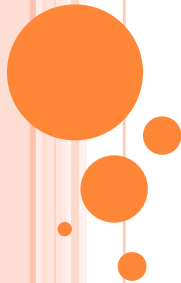


# ***DROWNING MORTALITY IN THE ASIAN TSUNAMI AND CORRELATES OF SURVIVAL***



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## **BACKGROUND**

- At 07.58 in the morning on December 26<sup>th</sup>, 2004, an undersea earthquake occurred 30 km off the western coast of northern Sumatra, Indonesia.
- Registering a magnitude between 9.1 and 9.3 on the modified Richter scale, it had the longest duration of faulting ever observed, between 8.3 and 10 minutes.
- The forces involved were so great they shifted the North Pole several centimeters, and triggered tsunami waves up to 30 meters high that inundated coastlines of countries bordering the Indian Ocean, killing more than 225,000 people in 11 countries.
- In Indonesia, the closest country to the fault line, the tsunami caused an estimated 140,000 deaths

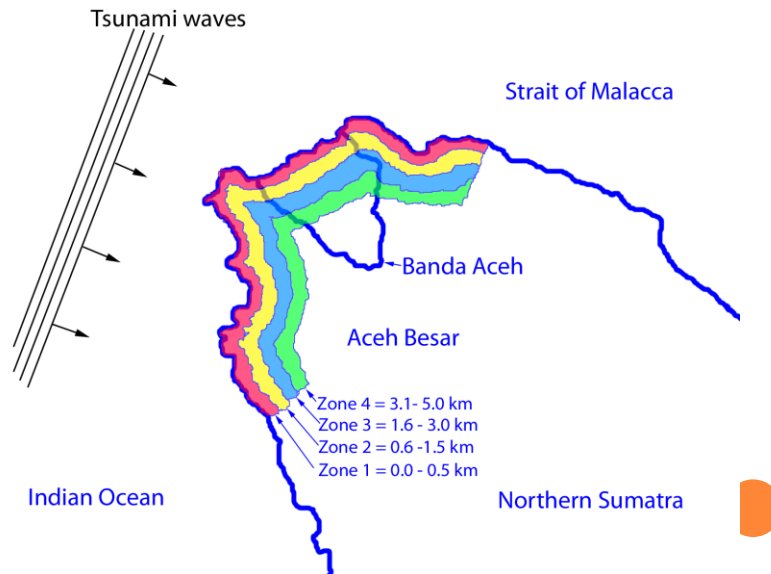
## METHODS

- Conducted Jan-Feb 2006 (13 months afterwards)
- Retrospective cohort design
- 3,568 households (14,299 people) were visited
- Information obtained from Survivors living in temporary housing in 2 areas
  - Banda Aceh City (urban)
  - Aceh Besar District (rural)
- Interviews on the composition of their households on the morning of 26 Dec 2004

## COHORT DESIGN

- Half of the cohort was selected from each area
- Both areas were divided into 4 zones of location during the event, beginning at the coastal area:
  - Zone 1 < 0.5km from the ocean
  - Zone 2 between 0.6 and 1.5 km
  - Zone 3 between 1.6 and 3 km
  - Zone 4 between 3.1 and 5 km
- Increasing distance ~ decreasing physical forces of the Tsunami waves

**Figure: Location of household members during Tsunami by zone, Aceh, Indonesia 2004**



### COHORT DESCRIPTION

		Households		Individuals (all)		Individuals (included)	
		N	%	N	%	N	%
Total		3,568		16,240		14,299	
Area	Banda Aceh	1,809	50.7	8,556	52.7	7,187	50.3
	Aceh Besar	1,759	49.3	7,684	47.3	7,112	49.7
Distance from the coast	<0.5km	872	24.4	3,891	24.0	3,713	26.0
	0.6-1.5km	915	25.6	4,223	26.0	3,820	26.7
	1.6-3km	922	25.8	4,135	25.5	3,546	24.8
	3.1-5km	859	24.1	3,901	24.0	3,220	22.5
Sex	Male			8,107	49.9	7,072	49.5
	Female			8,133	50.1	7,227	50.5
Age	Infants			436	2.7	365	2.6
	Children (1-17)			4,634	28.5	4,076	28.5
	Adults (18+)			11,155	68.7	9,846	68.9

