

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

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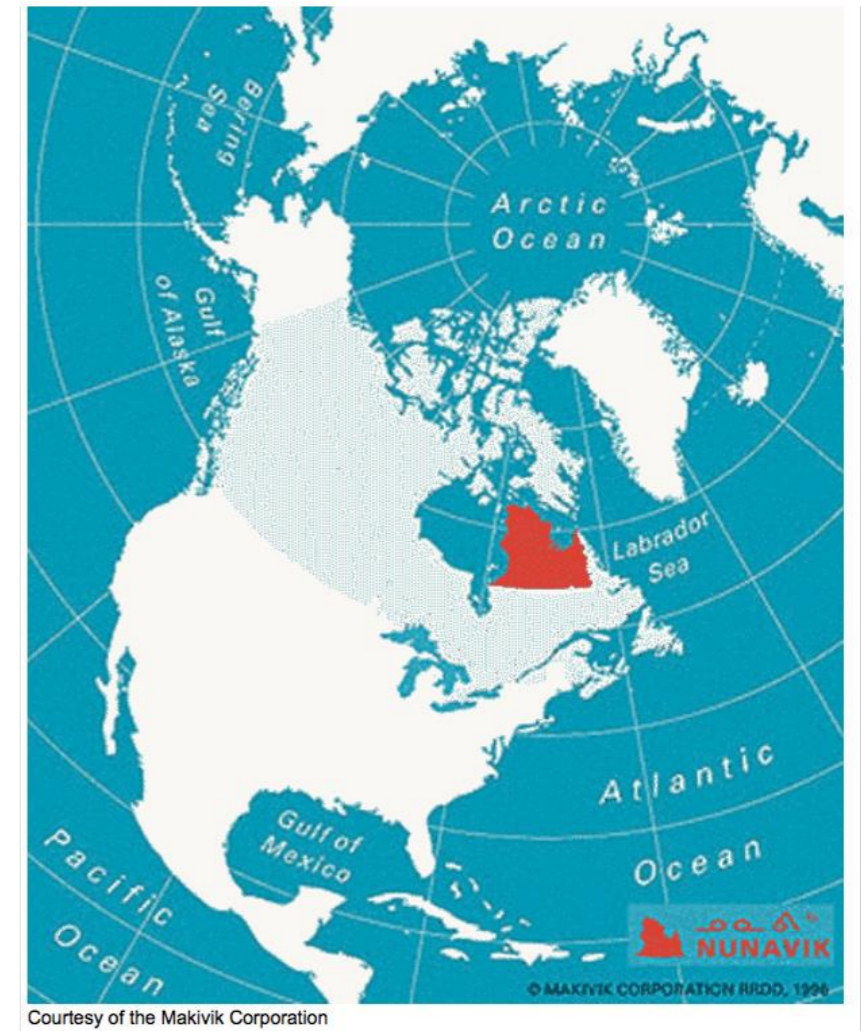
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# Background

