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2023年 福島県立医科大学『県民健康調査』国際シンポジウム
公立大学法人福島県立医科大学放射線医学県民健康管理センター
国際シンポジウム事務局(広報・国際連携室)

✉ kenkani@fmu.ac.jp Tel: 024-581-5454(平日9～17時)

2023 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

✉ kenkani@fmu.ac.jp, TEL: +81-24-581-5454 (Weekday, 9a.m. - 5 p.m. JST)

ともに考える福島の健康・暮らし・未来

2023(令和5)年 **参加無料・同時通訳有**
3月4日(土) 開会9:00~16:30
(開場・受付開始8:30~)

10:10-13:30 セッション1 科学的エビデンスから私たちの健康を考える (お昼休憩あり)

座 長: 大平哲也 (福島県立医科大学)、石川徹夫 (福島県立医科大学)

基調講演: キャリー・キタハラ (米国国立がん研究所)

講 演: 志村浩己 (福島県立医科大学)、島袋充生 (福島県立医科大学)、前田正治 (福島県立医科大学)、安田 俊 (福島県立医科大学)

Evidence on non-communicable diseases: Lessons from the Fukushima Health Management Survey

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Office of the Comprehensive Health Check and Health Promotion, Radiation Medical Science
Center for the Fukushima Health Management Survey, FMU

Agenda

**1. NCD after the nuclear accident:
what we know**

2. Estimated radiation dose & NCD

3. Possible mechanisms & prevention

NCD: Non-communicable diseases

NCD after the nuclear accident: what we know in CHC

≤15y: Children

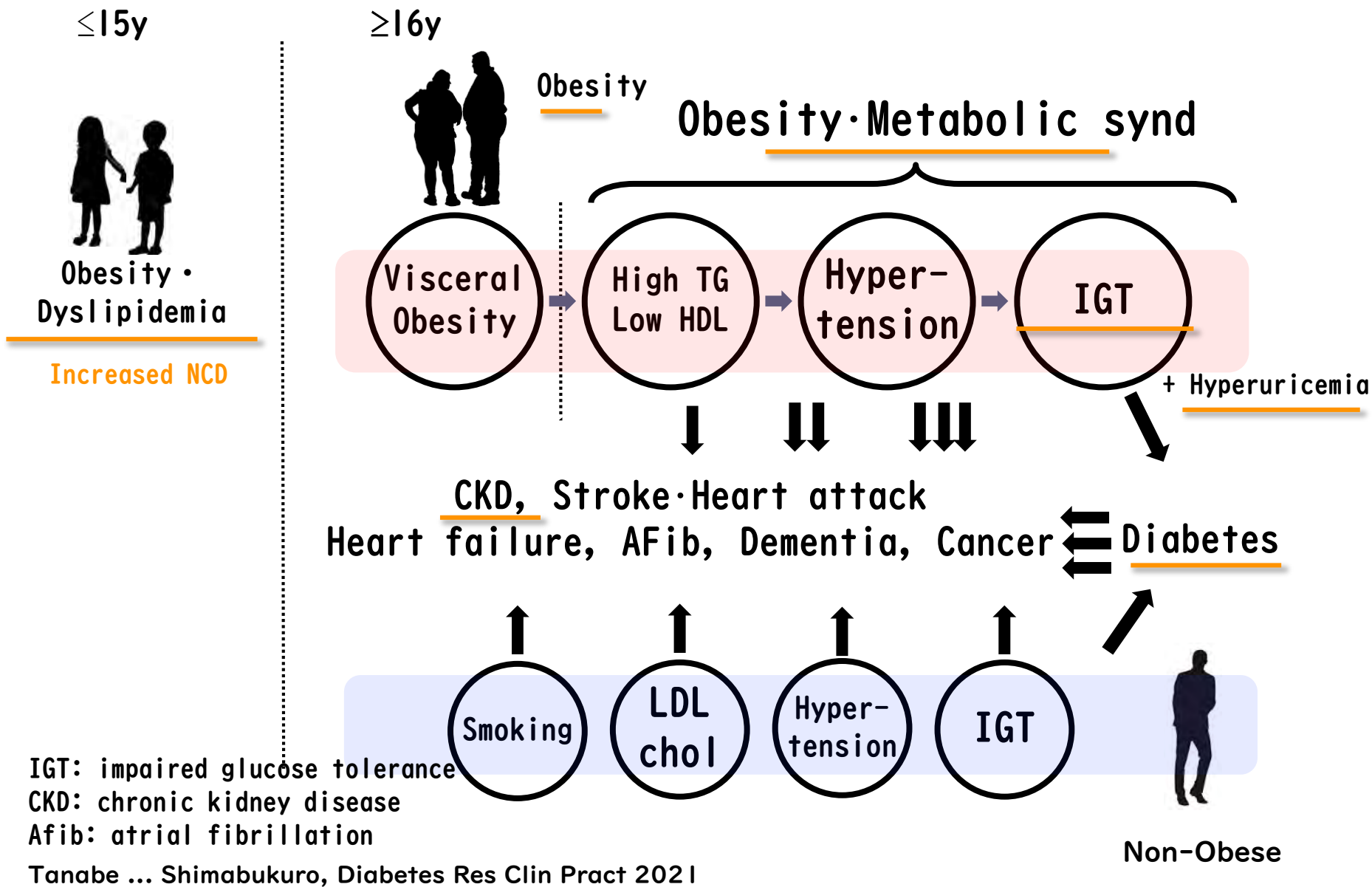
A certain number of children presented with obesity, dyslipidemia, hyperuricemia, liver dysfunction, hypertension, and IGT. Obesity improved in the follow-up survey, but the improvement of lipid abnormalities in boys was delayed.