## FIELDWORK

- Ethical Approval & Study Permit obtained
- Questionnaires developed
- Interviewer and supervisor training (local students of Health Polytechnics from Banda Aceh City)
  - Role playing used to standardize interviews and response coding
- Interviews in respondents local language if desired or in bahasa Indonesia
- Informed consent obtained from respondent prior to the interview

## VARIABLES COLLECTED DURING

- **INTERVIEWS**
  - Exposure status (maximum depth and force of water sustained)
  - Injury/death resulting from exposure
  - Demographics (age, sex and role in family)
  - Event exposure (where/how exposed to waves)
  - Individual factors (ability to swim, clothing worn, disabilities, activities, company)
  - Location at the time of exposure (indoors, what level, outdoors)
  - Behavior engaged in while attempting to survive
  - Final location (inside, outside) and outcome (time to death if known, whether body was recovered), affected injuries if survived, aid and medical care received for injuries

## VARIABLES COLLECTED DURING INTERVIEWS

Location: The location at the time of tsunami wave exposure

Individuals inside their houses or another buildings were divided into two categories

- inside, on the ground floor or
- inside, on the upper floor

Those outside are classified into a further four categories

- outside, in vehicle or
- outside, in area that was flooded.
- all other locations and
- unknown, respondent was unsure of their location at the time of the tsunami

## HEIGHT OF WATER

- Over individuals head
- Below shoulder height
- Below waist height
- Below knee height
- Only feet wet
- Unknown

## SWIMMING ABILITY

- Defined as a positive response to the following: “If dressed and falling into a pond 25 meters wide and too deep to stand, could you (or other household member) cross the pond using any method of movement through the water, and get out?”
- Additionally, an individual was categorized as able to swim if their behavior during the tsunami included witnessed swimming (treading water, swimming to a floating object, structure or solid ground).

## OUTCOME

Five outcomes due to Tsunami were possible for each household member:

- Died within 72 hours as a direct result of the tsunami;
- Died from any other cause;
- Injured but survived with a permanent disability;
- Injured but recovered completely or
- Received no injury and survived.

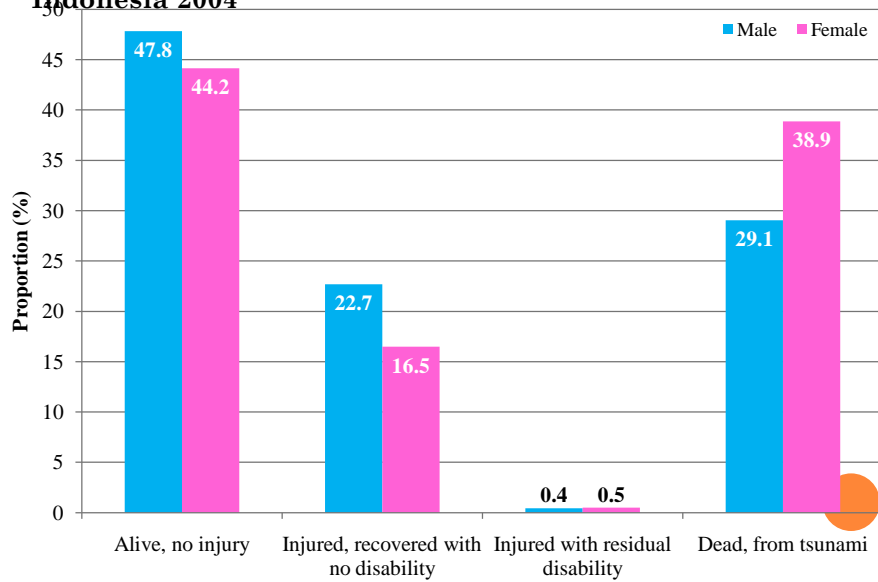
## VARIABLES NOT ASSOCIATED WITH SURVIVAL

