

Housing characteristics as determinants of tuberculosis in an Inuit community: a case-control study

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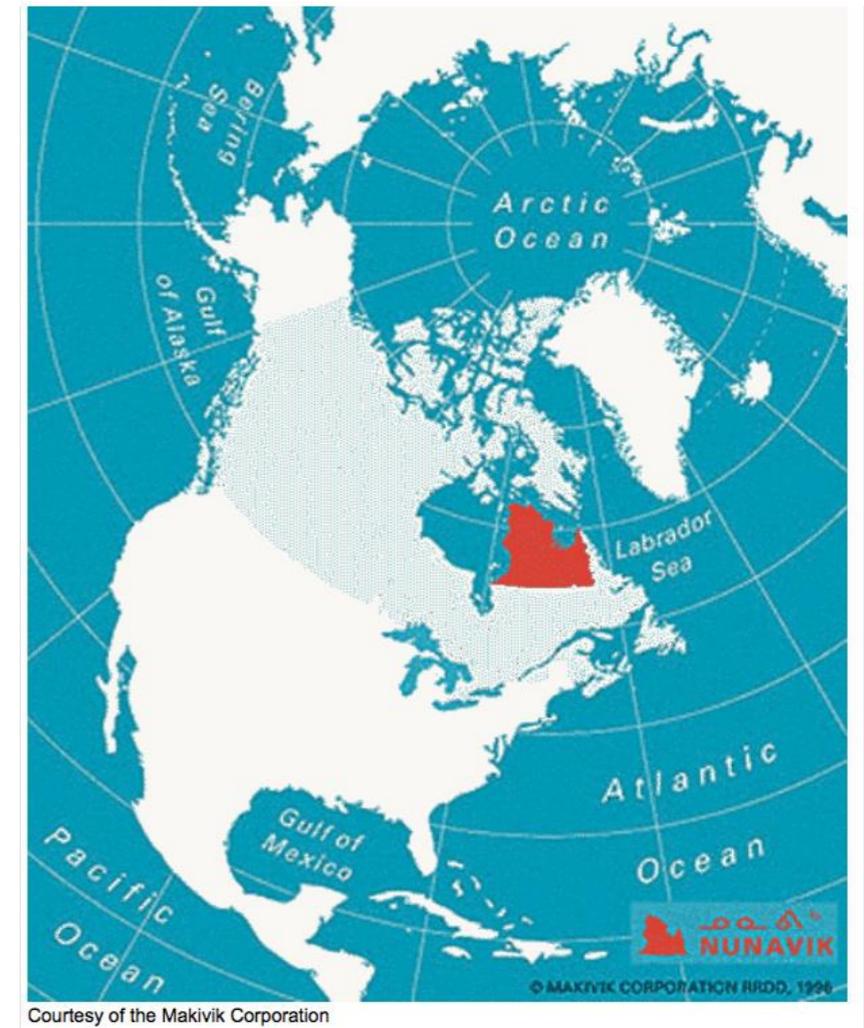
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Background

- The incidence of tuberculosis is 38-fold higher in Canada's Inuit communities vs national average
- Housing widely regarded as determinant of TB—older, ecologic studies
- Impact of low ventilation & crowding on TB risk not studied in Inuit communities
- November 2011 - November 2012— an exceptional outbreak of TB in one village in Nunavik