≥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



Agenda

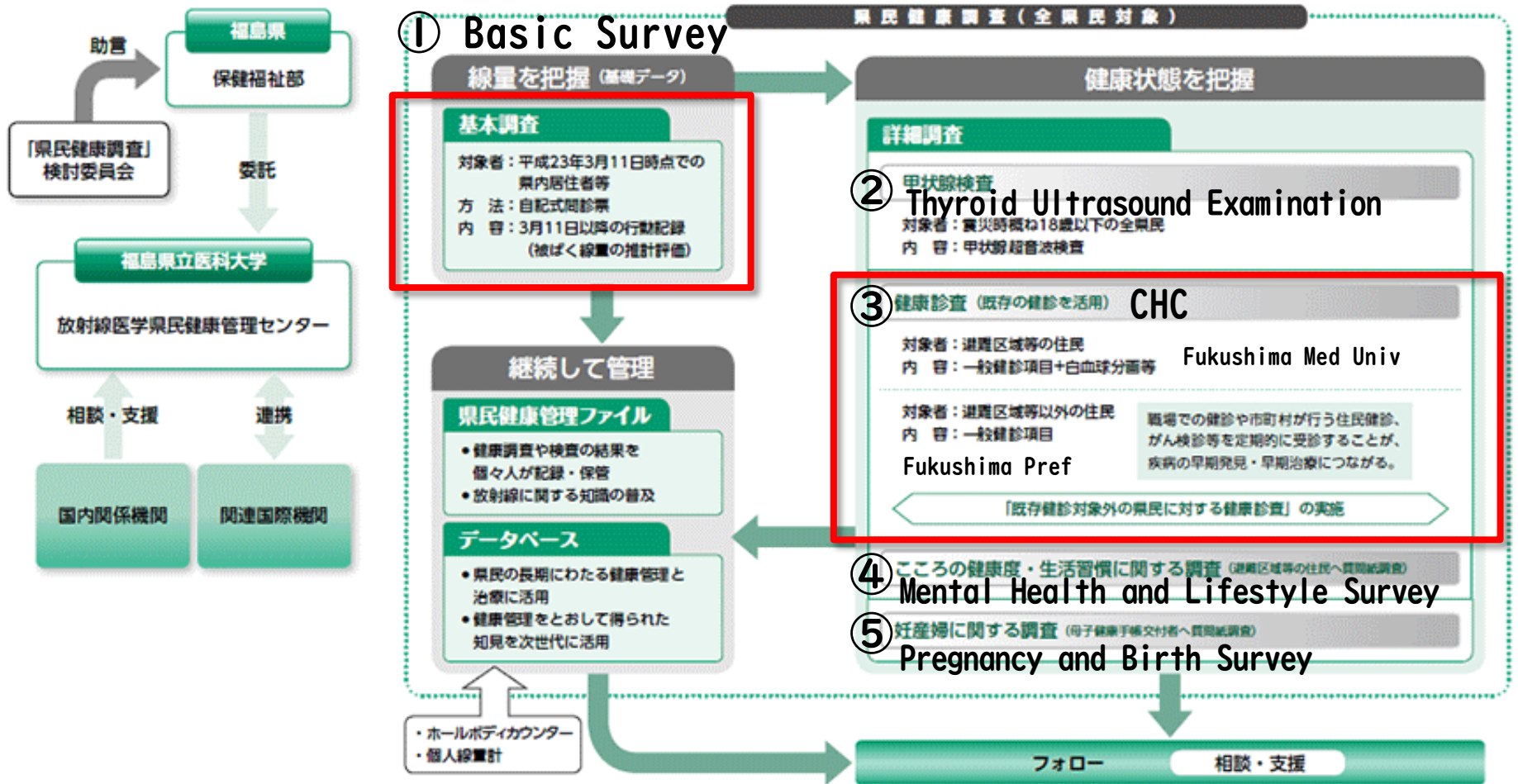
1. NCD after the nuclear accident:
what we know

