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2024 Fukushima Medical University International Symposium on the Fukushima Health Management Survey

Secretariat of International Symposium

Office of Public Communications and International Cooperation, Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University

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Build Back Better, Together



2024 Fukushima Medical University International Symposium  
on the Fukushima Health Management Survey

## 3.11: Sharing lessons of Fukushima with Japan and the world

March 2<sup>nd</sup>, 2024

### Session 1-3

# Lessons from 12 years of the Comprehensive Health Check

**SHIMABUKURO Michio, MD, PhD**

Department of Diabetes, Endocrinology, and Metabolism, Fukushima Medical University  
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Center for the Fukushima Health Management Survey, FMU

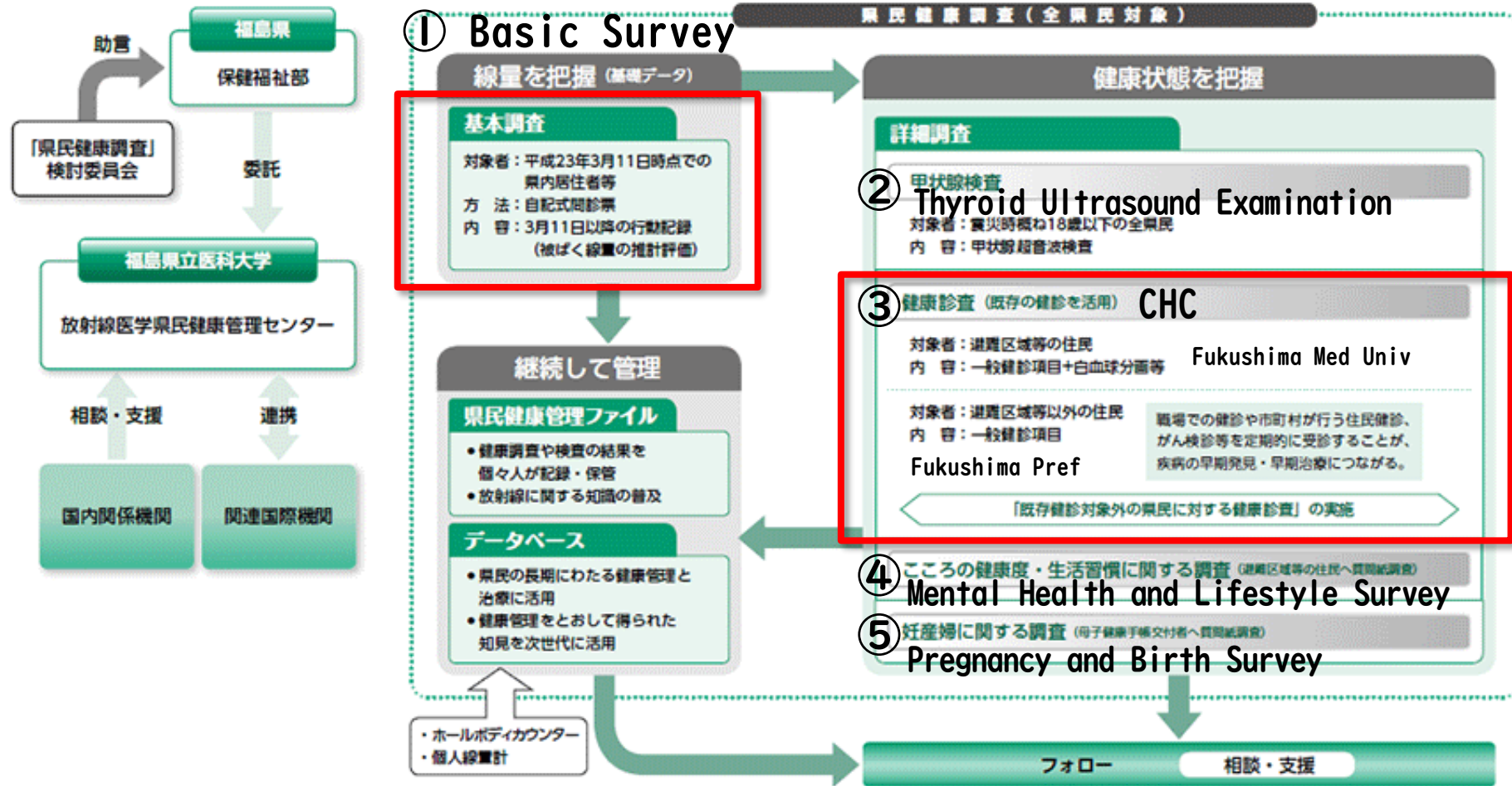
# Topics

**1. Lessons from 12 years of the  
Comprehensive Health Check**

**2. Possible mechanisms**

**3. Future perspective**

# FHMS includes 5 surveys



CHC: Comprehensive Health Check  
 FHMS: Fukushima Health Management Survey

From website of the Radiation Medical Science Center for the Fukushima Health Management Survey, Fukushima Medical University

# Estimated radiation doses & NCD

## Backgrounds

- Basic survey in the FHMS