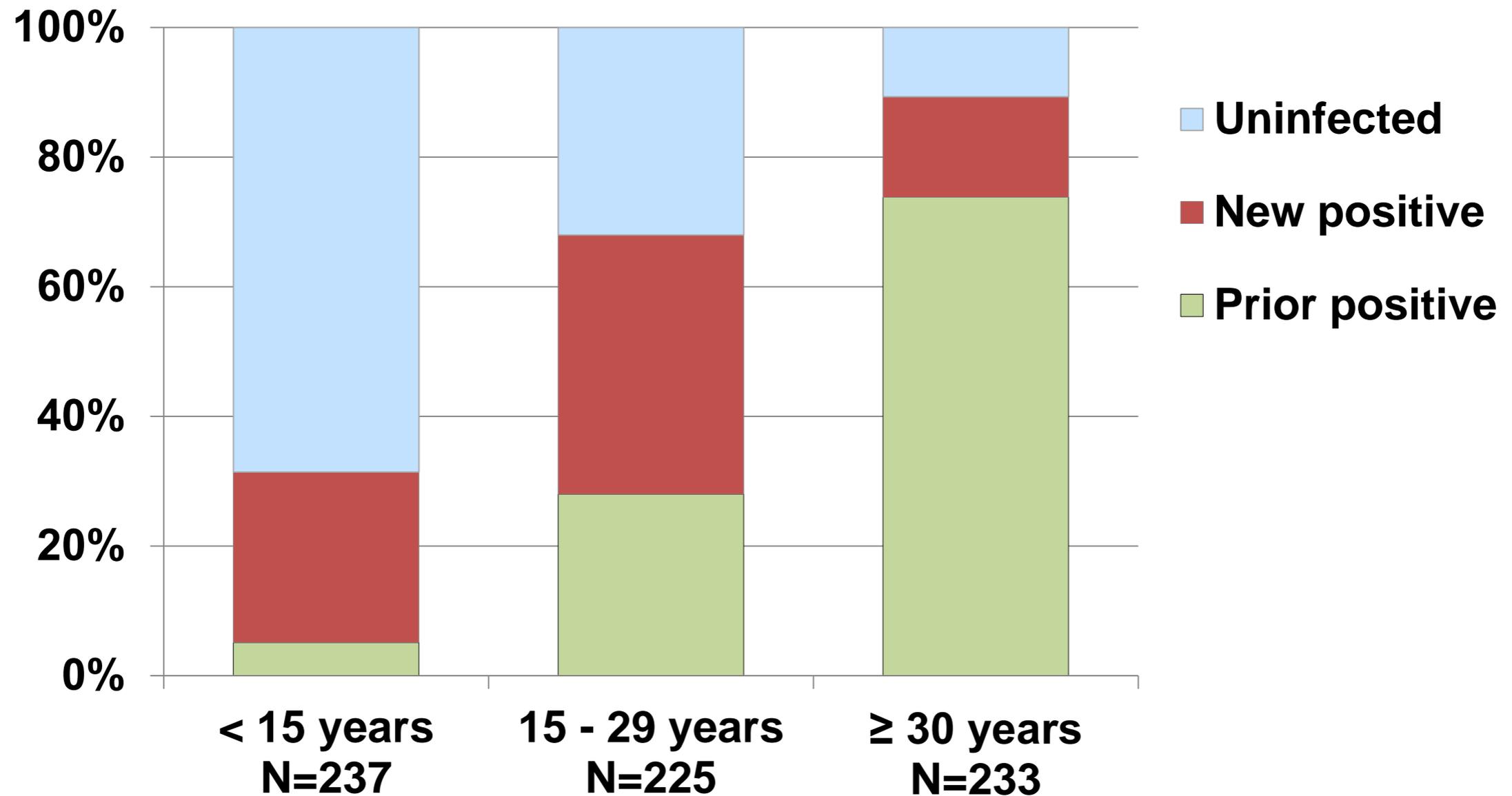


The Outbreak



- Village population: 933
- Over the course of 1 year:
 - 92 (10%) treated for active TB
 - 50 (5.5%) culture-confirmed
- 695 villagers evaluated as contacts

TST-status among 695 villagers evaluated for TB during the outbreak, by age group