- 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

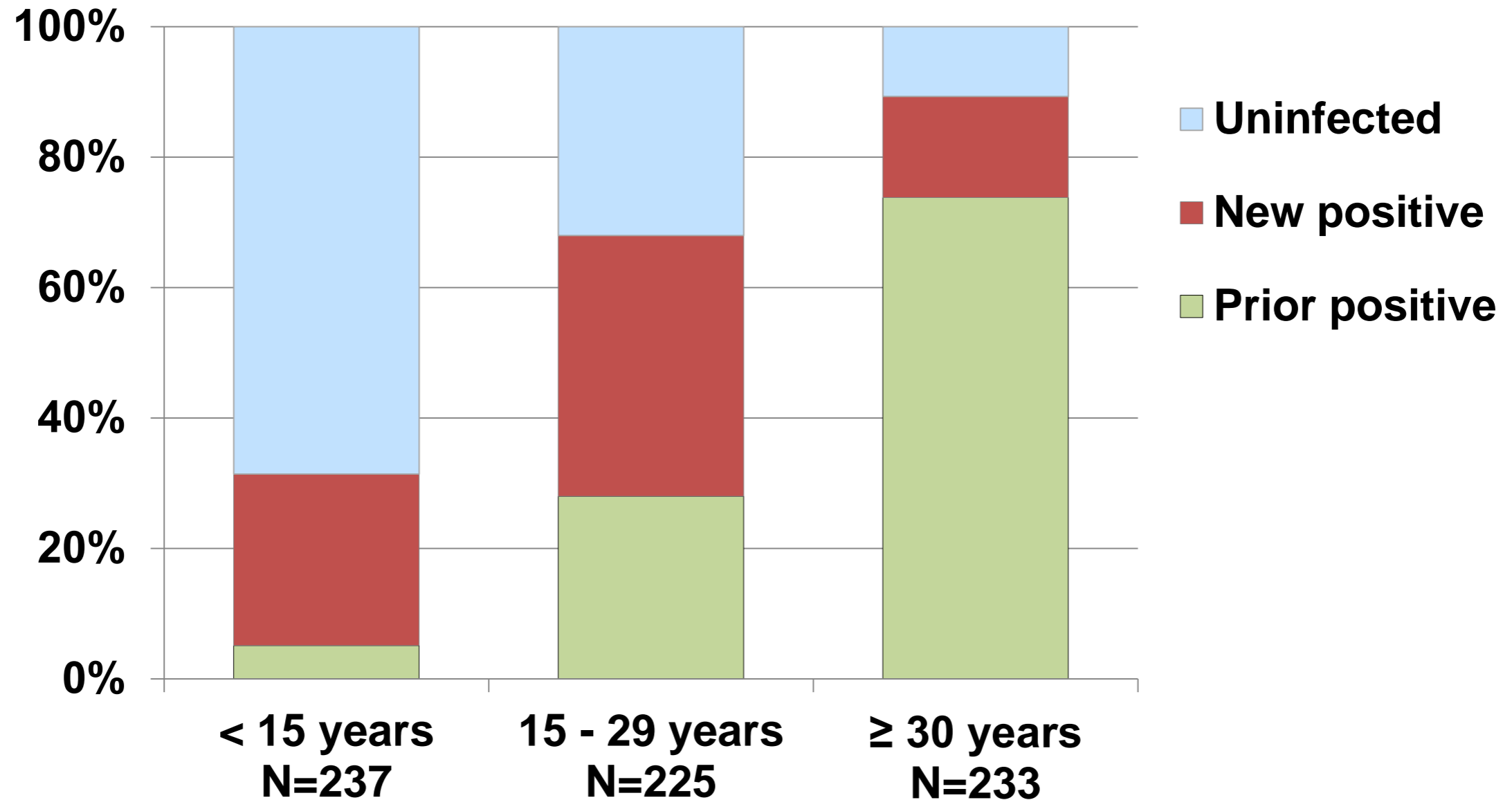


# The Outbreak



- 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

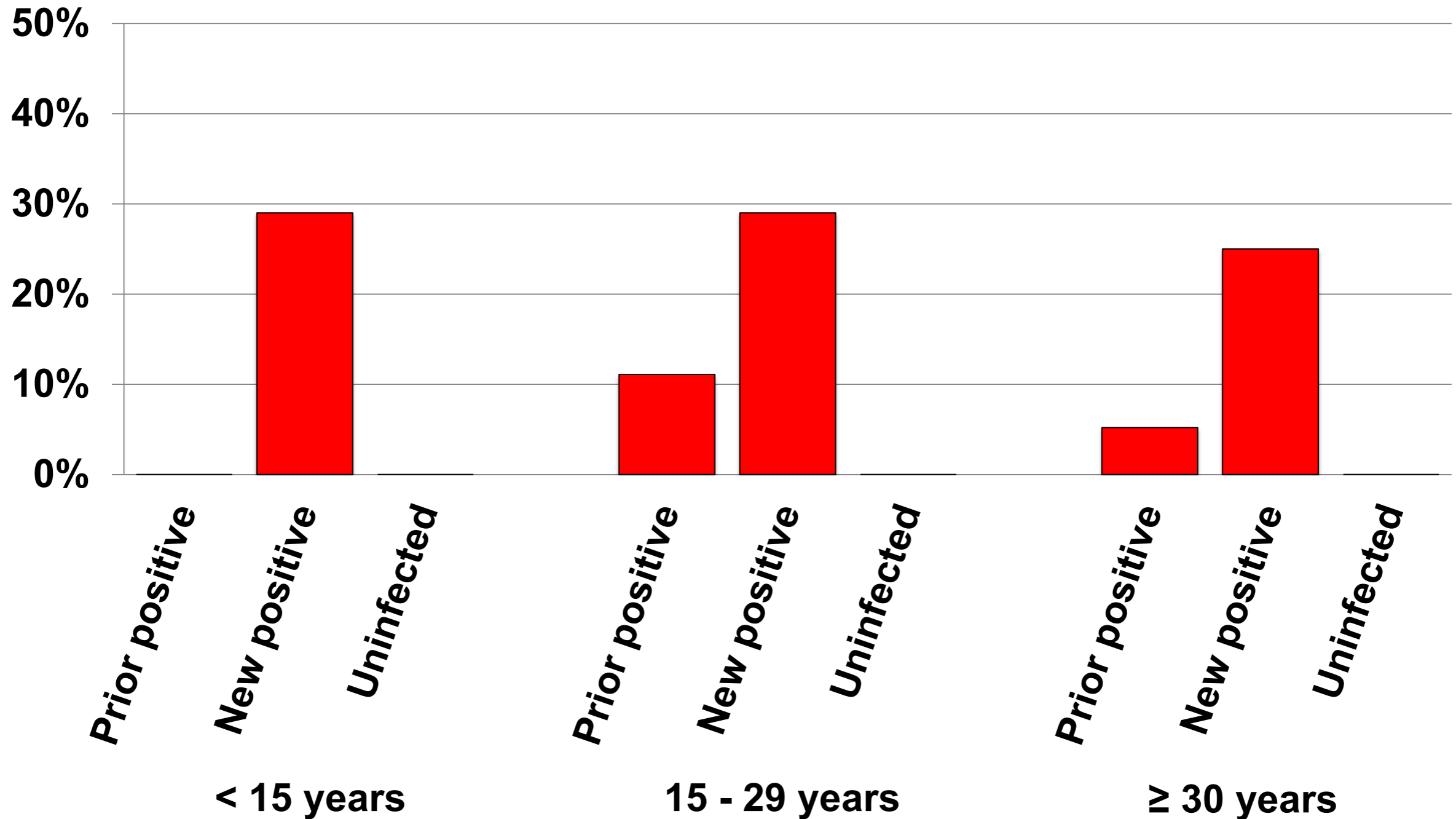


**260 (37%): Uninfected**

**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 CO<sub>2</sub> as tracer gas*



# Results - characteristics of dwellings

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



# Results - characteristics of dwellings

Dwelling characteristic	Summary	
<b><i>Dwelling occupancy</i></b> , 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	
<b><i>Ventilation</i></b>		
Dwellings where ventilation measured, N(%)	53 (67%)	
Air changes per hour (ACH)	<b><i>Living area</i></b>	<b><i>Bedrooms</i></b>
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

<b>Variable</b>	<b>Newly infected, N=88<sup>†</sup></b>	<b>Uninfected, N=67</b>	<b>Multivariable analysis</b>
	<b>N (%) or</b>	<b>Mean (<math>\pm</math> SD)</b>	<b>Adjusted OR (95% CI)</b>
<b>Age</b>			
Under 15 years	30 (34%)	45 (67%)	ref
15-29 years	44 (50%)	17 (25%)	<b>4.4 (1.8-10)</b>