- Occupation
- Educational attainment
- Construction materials of household
- Clothing worn

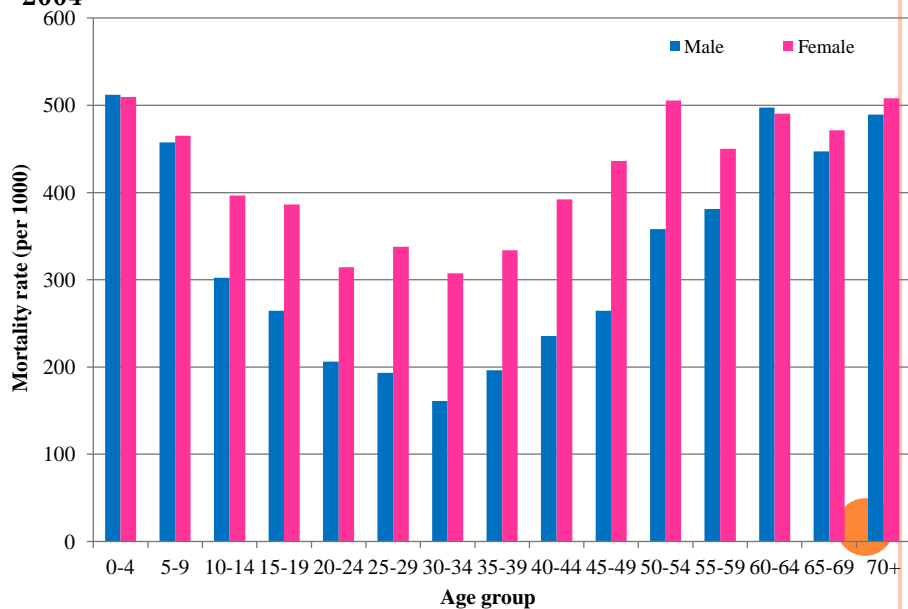
## VARIABLES ASSOCIATED WITH SURVIVAL

- Sex -- male
- Age -- 15 -44 years
- Height of water – not over head
- Being outdoors or on upper floor
- Further distance from shore
- Ability to swim

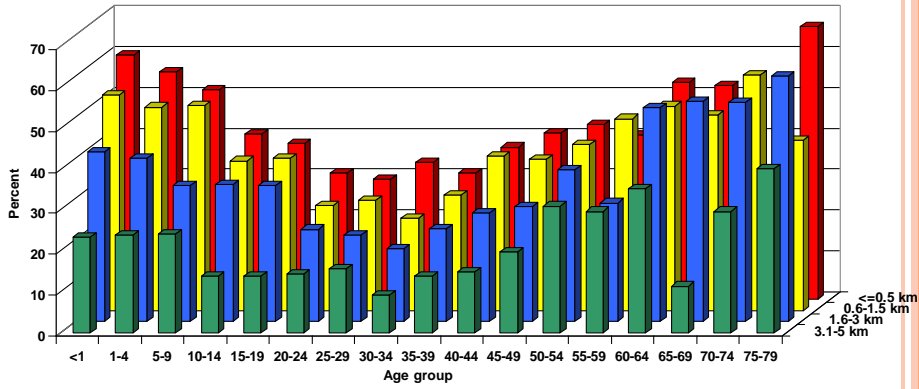
**Figure. Outcome of household members due to Tsunami, Aceh, Indonesia 2004**



