# Suboptimal Health

## predicts the risk of non-communicable disease in the general population


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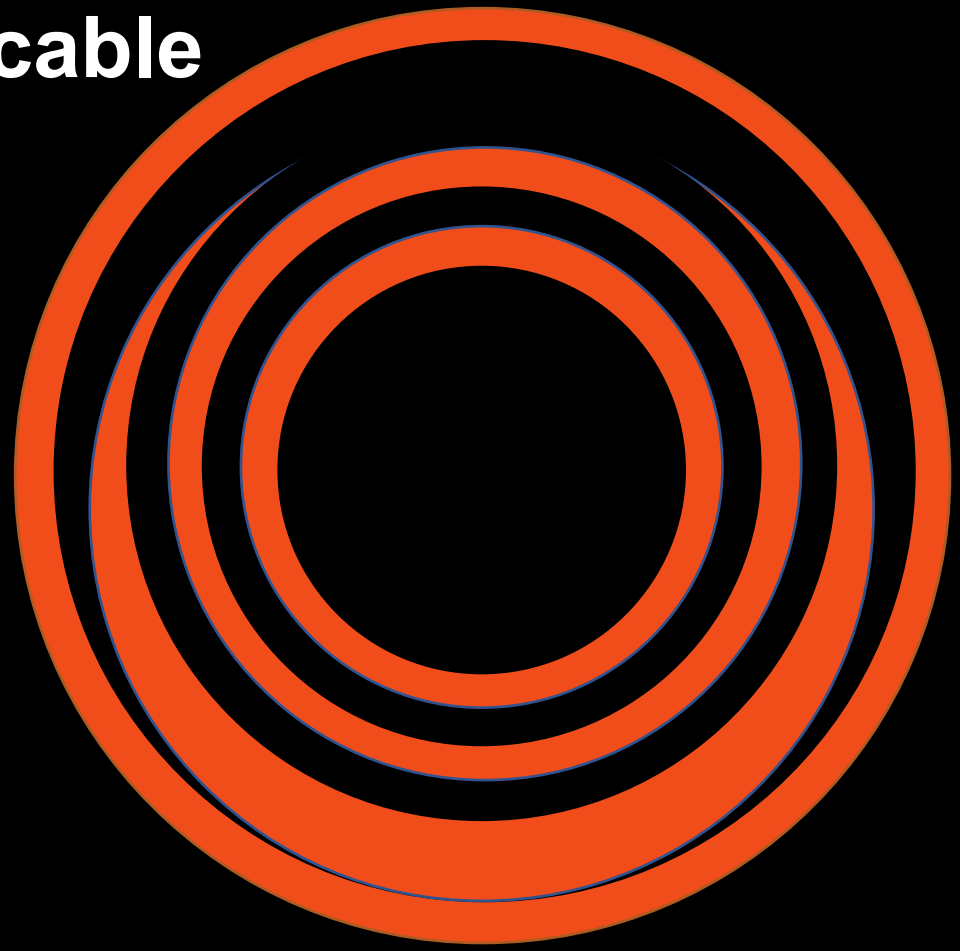


# Declaration of Interest

We, the authors, have no potential conflict of interests and nothing to disclose.

# Take home messages

- Suboptimal Health Status is the physical state between health and disease, and is considered a reversible stage of pre-chronic disease.
- The Suboptimal Health Status questionnaire (SHSQ-25) is a reliable tool to detect suboptimal health.
- Assessment of Suboptimal Health Status, via the SHSQ-25, predicts the risk of developing chronic diseases, providing health professionals with a unique window of opportunity for early interventions prior to disease onset.