$\geq$ 30 years	14 (16%)	5 (8%)	4.2 (0.8-21.9)
<b><i>Lowest ventilation in living areas<sup>††</sup></i></b>			
> 0.71 ACH	27 (31%)	32 (50%)	ref
$\leq$ 0.71 ACH	61 (69%)	34 (52%)	1.7 (0.6-4.7)
<b><i>Volume of living area<sup>††</sup></i></b>			
> 65.5 m <sup>3</sup>	30 (34%)	25 (38%)	ref
$\leq$ 65.5 m <sup>3</sup>	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 <sup>†</sup>	Uninfected, N=67	Multivariable analysis
Variable	N (%) or Mean ( $\pm$ SD)	Mean ( $\pm$ SD)	Adjusted OR (95% CI)
<b><i>Occupancy<sup>†††</sup>-Number of adults per room:</i></b>			
Only among participants living with a smear-positive person	1.1 $\pm$ 0.5	0.8 <sup>*</sup>	<b>1.8 (1.1-3.1)</b>
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)
<b>Visited a gathering house</b>	47 (53%)	16 (24%)	<b>3.4 (1.3-8.6)</b>
<b>Lived with smear-positive person<sup>**</sup></b>	20 (23%)	1 (1%)	<b>14.0 (2.4-81.8)</b>

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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- Mayor, Village Council, & community members of the affected village