  - Four months after 2011 Great East Japan Earthquake (GEJE) and the subsequent accidents at the Fukushima Daiichi Nuclear Power Plant (FDNPP) March 11, 2011 to July 11, 2011
  - Estimated radiation doses were determined in all Fukushima residents (Yasumura S et al., 2012)

## Purpose

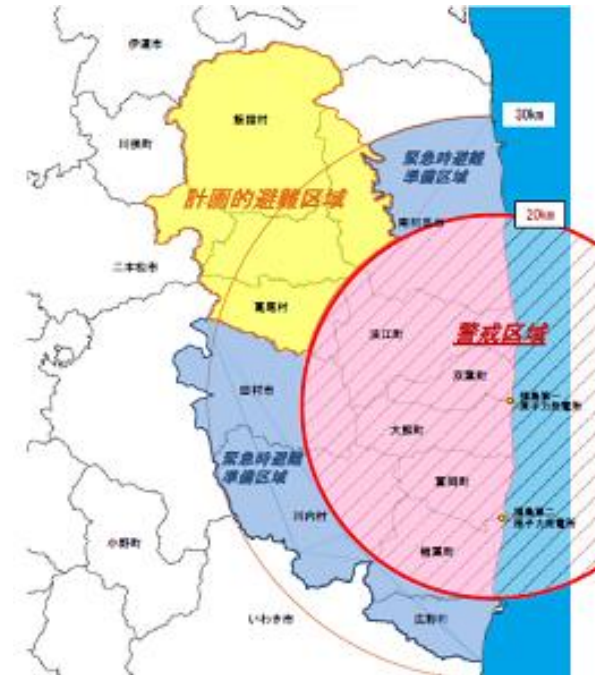
- To determine the relationship between estimated radiation doses and NCD in residents who underwent CHC of the FHMS in 2011
- Sakai et al., J Epidemiol 2022:32 (Suppl\_XII);S84.

CHC: Comprehensive Health Check  
FHMS: Fukushima Health Management Survey  
NCD: Non-communicable diseases

# Methods

- Residents who had lived in the area surrounding FDNPP and were forced to evacuate by government order after the disaster, and those who have received CHC.
- Participants in CHC 2011,  $n=72,869$  (Men 31,982, Women 40,887) ( $\geq 16y$ , 30.9%) 16–84y, 54,087 (Men 22,599, Women 31,488).
- Of the above, 52.5% participated in the Basic Survey. For non-participants, radiation doses were estimated with multiple imputation (age, sex, and areas).
- Residents were categorized to 0-1 ( $\geq 0$  and  $<1$ ), 1-2 ( $\geq 1$  and  $<2$ ), and  $\geq 2$  mSv/y groups.
- With 2011 as a baseline, onsets of NCS from 2012 to 2017 as hazard ratios (95% confidential intervals, CI).
- Hazard ratio (95% CI) were calculated as for 1 mSv/y as reference in a Cox proportional hazards model.