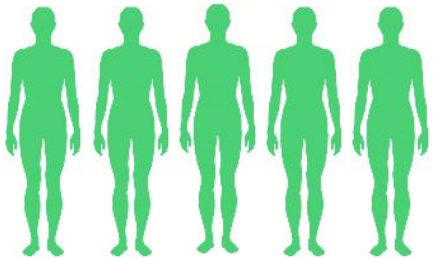
# Health

*"A state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity".*

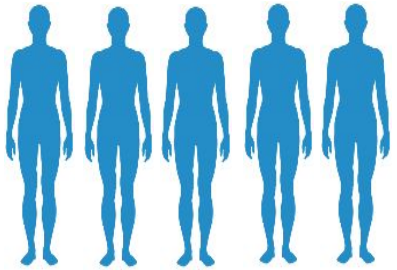
World Health Organization

# Suboptimal health status (SHS) is the physical state between health and disease

**Ideal health**

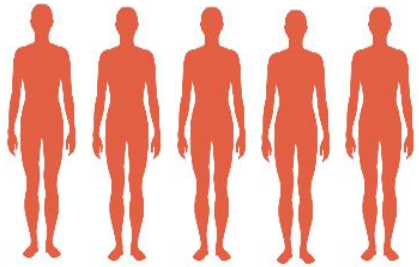


**High risk**
(Suboptimal Health Status)



PATENTED

**Chronic Diseases**

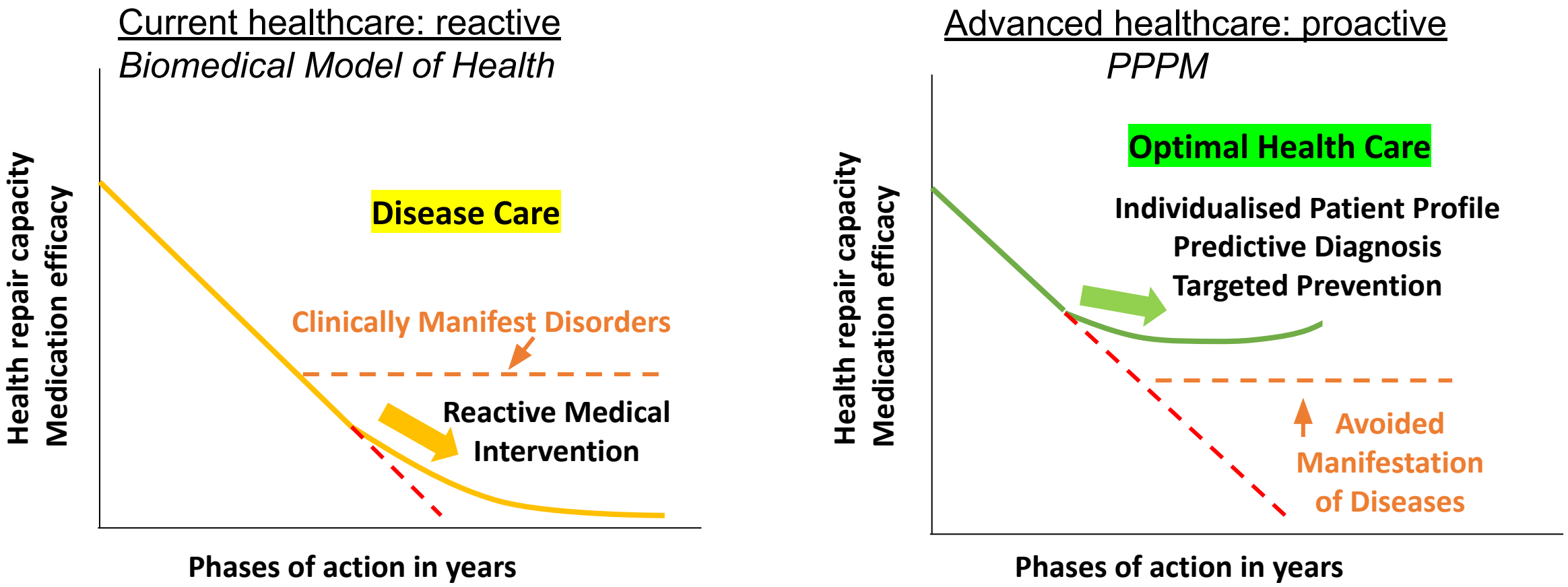


Wang et al, EPMA J, 2021

Yan et al, J Epidemiol, 2009

# Suboptimal health: a paradigm shift from reactive to proactive healthcare

## Suboptimal Health provides a unique window of opportunity to prevent chronic disease



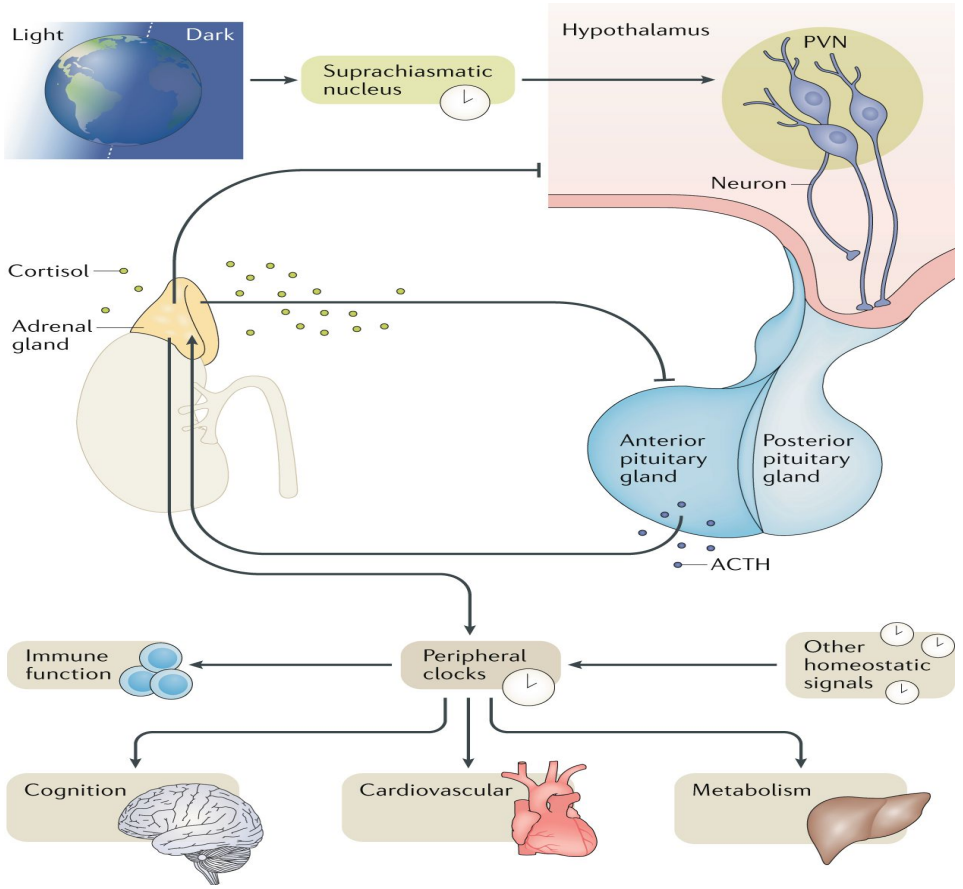

Golubnitschaja … Wang et al., EPMA J 2016

**Research has identified stress as a key factor contributing to suboptimal health.**

Pathophysiological response: Neuroendocrine responses activated by the Hypothalamic- Pituitary-Adrenal (HPA)

Chronic stress: processes become maladaptive and can lead to disease

- Direct pathway: Effects of cortisol, CRP, IL-6
- Indirect pathway: Unhealthy diet, physical activity, alcohol and tobacco use