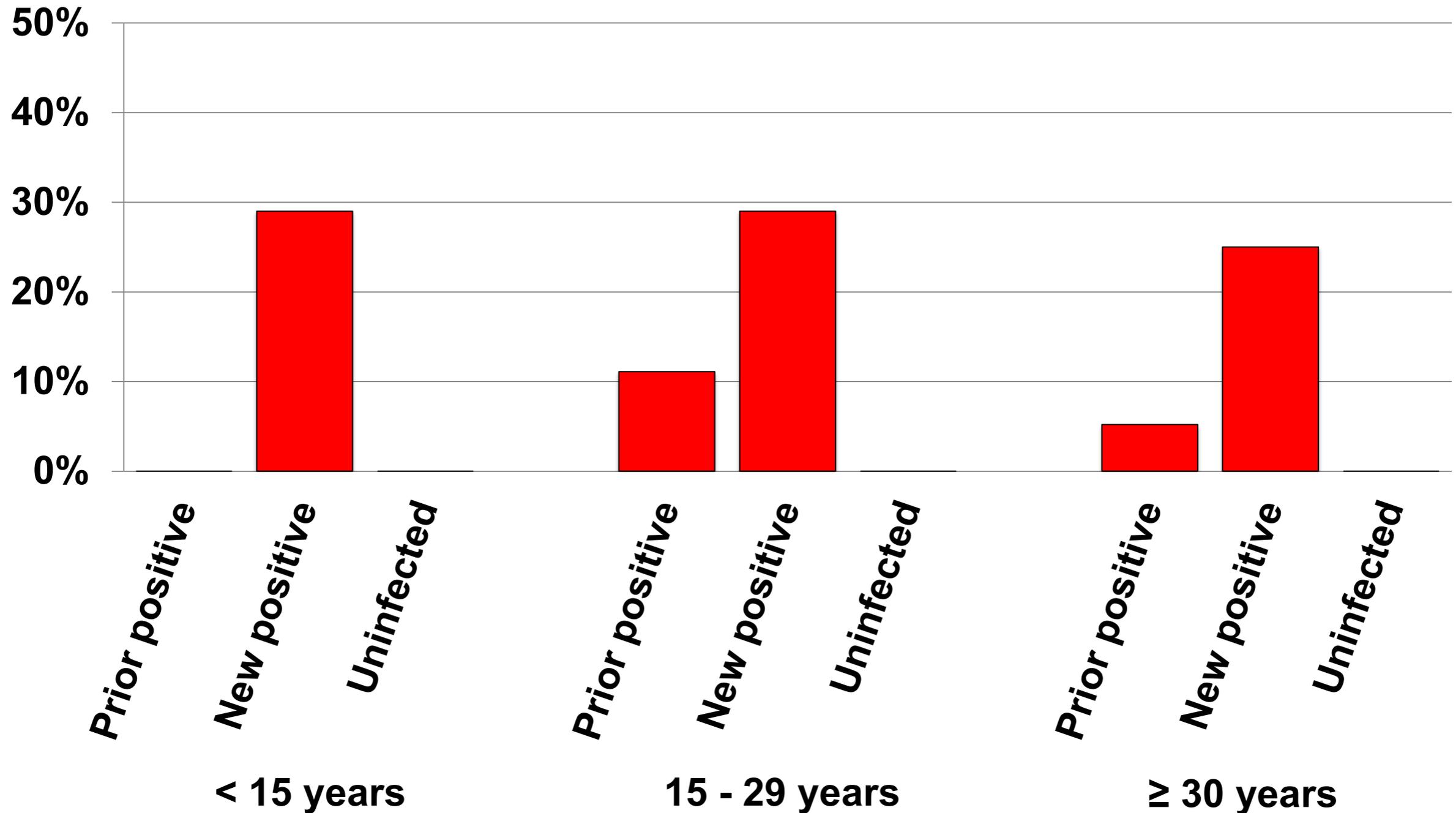


260 (37%): Uninfected

188 (27%): New positive TST, positive reaction documented between November 2011 and November 2012 in absence of documented prior positive

247 (35%): Prior positive TST, positive reaction documented before November 2011.