Evacuation zone  
on 2011 April 22,  
Fukushima government HP



CHC: Comprehensive Health Check  
FHMS: Fukushima Health Management Survey  
NCD: Non-communicable diseases

# Results: estimated radiation doses

- Residents who participated in the Basic Survey (obtained estimated radiation doses) (n=28,402, 52.5%)
  - <1 mSv : n=19,238 (67.7%)
  - 1-2 mSv : n=7,089 (25.0%)
  - ≥2 mSv : n=2,075 (7.3%)
- Residents who did not participate in the Basic Survey (47.5%) (calculated estimated doses with multiple imputation)
  - <1 mSv : 67.5%
  - 1-2 mSv : 24.6%
  - ≥2 mSv : 7.9%
- Distribution: a similar tendency between the above two groups
- Analyses were done for the Basic Survey + the non-Basic Survey groups, and the Basic Survey group alone.

## Increased NCD in estimated radiation doses $\geq 2\text{mSv/y}$ group

	Model 1	Model 2a	Model 2b	Model 3	Model 4
Adjusted for	Sex, Age	Sex, Age, BMI	Sex, Age, Evacuation	Sex, Age, BMI, Evacuation	All parameters*
Hypertension	<b>1.29</b> (1.16-1.44)	<b>1.20</b> (1.08-1.33)	<b>1.22</b> (1.09-1.36)	<b>1.13</b> (1.01-1.26)	<b>1.09</b> (0.98-1.22)
Diabetes	<b>1.17</b> (1.02-1.36)	<b>1.06</b> (0.92-1.23)	<b>1.09</b> (0.94-1.27)	<b>1.00</b> (0.86-1.16)	<b>1.01</b> (0.87-1.18)
Dyslipidemia	<b>1.28</b> (1.04-1.57)	<b>1.20</b> (0.98-1.46)	<b>1.19</b> (0.95-1.47)	<b>1.12</b> (0.90-1.39)	<b>1.13</b> (0.91-1.40)
Chronic kidney disease	<b>1.04</b> (0.95-1.13)	<b>1.01</b> (0.92-1.10)	<b>0.99</b> (0.90-1.08)	<b>0.96</b> (0.88-1.06)	<b>1.04</b> (0.95-1.14)
Hyperuricemia	<b>1.16</b> (1.04-1.29)	<b>1.09</b> (0.98-1.22)	<b>1.11</b> (0.99-1.24)	<b>1.05</b> (0.94-1.18)	<b>1.08</b> (0.96-1.20)
Liver dysfunction	<b>1.17</b> (1.06-1.29)	<b>1.13</b> (1.03-1.24)	<b>1.08</b> (0.98-1.19)	<b>1.05</b> (0.95-1.15)	<b>1.06</b> (0.96-1.17)
Polycythemia	<b>1.32</b> (1.02-1.71)				<b>1.07</b> (0.82-1.39)
Anemia	<b>0.88</b> (0.77-1.01)				<b>1.14</b> (0.99-1.31)
Thrombocytopenia	<b>0.95</b> (0.74-1.23)				<b>1.01</b> (0.78-1.32)
Lymphocytopenia	<b>0.91</b> (0.73-1.15)				<b>0.95</b> (0.75-1.20)
Neutropenia	<b>1.08</b> (0.86-1.36)				<b>1.21</b> (0.96-1.53)

Numbers are hazard ratios (95% confidential interval) as values with 1 mSv/y as reference in a Cox proportional hazards model



# Summary

- Estimated doses ( $\geq 2$  mSv/yr) were associated with increased hypertension, diabetes, dyslipidemia, hyperuricemia, liver dysfunction, and polycythemia in an age- and sex-adjusted model. However, the association disappeared after adjustment for evacuation status and lifestyle-related factors.
- It is unlikely that the high estimated radiation doses of the evacuees during the first four months after the accident were directly related to the onset of lifestyle-related diseases.
- Meanwhile, it is presumed that evacuation and lifestyle changes have affected the development of NCD among residents with higher estimated radiation doses.

