our setting.(4-7) The search radius was determined using a spatial variogram (constructed using HIV prevalence estimates aggregated by administrative ward), which showed there to be clear spatial dependence in the resulting HIV prevalence estimates within a distance of 3km whereafter the dependence ceased. The large sample size for this study meant that the resulting estimates were robust to the effects of random noise. For consistency and ease of comparison we applied the same technique and search radius to all four diseases.

Supplementary Figures and Tables

Figure S1. Population structure of eligible individuals and Vukuzazi participants.
Population pyramid of eligible residents of the AHRI demographic surveillance area (no outline)
and of Vukuzazi participants (black outline) by age and sex strata.
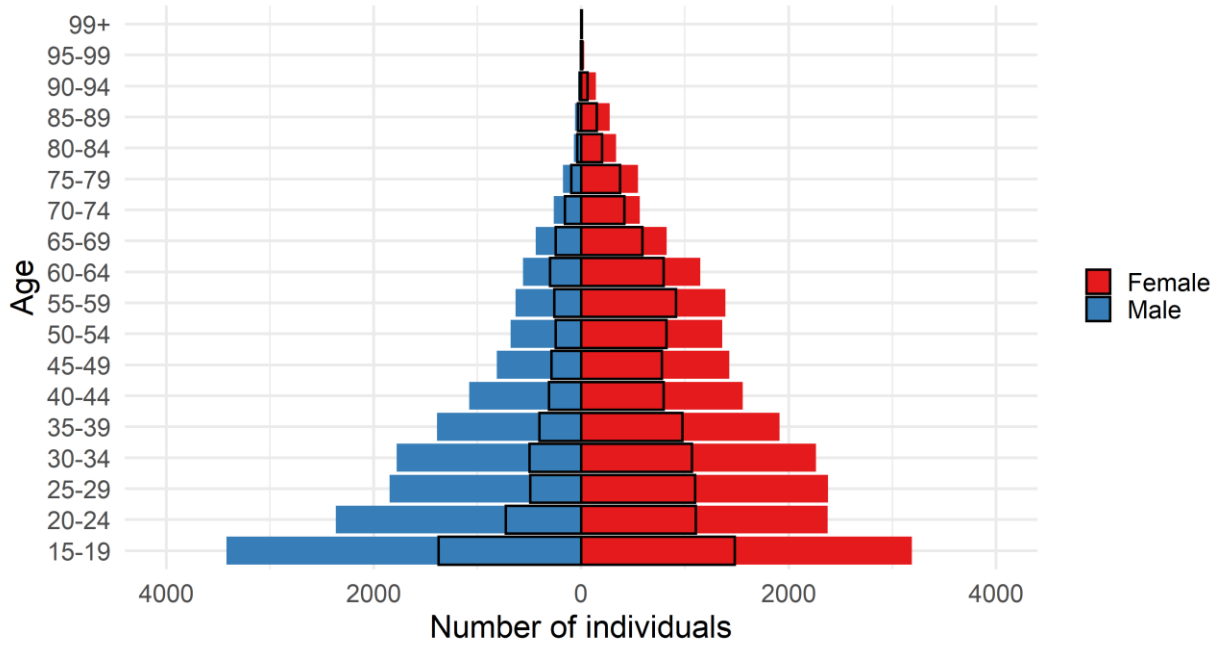
Figure S2. Outcome of recruitment efforts by age and sex. The percentage of eligible population whom the study team were unable to contact (blue), who refused further participation after hearing about the nature of the study (purple), who accepted an invitation card but did not attend Vukuzazi (light green) and who attended the Vukuzazi mobile health camp (dark green).
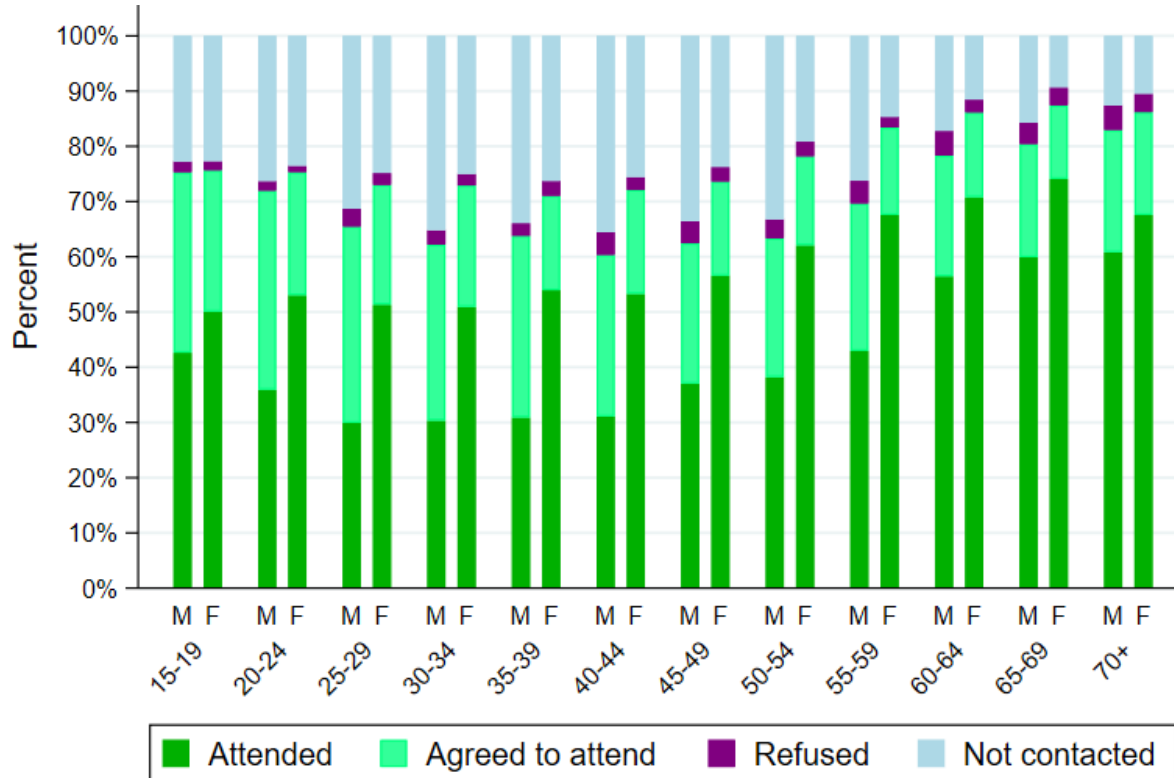
Table S1. Demographic characteristics of the eligible population, participants and non-participants.

