Development of A skills-based Measure of Health Literacy Regarding on Diabetes and Its Impact on Patients' Glycemic Control

Xinying Sun, PhD, Professor
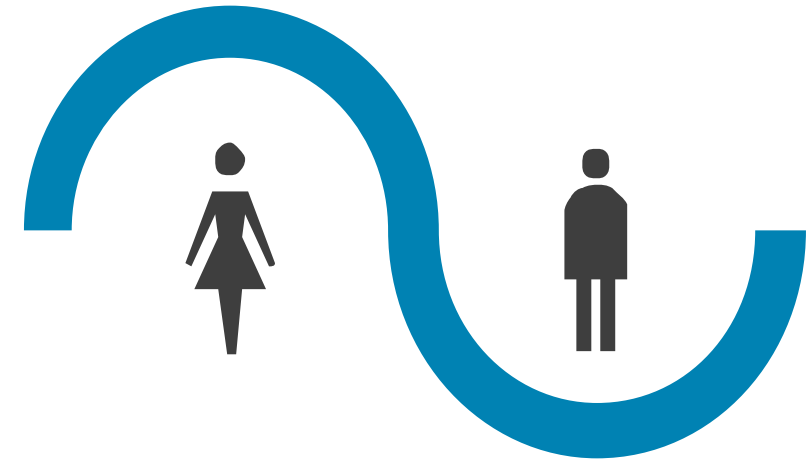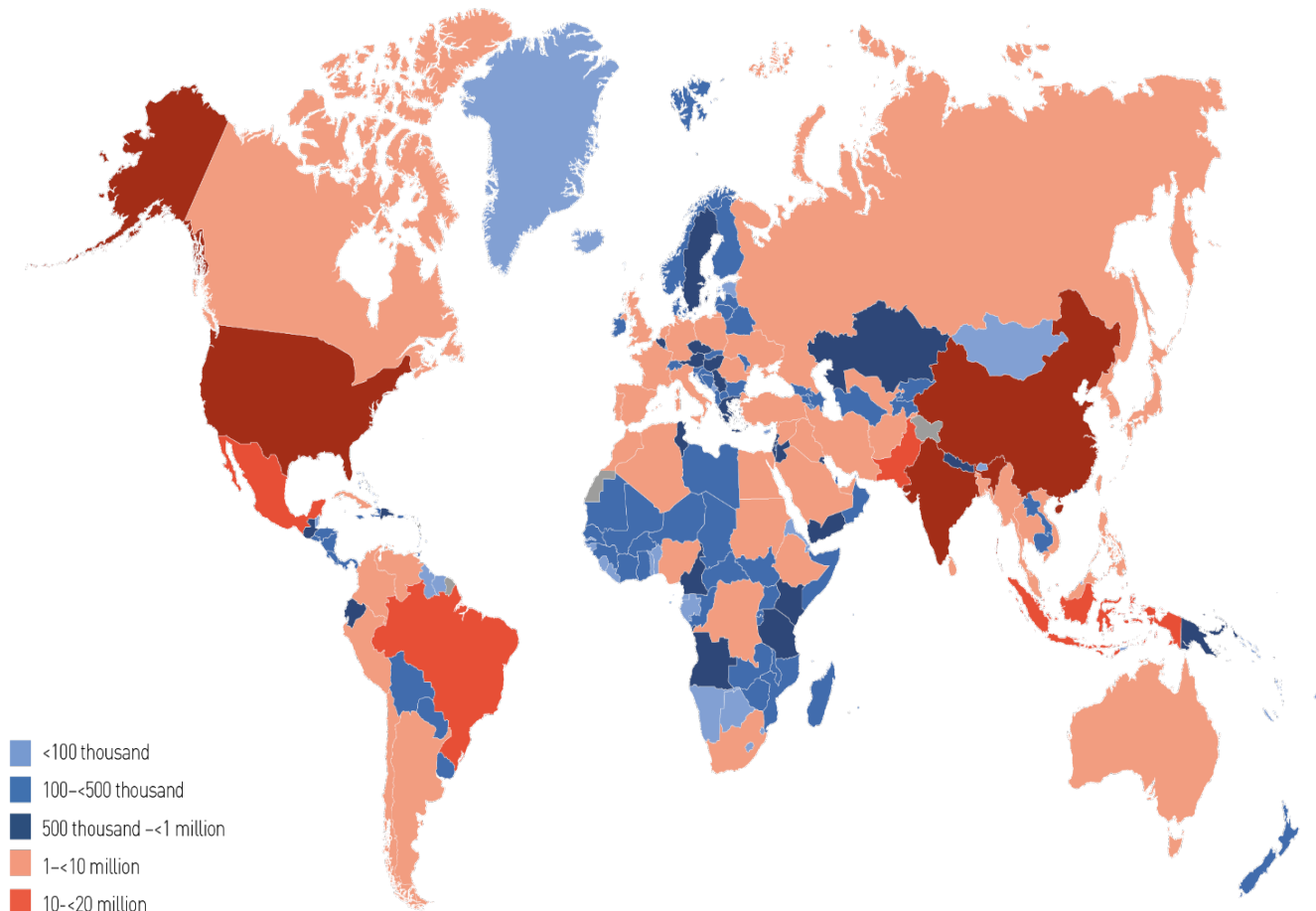
School of Public Health, Peking University