# Limitations

- Covered population low in the Basic Survey (30%) could not be representative of the population as a whole. However, post-multiple completion data showed the same results.
- Since CHC was initiated several months after the accident, they may not reflect the effects of radiation exposure during the acute phase.
- The maximum follow-up period for this study was 6 years; longer follow-up is needed to determine the true effect of radiation on NCD.
- The effects of diet, physical activity, and psychological stress were not examined in this study.

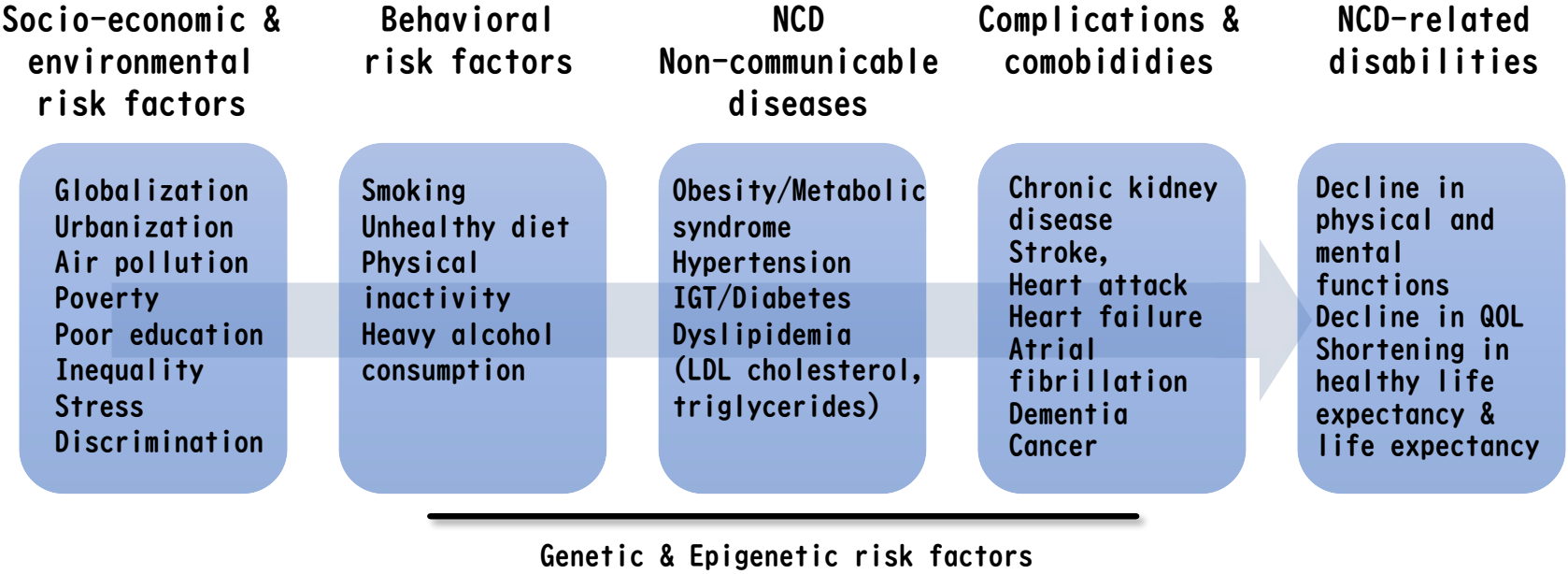
# Topics

1. Lessons from 12 years of the Comprehensive Health Check

2. Possible mechanisms

3. Future perspective

# How NCD Occurs



Dans et al, Lancet 2021:377;680  
 Park et al, <https://bit.ly/3HYhWHC>  
 Modified by Shimabukuro