2. Estimated radiation dose & NCD

3. Possible mechanisms & prevention

NCD: Non-communicable diseases

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 dose & NCD

Backgrounds

- Basic survey in the Fukushima Health Management Survey
 - 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 dose and NCD in residents who underwent CHC of FHMS in 2011
- Sakai et al, J Epidemiol 2022:32 (Suppl_XII);S84.

CHC: Comprehensive Health Check

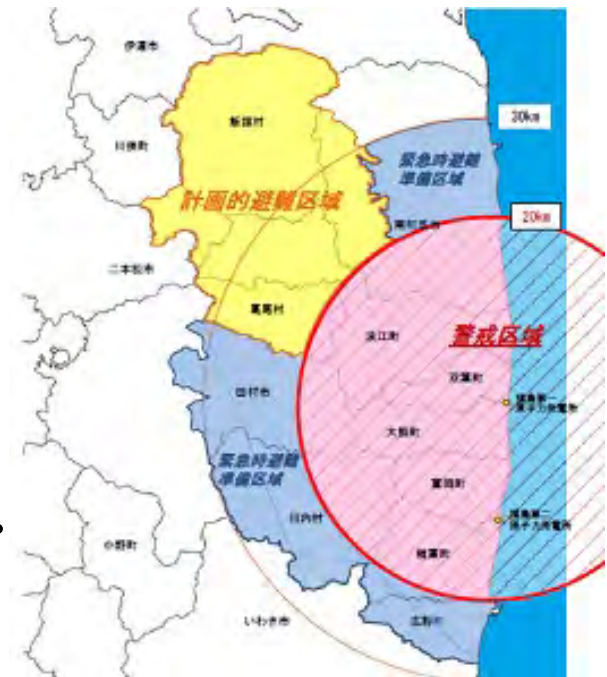
FHMS: Fukushima Health Management Survey

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) (≥ 16 y, 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 (≥ 0 and < 1), 1-2 (≥ 1 and < 2), and ≥ 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 dose

- Residents who participated in the Basic Survey (obtained estimated radiation doses)(n=28,402、 52.5%)
 - 0-1 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 participated in the Basic Survey(47.5%)(calculated estimated doses with multiple imputation)
 - 0-1 mSv : 67.5%
 - 1-2 mSv : 24.6%
 - ≥2 mSv : 7.9%
- Distribution: a similar tendency between the above two group
- Analyses were done for the Basic Survey + the non-Basic Survey groups, and the Basic Survey group alone.