Yan et al, J Epidemiol 2009

Russell & Lightman, Nature Reviews, 2019

# Development of an instrument for measuring SHS

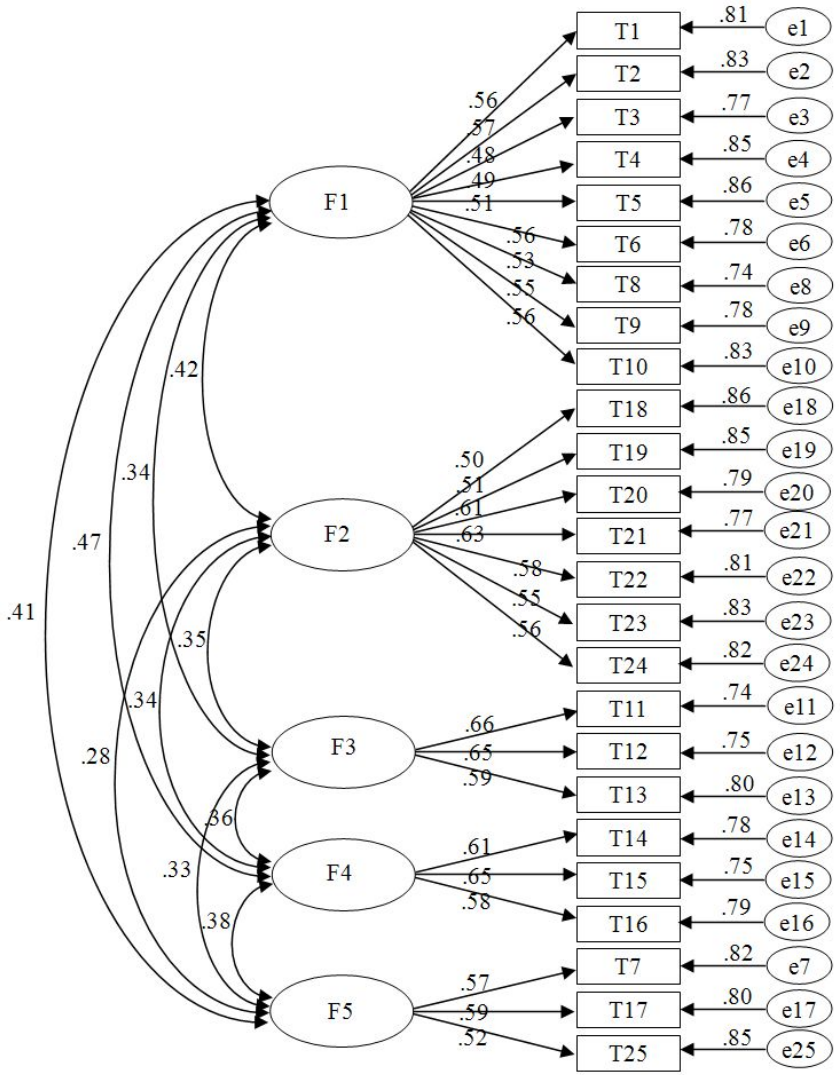


## SHSQ-25

Measures health across 5 domains using 25 items

**F1 – Fatigue**
**F2 – Mental**
**F3 – Cardiovascular**
**F4 – Digestive**
**F5 – Immune**

- Total score summed (high/low score)
- High score = SHS
- Low score = Good health
- Able to distinguish between people with optimal health and suboptimal health




Confirmatory Factor Analysis (CFA)

| | |
|---|---|
| $\chi^2$ | 1324.818 |
| Df | 478 |
| $\chi^2$/ Df | 2.772 |
| GFI | 0.915 |
| AGFI | 0.900 |
| RMSEA | 0.056 |

Wang, Russell, Yan, EPMA J 2018

# Suboptimal Health Status Questionnaire (SHSQ-25)



| | |
|---|---|
| 1. | Were exhausted without physical activities significantly increasing? |
| 2. | fatigue that could not be substantially alleviated by rest? |
| 3. | Were lethargic when working? |
| 4. | Suffered from headaches? |
| 5. | Suffered from dizziness? |
| 6. | Eyes ached or were tired? |
| 7. | Suffered from a sore throat? |
| 8. | Muscles or joints felt stiff? |
| 9. | Have pain in your shoulder/neck/waist? |
| 10. | Have a heavy feeling in your legs when walking? |
| 11. | Felt out of breath while sitting still? |
| 12. | Suffered from sore throat? |
| 13. | Were bothered by heart palpitations? |
| 14. | Appetite was poor? |
| 15. | Suffered from heartburn? |
| 16. | Suffered from nausea? |
| 17. | Could not tolerate cold environments? |
| 18. | Had difficulty falling asleep? |
| 19. | Had trouble with waking up during night? |
| 20. | Had trouble with your short-term memory? |
| 21. | Could not respond quickly? |
| 22. | Had difficulty concentrating? |
| 23. | Were distracted for no reason? |
| 24. | Felt nervous or jittery? |
| 25. | Caught a cold in the past 3 months? |

(SHSQ-25) Yan et al, J Epidemiol 2009

## SHSQ-25

- A subjective health measure
- A reliable and valid instrument to assess SHS
- Quick and easy to use
- Associated with objective biomarkers

**TABLE 2 Comparison of the cardiovascular risk factors between high and low SHS score group**

| | SHS score high | SHS score low | | |
|---|---|---|---|---|
| | Mean + Std. | Mean + Std. | *t* | *P* value[a] |
| SBP (mmHg) | 119.43±13.27 | 115.31±13.19 | 8.573 | <0.001 |
| DBP (mmHg) | 77.57±7.38 | 75.38±7.89 | 7.880 | <0.001 |
| GLU (mmol/L) | 5.23±0.57 | 5.17±0.55 | 2.941 | <0.001 |
| TCH (mmol/L) | 4.48±0.76 | 4.32±0.78 | 5.708 | <0.001 |
| TG (mmol/L) | 1.17±0.58 | 1.08±0.46 | 4.709 | <0.001 |
| HDLC (mmol/L) | 1.32±0.32 | 1.36±0.36 | −3.230 | <0.001 |
| LDLC (mmol/L) | 2.82±0.70 | 2.78±0.71 | 1.558 | 0.119 |
| COR (ng/ml) | 204.31±40.06 | 161.33±27.83 | 34.076 | <0.001 |
| BMI (kg/m$^2$) | 23.24±3.76 | 22.01±3.52 | 9.268 | <0.001 |

*SHS* suboptimal health status; *SBP* systolic blood pressure; *DBP* diastolic blood pressure; *GLU* plasma glucose; *TCH* total cholesterol; *TG* triglyceride; *HDLC* high-density lipoprotein cholesterol; *LDLC* low-density lipoprotein cholesterol; *COR* serum cortisol