# NCD after the nuclear accident: what we know in CHC

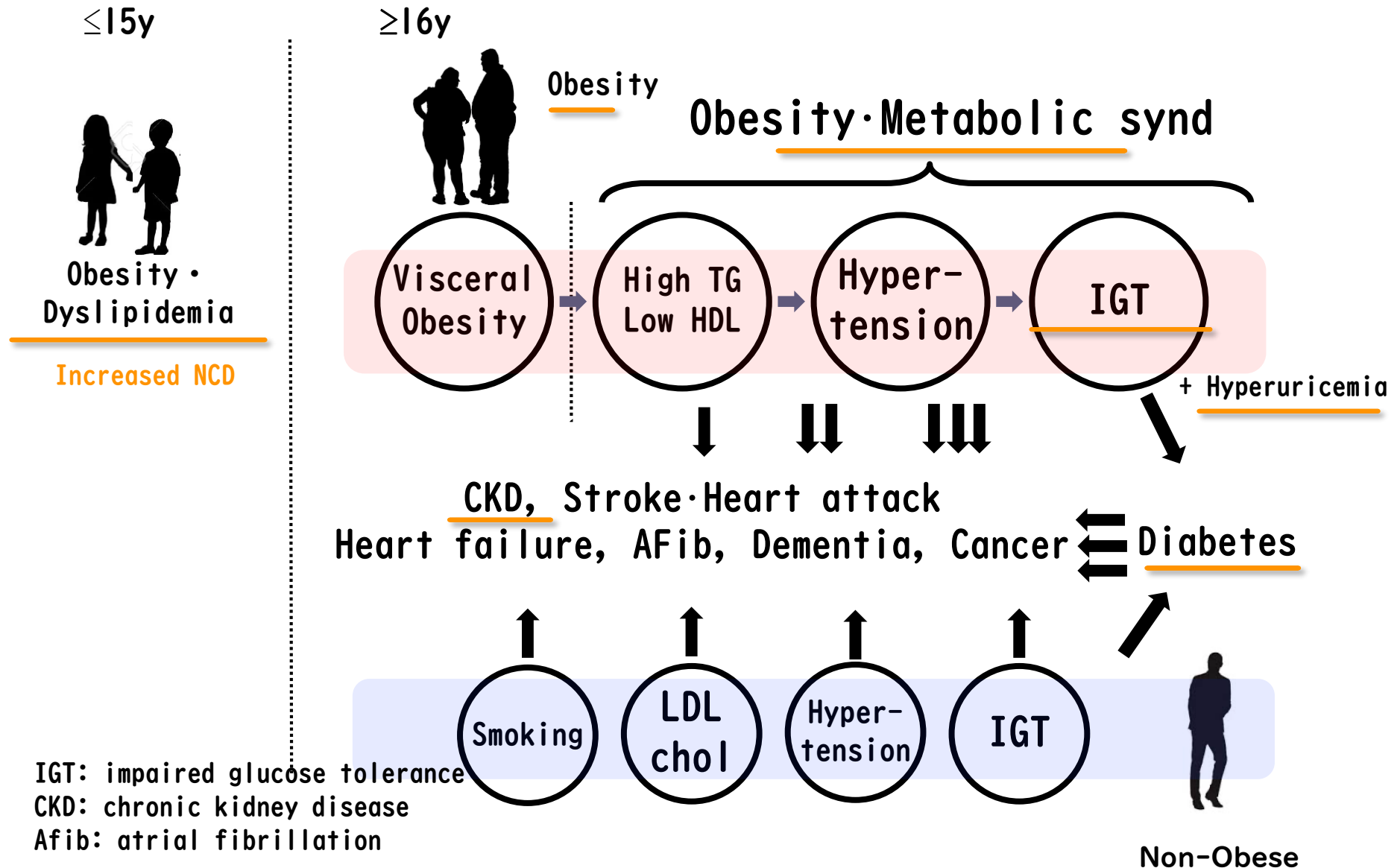
## ≤15y: Children

A certain number of children presented with obesity, dyslipidemia, hyperuricemia, liver dysfunction, hypertension, and IGT. Obesity improved in the follow-up survey, but the improvement of lipid abnormalities in boys was delayed.