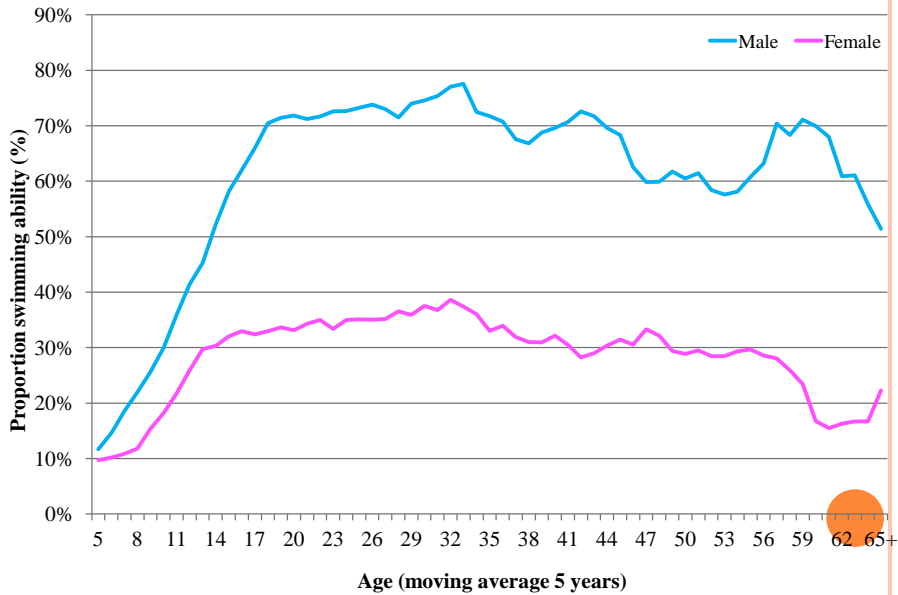
**Figure. Mortality Rate by Age Group and Gender, Aceh, Indonesia 2004**



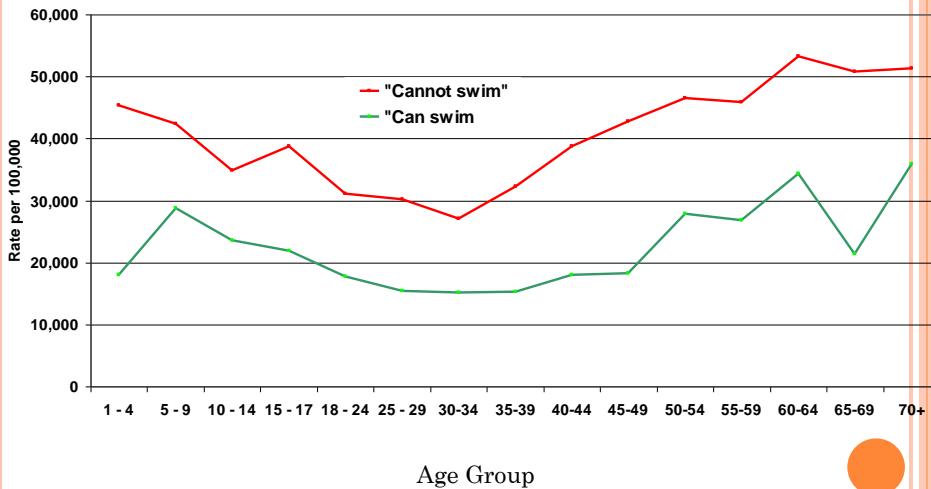
### MORTALITY RATES IN TSUNAMI BY AGE AND DISTANCE TO BEACH



**Figure. Proportion of Swimming Ability by Age Group and Gender, Aceh, Indonesia 2004**



**FIGURE. MORTALITY RATES IN TSUNAMI BY AGE GROUP AND SWIMMING ABILITY, ACEH, INDONESIA 2004**



## CONCLUSIONS

- Mortality in the tsunami was highest in those at the extremes of age, female, indoors at time of submersion and unable to swim
- The modifiable risk factor with the greatest potential for utility in pre-disaster preparation at the population level is swimming ability (increase survival)



**CAM ON**

***TERIMA KASIH***