Yan et al, J Urban Health 2012

# SHS is associated with objective biomarkers

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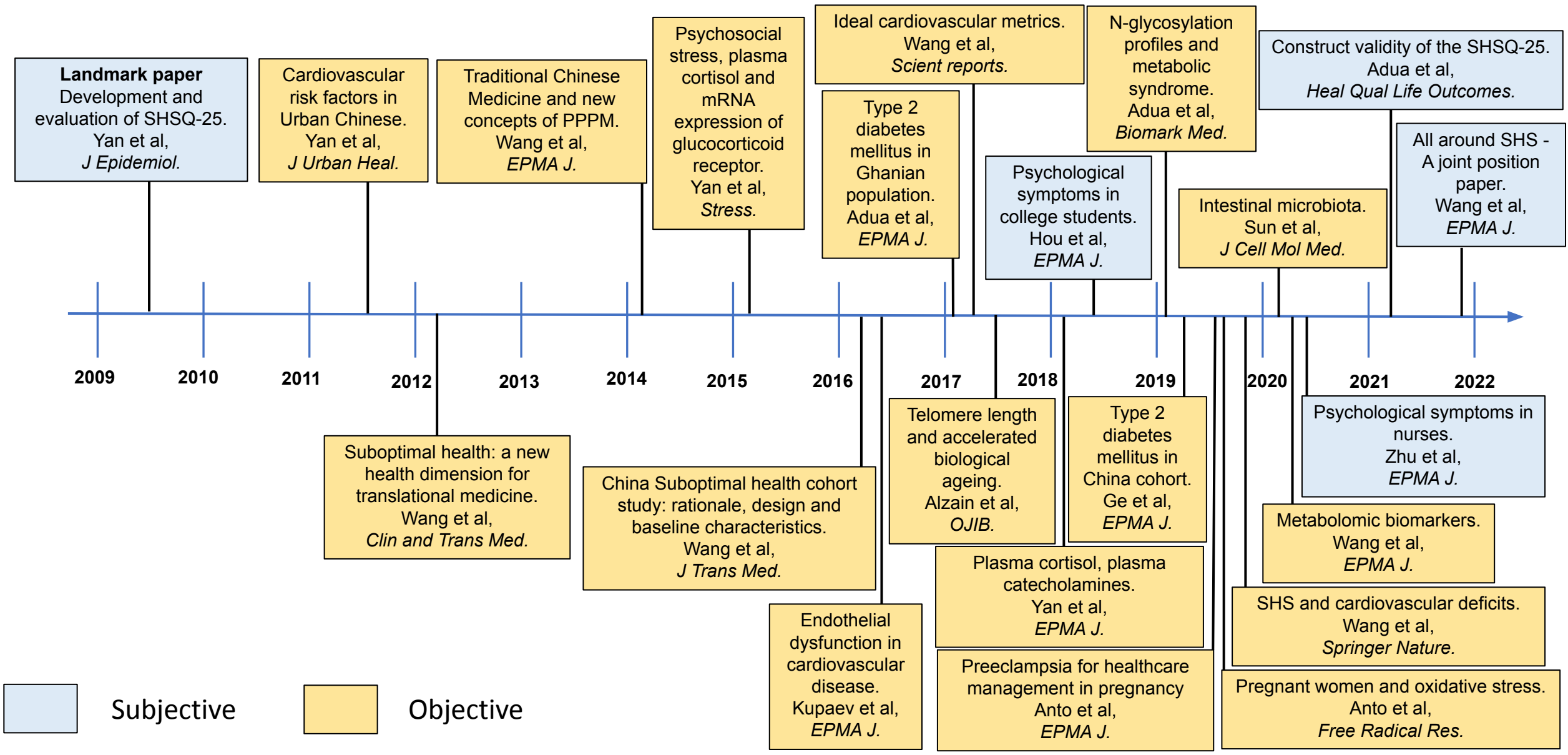

Adua *et al. Health Qual Life Outcomes (2021) 19:136*
https://doi.org/10.1186/s12955-021-01810-z

# Construct validity of the Suboptimal Health Status Questionnaire-25 in a Ghanaian population

Eric Adua[1,2,3*†], Ebenezer Afrifa-Yamoah[4†], Kwasi Frimpong[4,5], Esther Adama[6], Shantha P. Karthigesu[1], Enoch Odame Anto[1,7], Emmanuel Aboagye[8], Yuxiang Yan[9], Youxin Wang[9], Xuerui Tan[2] and Wei Wang[1,9*]

BMC Health and Quality of Life Outcomes

**Adua et al, Health Qual Life Outcomes, 2021**

# SHS and Pre-eclampsia Press

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AACC Press Releases

## The High Maternal Death Rate in Resource-Limited Countries Could Be Reduced With a Simple Questionnaire

MEDIA CONTACTS

NEWS MEDICAL LIFE SCIENCES

## Questionnaire-based algorithm predicts preeclampsia risk in pregnant woman

Research presented today at the 71st AACC Annual Scientific Meeting & Clinical Lab Expo shows that a questionnaire-based algorithm predicts the risk of a pregnant woman developing preeclampsia. This method could lower the high maternal death rate in resource-limited countries by identifying women who need treatment for this often fatal condition.

Preeclampsia is a multisystem disorder that can cause complications for mothers and babies, from brain and liver injury in mothers to premature birth. It is one of the top causes of maternal-fetal mortality worldwide, and it disproportionately affects women in resource-limited countries. While preeclampsia is fatal for only 1 out of every million births in the U.K., it is responsible for more than 570 deaths per million births in Ghana. Worse yet, this is considered an average preeclampsia death rate for low- and middle-income countries.

Preeclampsia often kills because healthcare providers aren't able to monitor pregnant women for its onset. To address this, a research team led by Enoch Anto, a PhD candidate at Edith Cowan University in Perth, Australia, created a simple, low-cost algorithm that identifies pregnant women who are at risk for preeclampsia. A key component of the algorithm is the suboptimal health status questionnaire-25 (SHSQ-25), which assesses a patient's overall health

EurekAlert! AAAS SciTechDaily

Simple test predicts dangerous pregnancy disorder | EurekAlert! Science News Page 1 of 2

NEWS RELEASE 22-OCT-2019

## Simple test predicts dangerous pregnancy disorder

EDITH COWAN UNIVERSITY

An Australian research breakthrough has developed a way to predict the onset of the deadly pregnancy complication pre-eclampsia, which affects around 76,000 women and half a million babies each year, mostly in developing countries like Ghana.