## ≥16y

- **Increased**: obesity, metabolic synd, IGT & diabetes, chronic kidney disease, hyperuricemia, and polycythemia
  - **Increased but improved**: blood pressure, LDL-cholesterol (residents under treatment increased), liver dysfunction (decreased due to the improvements of daily physical activity and frequency of breakfast intake)
  - **No changes**: WBC counts and fractions within the evacuated areas: no direct effects observed
- CHC: The Comprehensive Health Checkup  
IGT: impaired glucose tolerance

# Increased NCD after the diaster



IGT: impaired glucose tolerance  
 CKD: chronic kidney disease  
 Afib: atrial fibrillation

Tanabe ... Shimabukuro, Diabetes Res Clin Pract 2021

# Lifestyle- and disaster-related factors and NCD risk:

CHC ≥40y, men 10,120, women 13,961

↑ increase, ↓ decrease, empty not significant, - not analyzed	obesity		leanness		Hyper-tention		Diabetes mellitus		Dyslipi-demia		Liver dysfunction		CKD	
	M	W	M	W	M	W	M	W	M	W	M	W	M	W
Aging		↑	↑	↓	↑	↑	↑	↑		↑	↓	↑	↑	↑
Obesity	-	-	-	-	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Leanness	-	-	-	-	↓	↓		↓	↓	↓				
Excercise ≥ 2x/w									↓		↑			
Sleep satisfaction								↓						
EtOH < 40g/d			↓		↑			↓	↓	↓				
EtOH ≥ 40g/d					↑	↑			↓		↑	↑	↓	
Current smoking			↑	↑			↑		↑					
Evacuation		↑			↑				↑	↑	↑	↑		
Change of jobs	↑		↓	↓			↑		↑		↑			
Depressive symptoms											↑	↑		
PTSD symptoms														
Radiation concerns	↑													
Participation in recreation	↓		↓								↓			↑

Based on the report submitted to the 41st Prefectural Oversight Committee Meeting for the FHMS

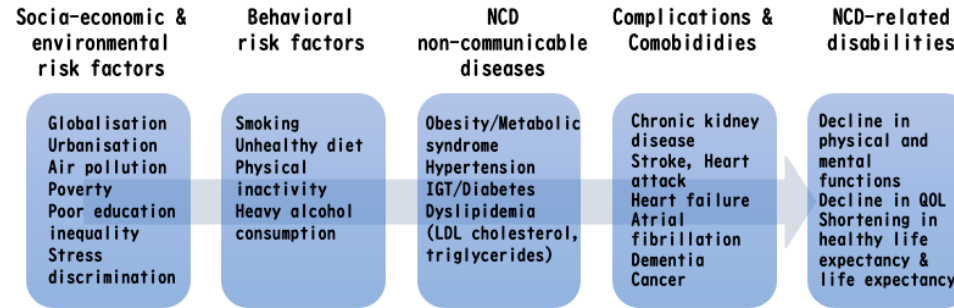
# Topics

1. Lessons from 12 years of the Comprehensive Health Check
2. Possible mechanisms
3. Future perspective

# NCD : Who and how to prevent it

## How NCD Occurs

NCD: Non-communicable diseases



Dans et al, Lancet 2021:377:680  
 Park et al, <https://bit.ly/3HYhWHC>  
 Modified by Shimabukuro

Genetic & Epigenetic risk factors

### Global level

UN, WHO

- Health policy development and implementation
- Supporting NCD research
- Monitoring of NCD
- Support for national and international cooperation

### Country level

Government, Ministry

- Budget for health promotion system (health screening opportunities)
- Research support
- Develop sustained primary health care system