Oct. 21,2020

International Diabetes Federation(201, 42563 million)

China：114 million DM，10.9%

Number of people (20-79 years) with diabetes, 2019

<100 thousand
100~<500 thousand
500 thousand ~<1 million
1~<10 million
10-<20 million
≥20 million
No estimates made

10.2%   11.7%

http://www.diabetesatlas.org

Wang L, Gao P, Zhang M, et al. JAMA, 2017.

Health Literacy Measure regarding on Diabetes

The Literacy Assessment for Diabetes（LAD）

- Similar with REALM

- Level 1, level 2 and level 3

- Words regarding on Diabetes

Nath C R , Sylvester S T , Yasek V , et al. Development and Validation of a Literacy Assessment Tool for Persons With Diabetes[J]. The Diabetes Educator, 2001, 27(6):857-864

Literacy Assessment for Diabetes
(LAD)
Shirley Theriot Sylvester, PhD, Charlotte Nath, RN, EdD, CDE

Patient Name/Number _____ Birth date _____
Date _____ Clinic _____ Examiner _____

List 1		List 2		List 3	
eat eet	___	**thirst** thŭrst	___	**artery** 'art-tĕ-ree or 'ar-tree	___
pill pĭl	___	**exercise** 'ek-sir-sīz	___	**biosynthetic** bi-ŏ-sin-'thet-ik	___
eye ī	___	**exchange** īks-'chānj	___	**abnormal** ab-'nor-muhl	___
fat fat	___	**direction** duh-'rek-shŭn	___	**cholesterol** kah-'les-tuh-rawl or rŏl	___
milk milk	___	**hospital** 'hos-pit-uhl	___	**glycogen** 'gli-kuh-jĕn	___
sugar 'shoo-gĕr	___	**calorie** 'kal-uh-ree	___	**nephropathy** ni-'frap-uh-thē	___
lunch lunch	___	**colon** 'kŏ-luhn	___	**prescription** pri-'skrip-shuhn	___
meals meelz	___	**urination** yoor-uh-'nay-shun	___	**pregnancy** 'preg-nuhn-see	___
kidney 'kid-nee	___	**vision** 'vizh-un	___	**ketones** 'kee-tōnz	___
drink drink	___	**protein** 'prō-teen	___	**ketoacidosis** kee-tō-ass-ih-'dō-sus	___
nurse nurs	___	**vegetable** 'vej-tuh-bul	___	**pancreas** 'pan-kree-uhs	___
fiber 'fī-bĕr	___	**snack** snak	___	**hypoglycemia** hi-pō-gli-'see-mee-uh	___
fruits frootz	___	**cereal** 'ser-ee-ul	___	**atherosclerosis** ath-uh-rō-skluh-'rō-sis	___
supper 'sŭp-ĕr	___	**injection** in-'jek-shun	___	**occupation** ok-yoo-'pay-shuhn	___
bread bred	___	**glucose** 'gloo-kōs	___	**triglycerides** trī-'glis-uh-rīds	___
heart hart	___	**breakfast** 'brek-fuhst	___	**emergency** ih-'mŭr-juhn-see	___
blood bluhd	___	**insulin** 'in-suh-lin	___	**communication** kuh-mū-nuh-'kā-shuhn	___
stress stress	___	**alcohol** 'al-kuh-hall	___	**hemoglobin** 'hē-muh-glō-buhn	___
meat meet	___	**medication** med-ah-'kā-shuhn	___	**endocrinologist** en-duh-krih-'nawl-uh-jist	___
doctor 'dok-tŭr	___	**symptom** 'simp-tuhm	___	**retinopathy** ret-ehn-'op-uh-thē	___