Researchers from Edith Cowan University in Perth Western Australia have developed a simple, low-cost way to predict preeclampsia, one of the leading causes of maternal-foetal mortality worldwide.

IMAGE: RESEARCHERS HAVE DEVELOPED A SIMPLE, LOW-COST WAY TO PREDICT PREECLAMPSIA, A POTENTIALLY DEADLY CONDITION THAT KILLS 76,000 MOTHERS AND 500,000 BABIES EVERY YEAR. view more >

CREDIT: EDITH COWAN UNIVERSITY

Preeclampsia can cause devastating complications for women and babies, including brain and liver injury in mothers and premature birth.

**Survey gives early warning**

ECU researchers assessed the health status of 993 pregnant Ghanaian women using the Suboptimal Health Questionnaire.

The Suboptimal Health Questionnaire was developed in 2009 by Professor Wei Wang from ECU's School of Health and Medical Sciences. Combining scores for fatigue, heart health, digestion, immunity and mental health, the questionnaire provides an overall 'suboptimal health score' that can help predict chronic diseases.

Professor Wang's PhD candidate Enoch Anto found that 61 per cent of women who scored high on the questionnaire went on to develop preeclampsia, compared with just 17 per cent of women who scored low.

When these results were combined with blood tests that measured women's calcium and magnesium levels, the researchers were able to accurately predict the development of preeclampsia in almost 80 per cent of cases.

Mr Anto said preeclampsia was very treatable once identified, so providing an early warning

https://www.eurekalert.org/pub_releases/2019-10/ecu-stp102119.php 6/11/2019

YAHOO! NEWS

Simple, cheap test could save 500K babies, 76K women's lives a year Page 1 of 5

## Simple, cheap test could save 500K babies, 76K women's lives a year

https://news.yahoo.com/simple-cheap-test-can-predict-dangerous-pregnancy-complicat... 7/11/2019

THE WEEK
JOURNALISM WITH A HUMAN TOUCH

## Affordable method predicts dangerous pregnancy complication

Affordable method predicts dangerous pregnancy complication - The Week Page 2 of 7

Australian researchers have developed a simple, low cost method to predict preeclampsia, a potentially dangerous pregnancy complication characterised by high blood pressure.

Preeclampsia is a pregnancy complication that causes premature birth, and brain and liver injury in mothers, killing nearly half a million babies each year, globally. The study, published in the EPMA Journal, noted that in developing nations, preeclampsia is a leading cause of death for both mothers and babies.

The researchers, including those from the Edith Cowan University (ECU) in Australia, assessed the health status of 993 pregnant Ghanaian women using the Suboptimal Health Questionnaire developed in 2009.

The questionnaire, the researchers said, combines participants' scores for fatigue, heart health, digestion, immunity and mental health, to generate an overall 'suboptimal health score' to predict chronic diseases.

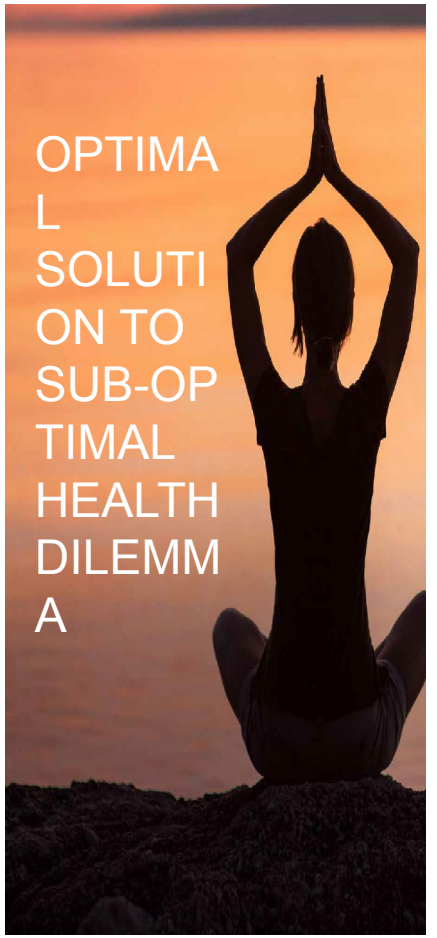
They found that 61 per cent of women who scored high on the questionnaire went on to develop preeclampsia as compared to just 17 per cent of women who scored low.

READ MORE:

**Modi govt to set 30-year age limit for women using IVF: Harsh Vardhan** (https://www.theweek.in/news/health/2019/09/20/modi-govt-to-set-30-year-limit-for-women-using-ivf-harsh-vardhan.html)

**No maternity leave for govt employees having 3rd child: Uttarakhand HC** (https://www.theweek.in/news/india/2019/09/20/no-

https://www.theweek.in/news/health/2019/10/23/Affordable-method-predicts-dangerous... 7/11/2019