	Eligible population (N=34721)	Vukuzazi participants (N=17118)	Vukuzazi non-participants (N=17603)	p-value[1]
Age group	**n=34721**	**n=17118**	**n=17603**	<0.000
<25	10294 (29.6%)	4684 (27.4%)	5610 (31.9%)	
25-34	7523 (21.7%)	3155 (18.4%)	4368 (24.8%)	
35-44	5612 (16.2%)	2489 (14.5%)	3123 (17.7%)	
45-54	4102 (11.8%)	2123 (12.4%)	1979 (11.2%)	
55-64	3617 (10.4%)	2270 (13.3%)	1347 (7.7 %)	
>65	3573 (10.3%)	2397 (14.0%)	1176 (6.7 %)	
Gender	n=34721	n=17118	n=17603	<0.000
Male	14402 (41.5%)	5500 (32.1%)	8902 (50.6%)	
Female	20319 (58.5%)	11618 (67.9%)	8701 (49.4%)	
Education	n=34580	n=17076	n=17504	<0.000
None	8076 (23.4%)	4320 (25.3%)	3756 (21.5%)	
Less than complete secondary	11402 (33.0%)	6409 (37.5%)	4993 (28.5%)	
Complete seconary and above	15102 (43.7%)	6347 (37.2%)	8755 (50.0%)	
Marital Status	n=29803	n=14839	n=14964	<0.000
Single	7566 (25.4%)	3567 (24.0%)	3999 (26.7%)	
Married/Living as married	19041 (63.9%)	9185 (61.9%)	9856 (65.9%)	
Seperated/Widowed/Divorced	3196 (10.7%)	2087 (14.1%)	1109 (7.4 %)	
Employment Status[2]	n=15746	n=6516	n=9230	<0.000
Unemployed[3]	6959 (44.2%)	3653 (56.1%)	3306 (35.8%)	
Employed	8787 (55.8%)	2863 (43.9%)	5924 (64.2%)	
Residence Location	n=34531	n=17026	n=17505	<0.000
Urban	2862 (8.3 %)	946 (5.6 %)	1916 (10.9%)	
Peri-urban	11720 (33.9%)	5509 (32.4%)	6211 (35.5%)	
Rural	19949 (57.8%)	10571 (62.1%)	9378 (53.6%)	

[1]Chi-squared test of difference in each demographic category between Vukuzazi participants and non-participants. [2]Employment status calculated among members of the resident population in the labour force. [3]Department of Statistics South Africa's strict definition of unemployment (Ref 1).

Table S2. Combinations of diseases contributing to multimorbidity in Vukuzazi. Table includes all participants who enrolled between May 2018-December 2019 (n = 17,118). Glu = Elevated blood glucose; BP = elevated blood pressure; Missing = participants who did not complete disease screening activities for all four diseases.

Disease combinations	N	percent
No disease	7553	44.12
Glu	385	2.25
Glu_BP	881	5.15
Glu_BP_TB	14	0.08
Glu_TB	9	0.05
HIV	4380	25.59
HIV_Glu	162	0.95
HIV_Glu_BP	194	1.13
HIV_Glu_BP_TB	1	0.01
HIV_Glu_TB	6	0.04
HIV_BP	945	5.52
HIV_BP_TB	15	0.09
HIV_TB	93	0.54
BP	2319	13.55
BP_TB	26	0.15
TB	69	0.4
Missing	66	0.39

Table S3. Details of control states for four diseases assessed in Vukuzazi.

	HIV		Elevated blood glucose		Elevated blood pressure		Active tuberculosis	
	N	percent	N	Percent	N	Percent	N	Percent
Controlled (Diagnosed, On optimal treatment)	4526	78.1%	117	7.1%	1866	42.5%	69	29.6%
Uncontrolled (Newly diagnosed)	599	10.3%	415	25.1%	764	17.4%	164	70.4%
Uncontrolled (Previously diagnosed, Not on treatment)	151	2.6%	559	33.8%	704	16.0%	0	0
Uncontrolled (Previously Diagnosed, On suboptimal treatment)	520	9.0%	561	34.0%	1061	24.1%	0	0
Total	5796	100,0%	1652	100.0%	4395	100.0%	233	100.0%

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