Increased NCD in estimated radiation dose $\geq 2\text{mSv/y}$ 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	1.29 (1.16-1.44)	1.20 (1.08-1.33)	1.22 (1.09-1.36)	1.13 (1.01-1.26)	1.09 (0.98-1.22)
Diabetes	1.17 (1.02-1.36)	1.06 (0.92-1.36)	1.09 (0.94-1.27)	1.00 (0.86-1.16)	1.01 (0.87-1.18)
Dyslipidemia	1.28 (1.04-1.57)	1.20 (0.98-1.46)	1.19 (0.95-1.47)	1.12 (0.90-1.39)	1.13 (0.91-1.40)
Chronic kidney disease	1.04 (0.95-1.13)	1.01 (0.92-1.10)	0.99 (0.90-1.08)	0.96 (0.88-1.06)	1.04 (0.95-1.14)
Hyperuricemia	1.16 (1.04-1.29)	1.09 (0.98-1.22)	1.11 (0.99-1.24)	1.05 (0.94-1.18)	1.08 (0.96-1.20)
Liver dysfunction	1.17 (1.06-1.29)	1.13 (1.03-1.24)	1.08 (0.98-1.19)	1.05 (0.95-1.15)	1.06 (0.96-1.17)
Polycythemia	1.32 (1.02-1.71)				1.07 (0.82-1.39)
Anemia	0.88 (0.77-1.01)			*age, sex, current smoking, binge drinking, evacuation, hypertension, diabetes, dyslipidemia, and blood biochemical parameters at baseline	1.14 (0.99-1.31)
Thrombocytopenia	0.95 (0.74-1.23)				1.01 (0.78-1.32)
Lymphocytopenia	0.91 (0.73-1.15)				0.95 (0.75-1.20)
Neutropenia	1.08 (0.86-1.36)				1.21 (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 (>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.

Limitation

- 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.

Agenda

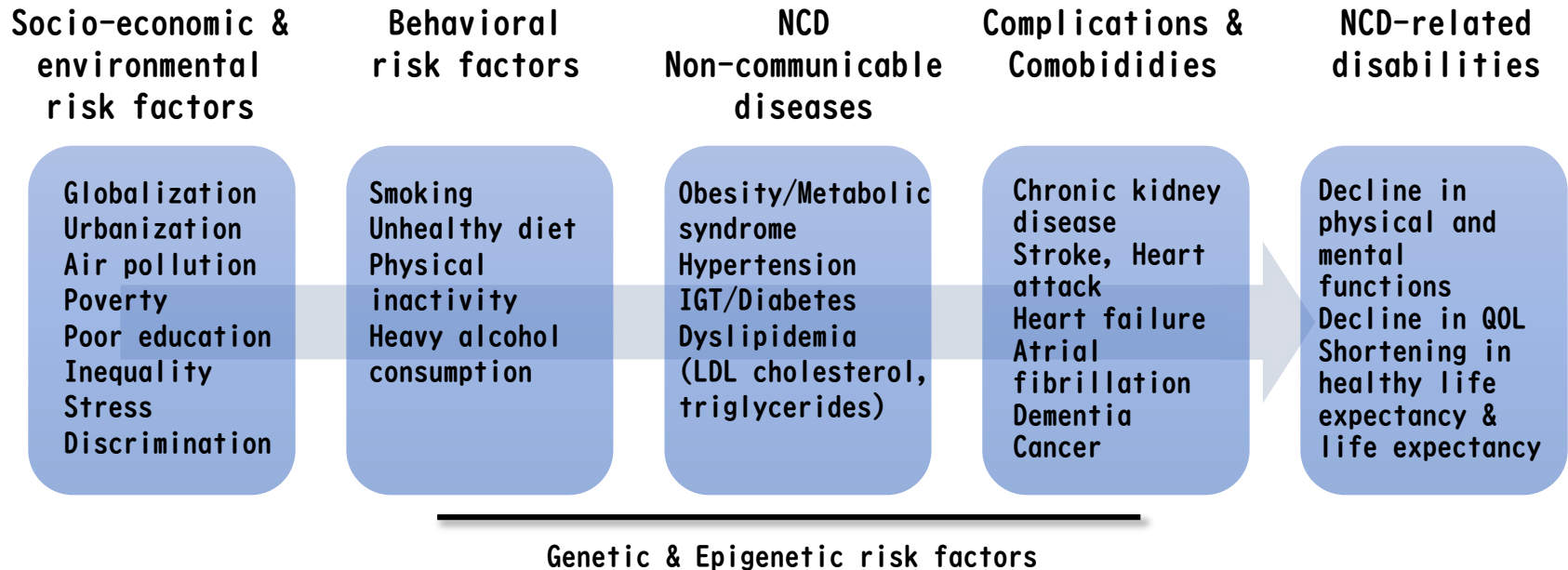
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what we know