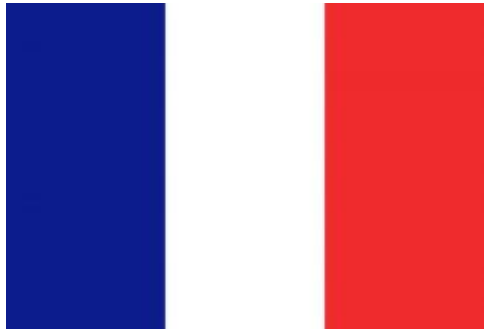


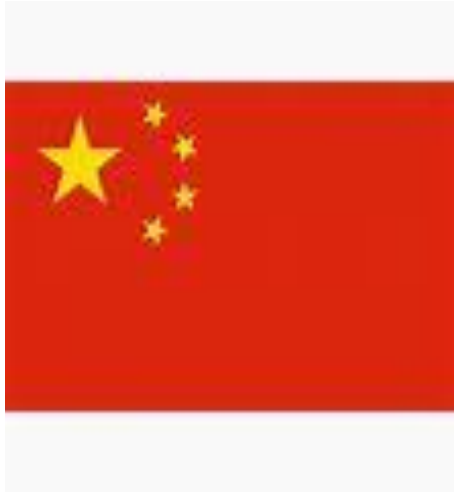

Anto et al, Free Radical Res, 2019

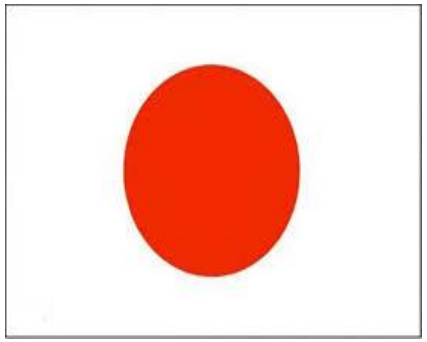
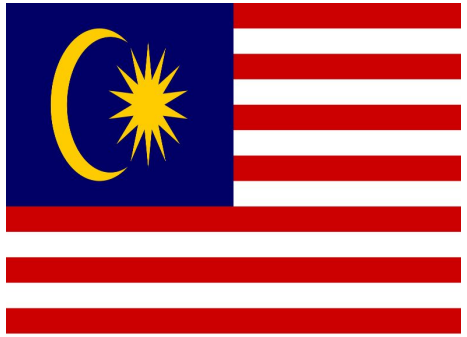
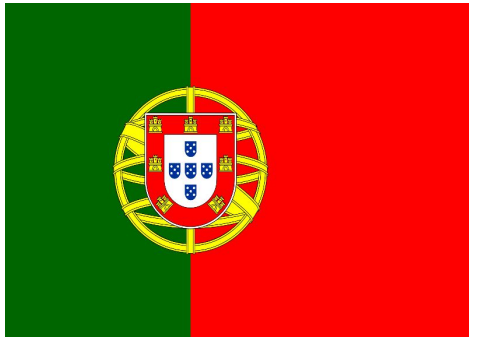
Wang et al, EPMA J, 2021

Anto et al, EPMA J, 2019

# SHSQ-25 is recognized and used throughout the world





Alzain et al, OJIB, 2017

Wang et al, EPMA J, 2021

Adua et al, EPMA J, 2016

# SHSQ-25 translated into multiple versions

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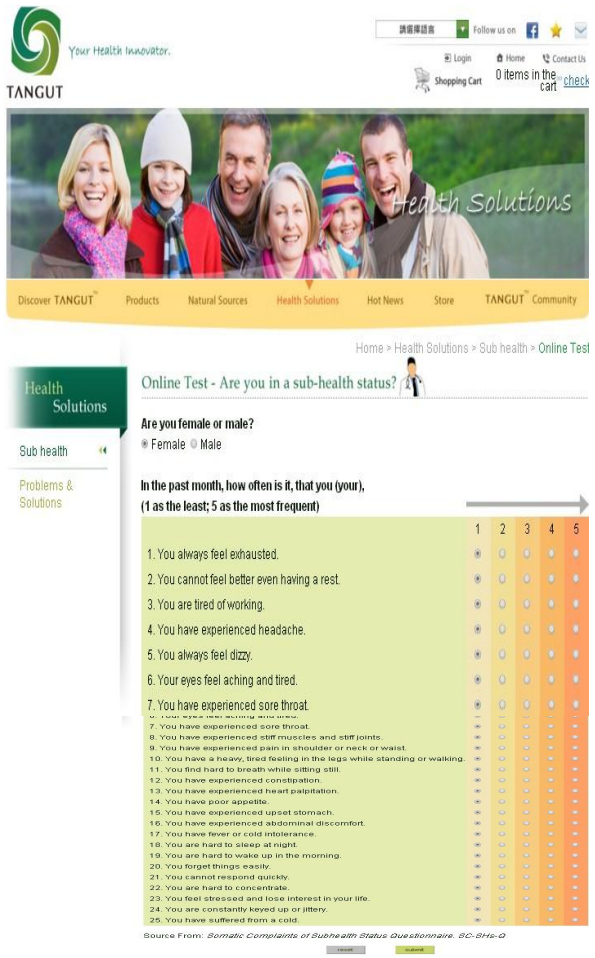



在过去的三个月内，对于下表中所列的症状在您身上发生的频率是怎样的？(每行单选)

| 症状 | 完全没有 | 很少有 | 有 | 经常有 | 几乎总是 |
|---|---|---|---|---|---|
| T1. 感觉疲劳（在运动量没有明显增加的情况下） | 0 | 1 | 2 | 3 | 4 |
| T2. 疲劳在休息后缓解 | 0 | 1 | 2 | 3 | 4 |
| T3. 工作时您有困倦或倦怠的现象 | 0 | 1 | 2 | 3 | 4 |
| T4. 感觉头痛 | 0 | 1 | 2 | 3 | 4 |
| T5. 感觉头晕 | 0 | 1 | 2 | 3 | 4 |
| T6. 眼睛酸胀 | 0 | 1 | 2 | 3 | 4 |
| T7. 咽喉疼痛 | 0 | 1 | 2 | 3 | 4 |
| T8. 肌肉和关节经常感到发僵或僵硬 | 0 | 1 | 2 | 3 | 4 |
| T9. 肩、颈或腰部酸痛 | 0 | 1 | 2 | 3 | 4 |
| T10. 走路时感到双腿沉重 | 0 | 1 | 2 | 3 | 4 |
| T11. 静息时感到气短 | 0 | 1 | 2 | 3 | 4 |
| T12. 胸闷 | 0 | 1 | 2 | 3 | 4 |
| T13. 心悸 | 0 | 1 | 2 | 3 | 4 |
| T14. 食欲减退 | 0 | 1 | 2 | 3 | 4 |
| T15. 胃部不适 | 0 | 1 | 2 | 3 | 4 |
| T16. 消化不良 | 0 | 1 | 2 | 3 | 4 |
| T17. 低热或怕冷 | 0 | 1 | 2 | 3 | 4 |
| T18. 入睡有困难 | 0 | 1 | 2 | 3 | 4 |
| T19. 多梦或易惊醒的情形 | 0 | 1 | 2 | 3 | 4 |
| T20. 记忆力减退 | 0 | 1 | 2 | 3 | 4 |
| T21. 反应能力下降 | 0 | 1 | 2 | 3 | 4 |
| T22. 注意力不集中 | 0 | 1 | 2 | 3 | 4 |
| T23. 没有原因的心烦意乱 | 0 | 1 | 2 | 3 | 4 |
| T24. 紧张、焦虑现象 | 0 | 1 | 2 | 3 | 4 |
| T25. 最近一年中，患感冒的频率 | 0 | 1 | 2 | 3 | 4 |