Confirmed or probable disease, by age group and TST-status



Active TB occurred in:

53 (28%) of New positive TST

16 (7%) of Prior positive TST

Objectives

- If participants' dwelling characteristics, or exposure to TB when visiting other dwellings, were associated with:
 - (1) acquisition new TB infection
 - (2) progression to confirmed or probable active TB among those infected (TST-positive)

Methods

- Two unmatched case-control studies (1 for each objective)
- Recruitment - any community member residing in the village during the outbreak & with TB or evaluated as contact with TST result
- Data collected
 - *Questionnaires*
 - *Serum cotinine*
 - *Walk-through housing inspection*
 - *Measurement of air change (ventilation) using CO₂ as tracer gas*



Results - characteristics of dwellings

Dwelling characteristic	Summary
Total number of dwellings	80
Years since dwelling was built, mean \pmSD	19.3 \pm 8.2
<i>Heating method, N(%)</i>	
Radiator	8 (10%)
Pulsed air	71 (90%)

Results - characteristics of dwellings

Dwelling characteristic	Summary	
<i>Dwelling occupancy</i> , mean \pm SD		
Number of occupants	5.7 \pm 2.6	
Occupants per room	1.1 \pm 0.4	
Adult occupants per room	0.7 \pm 0.4	
<i>Ventilation</i>		
Dwellings where ventilation measured, N(%)	53 (67%)	
Air changes per hour (ACH)	<i>Living area</i>	<i>Bedrooms</i>
With heating off, mean \pm SD	0.67 \pm 0.28	0.32 \pm 0.28
With heating on, mean \pm SD	1.70 \pm 0.26	1.29 \pm 0.29

Factors associated with acquisition of infection during the outbreak, Table part 1 of 2

Variable	Newly infected, N=88 [†]	Uninfected, N=67	Multivariable analysis Adjusted OR (95% CI)
Age			
Under 15 years	30 (34%)	45 (67%)	ref
15-29 years	44 (50%)	17 (25%)	4.4 (1.8-10)
≥ 30 years	14 (16%)	5 (8%)	4.2 (0.8-21.9)
Lowest ventilation in living areas^{††}			
> 0.71 ACH	27 (31%)	32 (50%)	ref
≤ 0.71 ACH	61 (69%)	34 (52%)	1.7 (0.6-4.7)
Volume of living area^{††}			
> 65.5 m ³	30 (34%)	25 (38%)	ref
≤ 65.5 m ³	58 (66%)	41 (62%)	0.8 (0.3-2.1)

Also adjusted for: gender, smoking, annual personal income. Interaction between number of adults per room and living with smear-positive person was significant (p<0.001)

Factors associated with acquisition of infection during the outbreak, Table part 2 of 2

	Newly infected, N=88 [†]	Uninfected, N=67	Multivariable analysis
Variable	N (%) or Mean (\pm SD)	Mean (\pm SD)	Adjusted OR (95% CI)
<i>Occupancy^{†††}-Number of adults per room:</i>			
Only among participants living with a smear-positive person	1.1 \pm 0.5	0.8 [*]	1.8 (1.1-3.1)
Only among participants not living with a smear-positive person	0.7 \pm 0.3	0.7 \pm 0.3	0.8 (0.5-1.1)
Visited a gathering house	47 (53%)	16 (24%)	3.4 (1.3-8.6)
Lived with smear-positive person^{**}	20 (23%)	1 (1%)	14.0 (2.4-81.8)

Also adjusted for: gender, smoking, annual personal income. Interaction between number of adults per room and living with smear-positive person was significant (p<0.001)

Additional Findings

- *Adjusting for nutrition/diet related variables:*
 - inadequate intake of fruit and vegetables, protein, calories, and carbohydrates
- *Risk of progression to disease:*
 - Associated in invariable, but not multivariable:
 - residing in a newer dwelling
 - smaller living areas (volume less than the median)
 - living with a smear-positive person



Conclusions

- Low air change rates were common, particularly in bedrooms, and overcrowding was also common.
- *Transmission occurred in dwellings: one's own, and also when visiting others' dwellings*
- Increasing adult occupancy associated with increased risk of infection in dwellings where an occupant had smear-positive TB
 - Need to diagnose and treat TB while smear-negative
 - Need to address overcrowding
- We did not identify clinical, epidemiologic, or housing characteristics independently associated with progression to TB disease among infected (TST positive) participants. (87% contacts treated with INH)



Acknowledgments

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