### Community level

Local government, community, workplace, school, non-governmental organization (NPO, NGO)

- Offer healthy food
- Offer places and times for physical activity
- Creating systems to support NCD prevention and care services

### Individual level

Individual, Family

- Healthy lifestyle
- Health literacy

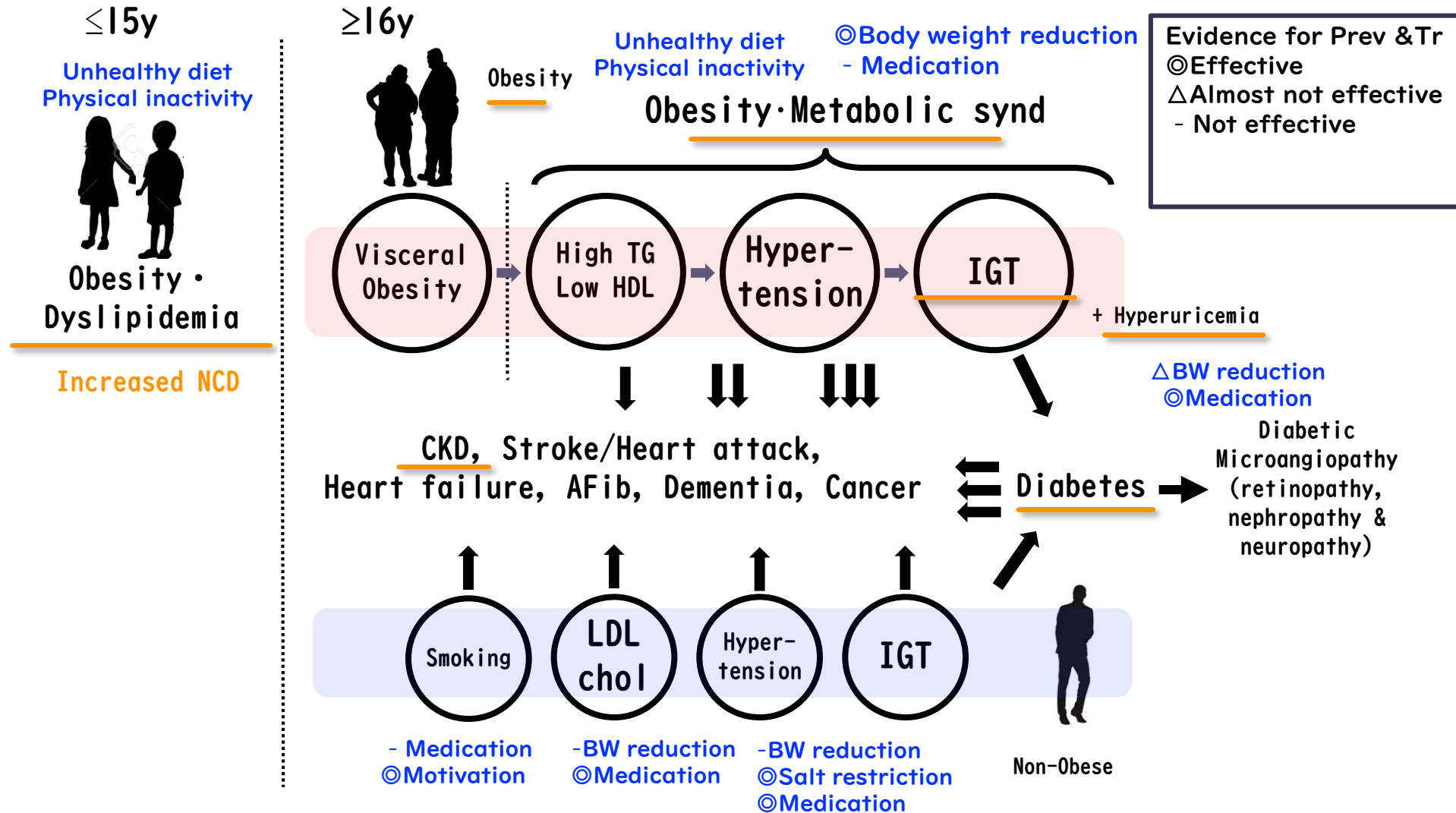
## Role of CHC

Budreviciute et al. Front Public Health 2020:574111 Modified by Shimabukuro (Private opinion)