얼마나 자주, 너 (너의)

1. 귀하는 피곤하십니까 운동량이 현저히 증가되지 않는 경우
2. 귀하는 휴식 후 피로가 풀릴 수 있습니까
3. 귀하는 일할 때 졸리거나 권태로운 현상이 있습니까
4. 두통
5. 머리가 어지럽다
6. 눈이 쓰리고 탱탱하다
7. 인후통
8. 근육과 관절은 항상 경직되거나 뻣뻣함을 느낀다
9. 어깨 목 또는 허리가 시큰거리다
10. 걸을 때 다리가 무겁다
11. 숨을 죽일 때 숨이 가쁘다
12. 가슴이 답답하다
13. 속이 떨리다
14. 식욕 감퇴
15. 속이 안 좋다
16. 소화 불량
17. 저열 혹은 추위를 탄다
18. 잠들기 힘들다
19. 꿈이 많거나 놀라 깨기 쉽다
20. 기억력이 감퇴하다
21. 순발력이 떨어지다
22. 집중력이 떨어지다
23. 이유 없이 정신이 사납다
24. 긴장, 불안
25. 귀하는 최근 3 개월 동안 감기에 걸린 적이 있습니까

**English Version** Yan et al, J Epidemiol, 2009

**Chinese Version** Wang et al, J Trans Med, 2016

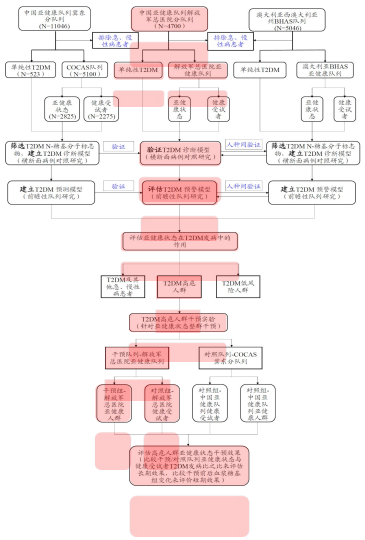
**Russian Version** Kupaev et al, EPMA J, 2016

**Korean Version** Guo et al, JoGH, 2022

# SHS cohorts

Wang et al, J Trans Med, 2016

## Chinese PLA General Hospital Cohort Study, (COACS Subgroup)



# International consortium



SUBOPTIMAL HEALTH STUDY CONSORTIUM

Certificate No.
xxx

## Certificate of Membership

*This Certificate is awarded to*

Professor xxx

(Affiliation)

In Recognition and Appreciation of Valued Services
and Contributions as a Member of
**Suboptimal Health Study Consortium**

*Wei Wang*
Prof, MD, PhD, FFPH, FRSB, FRSM

*Issued Date*

01.11.2021

SUBOPTIMAL HEALTH STUDY CONSORTIUM

# Interactive activity

The SHS team at ECU

Wang et al, EPMA J, 2021

Yan et al, J Epidemiol, 2009

# Knowledge gap – SHS and informal caring



Carers Australia

Carers are people who provide unpaid care and support to family members and friends who have a disability, mental illness, chronic condition, terminal illness, an alcohol or other drug issue or who are frail aged.

**Garcia et al, OJRD, 2018**

**Carers Australia, 2022**

## Carers are a disadvantaged group in society

- Experience significant burden
- Caring is an International issue
  - 2.7 million Australians affected
  - Total replacement cost $60 billion
- Primary carers
  - Provide majority of care
  - 90% female
  - Sub-groups of carers (such as mothers whose child has a rare disease).

### Psychological conditions

- Depression
- Anxiety
- High psychological distress

### Physical conditions

- Impaired immune function
- Hyperglycaemia
- Hyperlipidaemia
- Cardiovascular disease
- Shortened life-span (telomere)

Garcia et al, OJRD, 2018

Carers Australia, 2022

# The Association of Suboptimal Health Status and Caregiving in Australian Carers

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**Aim:** To understand the association between SHS and informal caring.

**Study design:** Observational, cross-sectional study (self-reported online survey)

**Participants:** Carers (n=170) and general population (n=170), female or male, aged between 18-75, able to speak English, and live in Australia.

**Recruitment:** Carer support groups, charity organisations, rare disease support groups, Facebook community groups and snowballing methods.