2. Estimated radiation dose & NCD

3. Possible mechanisms & prevention

NCD: Non-communicable diseases

How NCD Occurs



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

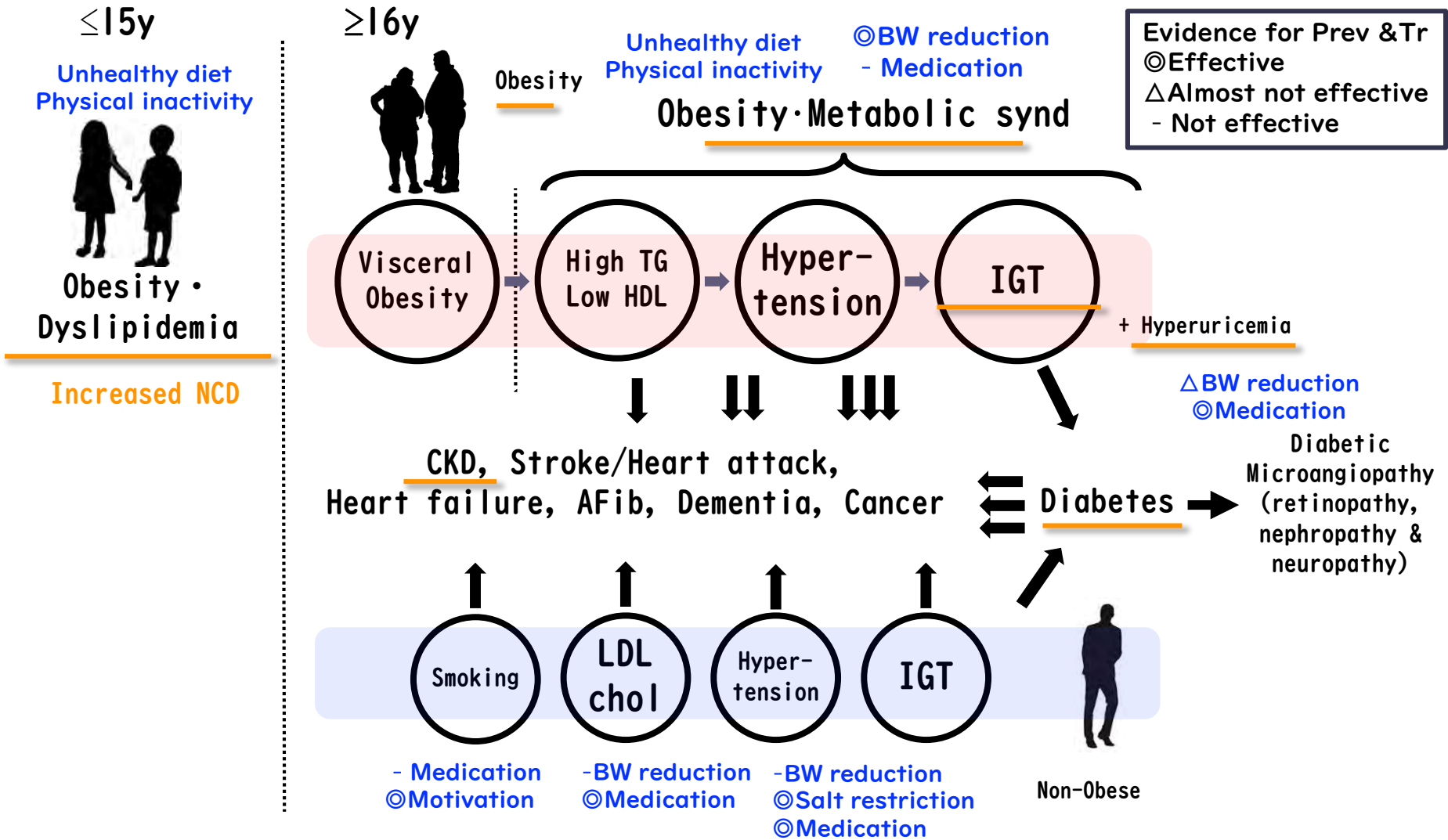


Lifestyle- and disaster-related factors and NCD risk: CHC 7y ≥40y, men 10,120, women 13,961

↑ 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								↓						
E+OH < 40g/d			↓		↑			↓	↓	↓				
E+OH ≥ 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 Monitoring Committee Meeting for Fukushima Health Management Survey

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



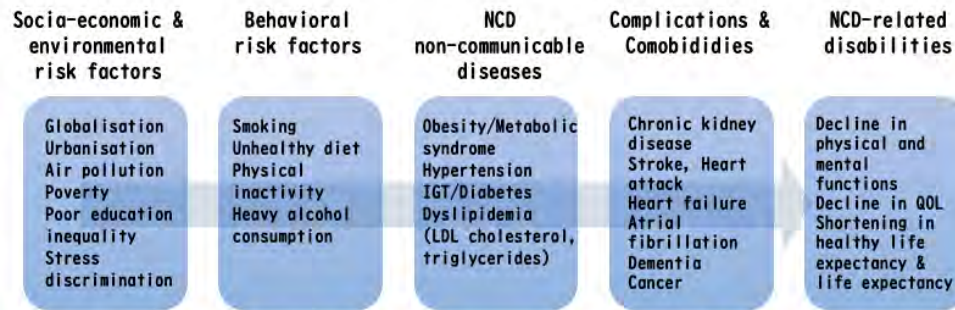
Evidence for Prev & Tr
⊙Effective
ΔAlmost not effective
- Not effective

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

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

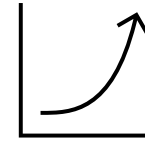
Role of CHC

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

CHC: Comprehensive Health Check

Summary

take home message



1. NCD after the nuclear accident

- Increased in adult, partially in children: **obesity, metabolic synd, IGT & diabetes, chronic kidney disease, hyperuricemia, and polycythemia.**

2. Estimated radiation dose & NCD

- 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.

3. Possible mechanisms & Prevention

- After the accident, **evacuation and lifestyle changes** → unhealthy diet, physical inactivity, and smoking & drinking → mental problem → obesity accompanying NCD are increasing.
- **Individuals** (> community, country, and global) learn true health knowledge (=evidence) and commit evidence -based prevention and treatment of NCD.

NCD: Non-communicable diseases

Thank you for your attention



**Fukushima Medical University gardens
photos by Shimabukuro**

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