CHC: Comprehensive Health Check



# Increased NCD after the disaster : Evidence for Prevention and Treatment Scientifically proven facts



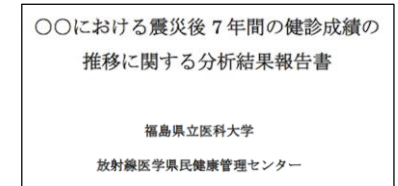
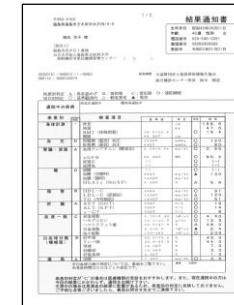
IGT: impaired glucose tolerance  
CKD: chronic kidney disease  
Afib: atrial fibrillation

# Role of CHC in 10 years summary

Reports of the 41st Prefectural Monitoring Committee Meeting for FHMS 2011-2019

1. Provide opportunities for health checkups
  - Secure the physical and mental health of residents who experienced major changes in their living environment after the earthquake.
  - Opportunities to receive checkups for people between 16-39y, who have few opportunities by current health policy.
2. Close cooperation with municipalities
  - **Sharing of residents health information** via planning of health events and reports conference
3. Analysis of factors associated with physical and mental health after the earthquake
  - Clarification and sharing of factors associated with physical and mental health
  - Academic papers: 48 Accepted thesis, 48 Submitted thesis (as of Jan, 2024)
4. Impacts of feedback from CHC
  - **An improvement in some risks** (blood pressure and LDL cholesterol levels) due to increased health awareness, corrected lifestyle, and higher treatment rates
  - The results of health checkups were used for **municipal health policy**
5. Proposal from CHC
  - **Proposal** made to municipalities and local residents on the importance of (1) physical activity and healthy diet, (2) mental health care, and (3) promotion of social participation.

## Notification of individual results



## Preparation and sharing of analysis reports

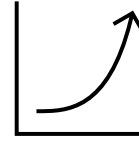


Health seminar

Fiscal Year	Numbers	Visitors
2016	3 M 11 times	495
2017	6 M 42 times	2,379
2018	6 M 26 times	2,324
2019	6 M 38 times	3,334
2020	3 M 17 times	1,432
2021	3 M 18 times	1,642
2022	4 M 25 times	2,028
2023 (Until the end of Dec.)	5 M 47 times	2,157

# Summary

take home message



## 1. Lessons from 12 years of the Comprehensive Health Check

- Increased in adult, partially in children: **obesity, metabolic synd, IGT & diabetes, chronic kidney disease, hyperuricemia, and polycythemia.**
- Estimated doses were associated with increased NCD → Presumably, evacuation and lifestyle changes may have affected the development of NCD among residents with higher estimated radiation doses.

## 2. Possible mechanisms

- After the accident, evacuation and lifestyle changes → unhealthy diet, physical inactivity, and smoking & drinking → mental problems → obesity accompanying NCD are increasing.

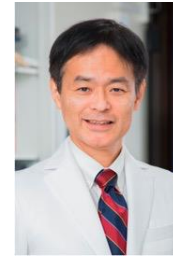
NCD: Non-communicable diseases

## 3. Future perspective

- Individuals and communities to learn **true health literacy (=evidence)** and commit evidence-based prevention and treatment of NCD.
- Sharing information among individuals, communities, municipalities, prefectures, countries, and global



Thank you for your attention



Fukushima Medical University gardens  
photos by Shimabukuro

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