**Primary measures:** SHSQ-25

**Secondary measures:** DASS-21; Carer burden; sociodemographic.

# The Association of Suboptimal Health Status and Caregiving in Australian Carers

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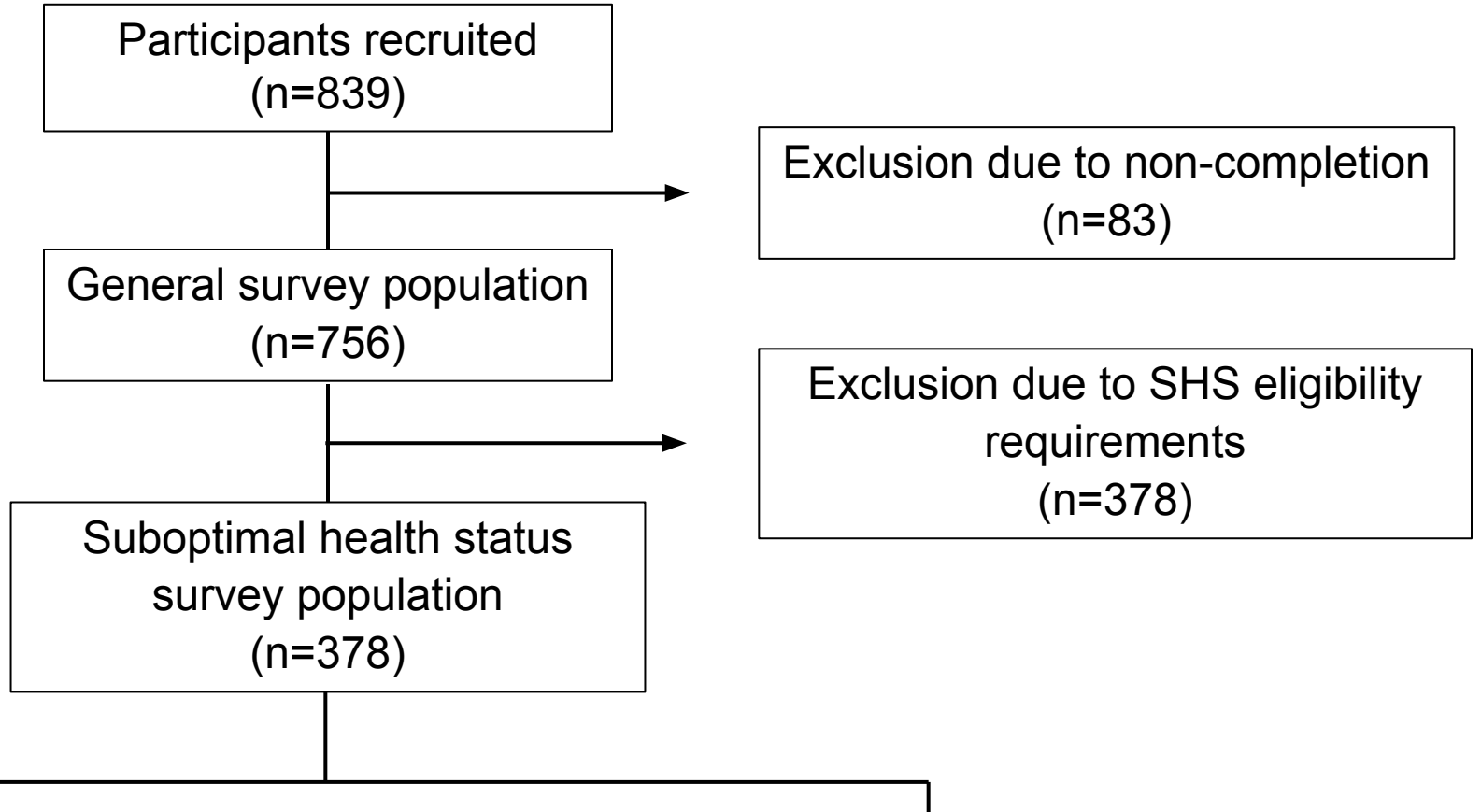
Carers Australia, 2022



# The Association of Suboptimal Health Status in Bereaved Parents

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Research question

Are elevated levels of prolonged grief disorder, depression, and post-traumatic stress disorder associated with SHS in bereaved mothers?

childhood dementia INITIATIVE

# SHS: A real-world case study



## Subject: Monique Garcia

| July 2021 | |
|---|---|
| Domain | Score |
| Fatigue | 6 |
| Mental | 12 |
| Cardiovascular | 2 |
| Digestive | 2 |
| Immune | 2 |
| **Total SHS score** | **24** |

**Carer (age 43)**

| April 2022 | |
|---|---|
| Domain | Score |
| Fatigue | 11 |
| Mental | 17 |
| Cardiovascular | 1 |
| Digestive | 1 |
| Immune | 2 |
| **Total SHS score** | **32** |

**Bereaved mother (age 44)**

| July 2022 | |
|---|---|
| Domain | Score |
| Fatigue | 6 |
| Mental | 12 |
| Cardiovascular | 1 |
| Digestive | 0 |
| Immune | 4 |
| **Total SHS score** | **23** |

**Bereaved mother (age 44)**

# SHS in carers who become bereaved parents



**Aim:** To understand the association between prolonged grief disorder, depression, and post-traumatic stress disorder with SHS in bereaved parents.

**Study design:** Observational, cross-sectional study (self-reported online survey)

**Participants:** Mothers and fathers (n=132), aged between 18-70, able to speak English, live in Australia, who child died in the last 5 years.

**Recruitment:** Grief community groups, snowballing methods.

**Primary measures:** Suboptimal health status (SHSQ-25)

**Secondary measures:** Depression, anxiety, and stress (DASS-21); Prolonged grief (PG-13);Post-traumatic stress disorder (PCL-5); sociodemographic data.

# SHS and carers of children with rare diseases

The Nathan CENTRE

# Suboptimal Health

| | | |
|---|---|---|
| Gene | vs | Environment |
| Nature | vs | Nurture |
| Genomics | vs | Genetics |
| Public Health | vs | Preventive Medicine |
| City | vs | Rural |
| Rich | vs | Poor |
| Health | vs | Disability |
| Developed | vs | Developing |
| Migrants | vs | Residences |
| Chronic Disease | vs | Infectious Disease |
| Common Disease | vs | Rare Disease |
| Pandemics | vs | Endemics |

Kotten et al *Nat Genet* 2010; Lu et al *J Proteome Res* 2011; Wang et al, *JAMA* 2011; Wang et al. *Nat Rev Cancer* 2011; Wang et al *Nat Precedings*, 2011; Lauc et al *PLoS Genet* 2011; Yan et al *J Urban Health* 2012; Chan et al *The Lancet* 2013; Lauc et al *PLoS Genet* 2013; Wang et al *EPMA Journal* 2014; Yan et al *Stress* 2015; Vuckovic et al *Arthritis & Rheumatology* 2015; Wang et al *Science* (Suppl) 2016; Keser et al *Diabetologia* 2017; Liu et al *J Tans Med* 2018; Anto et al *EPMA Journal* 2019; Li et al *JAMA Network Open* 2019; Xia at al *Nat Metabolism* 2020; Wang et al *Lancet Regional Health* 2020; Stambuk et al *Aging* 2020; Tian et al *JCI Insight* 2020; Zhang et al *NPJ Ageing & Mechanism of Diseases* 2021; Wang et al… Golubnitschaja. *Position Paper EPMA* 2021. *Wang et al BMJ SHS Workshop* –Sydney 2022

# Take home messages

- Suboptimal Health Status is the physical state between health and disease, and is considered a reversible stage of pre-chronic disease.
- The Suboptimal Health Status questionnaire (SHSQ-25) is a reliable tool to detect suboptimal health.
- Assessment of Suboptimal Health Status, via the SHSQ-25, predicts the risk of developing chronic diseases, providing health professionals with a unique window of opportunity for early interventions prior to disease onset.