Raw Score	**Estimation of Grade Level**	**Score**
0-20	Fourth Grade and Below (Oral instructions should be given repeatedly with visual assistance.)	List 1 _____
		List 2 _____
		List 3 _____
21-40	Fifth-Ninth Grade Level	
41-60	Ninth Grade and Above	Raw Score _____

This educational tool was developed and funded through a grant from the West Virginia Diabetes Council Program, West Virginia Bureau of Public Health, West Virginia Department of Health and Human Resources, and West Virginia University.
© 2000 WVU

Health Literacy Measure regarding on Diabetes

Diabetes Numeracy Test（DNT）

Diabetes Care Domain	Question Number
Nutrition	1–9
Exercise	10–13
Blood Glucose Monitoring	14–17
Oral Medication Use	18–22
Insulin Use	23–43

Numeracy Domain	Question Number
Addition	2,25
Subtraction	8
Multiplication	3,5,16,26,27
Division	11,21,28–31
Fractions/Decimals	4,6,7,8
Multi-step mathematics	9,12,13,20,35–43
Time	10,17,22
Numeration/Counting/Hierarchy	1,14,15,18,19,23,24,32–34

Question 1

You are told to follow the sliding scale shown here. The sliding scale indicates the amount of insulin you take based upon your blood sugar levels.

If Blood sugar is:	Units of Insulin
130-180	0
181-230	1
231-280	2
281-330	3
331-380	4

How much insulin would you take for a blood sugar of 295?

ANSWER _____ units

Correct answer: 3 units

Percent answered correctly 85%

Question 2

After seeing the Doctor, you are given the following instruction to lower a high blood sugar level before a meal:

"Starting with a blood sugar of 120, take 1 unit of Humalog insulin for each 50 points of blood sugar."

How much insulin should you take for a blood sugar of 375?

ANSWER _____ units

Correct: 5 units

Percent answered correctly 37%

Huizinga M M , Elasy T A , Wallston K A , et al. Development and validation of the Diabetes Numeracy Test (DNT). BMC Health Services Research, 2008, 8(1):96.

Health Literacy Measure regarding on Diabetes

Chinese Health Literacy Scale for Diabetes – multiple-choice version(CHLSD-MC)

Using Bloom's taxonomy,
It consists of four subscales:
- remembering (18 items)
- understanding (four items)
- applying (four items)
- analysing (four items)

YM Leung, Ho Fan Lau, Pui Hing Chau and Esther WY Chan. Chinese Health Literacy Scale for Diabetes – multiple-choice version(CHLSD-MC): a validation study. Journal of Clinical Nursing,2015,24,2679-2682

Chinese Version of DM-REALM

- 178 items

  - Printed literacy 165 items

  - Numeracy literacy 13 items

LI Chun-yu，ZHAO Xiao-shuang，Miyong Kim，QUAN Jin-yu，LI Chun-ying，LI Cai-fu. Impact of disease-related health literacy on the control of blood glucose in community patients with diabetes mellitus. Chinese Journal of Nursing,2012,47(1),69-71(in Chinese)
Kim MT, Li Z, Nguyen T, Ko J, & Kim KB, Han HR (In press). Development of DM focused print HL scale using rapid estimate of adult literacy in medicine model: (DM-REALM). HLRP: Health Literacy Research and Practice.

OBJECTIVE ▶

- To develop a skills-based measure of health literacy regarding on diabetes (HL-DM)

- To explore the relationship between health literacy and glycemic control.

METHODS ▶

- Recruited 7019 residents and 1194 T2DM in Beijing

- Self-designed measurement

- Test skills
  - Reading
  - Calculating
  - Information searching
  - Communication

- Classical Test Theory (CTT) & Item Response Theory (IRT)

- Structural Equation Model(SEM)

Stimuli materials

READING

    Blood glucose meter

    Test sheet

    Drug instructions

    Communication materials

NUMERACY

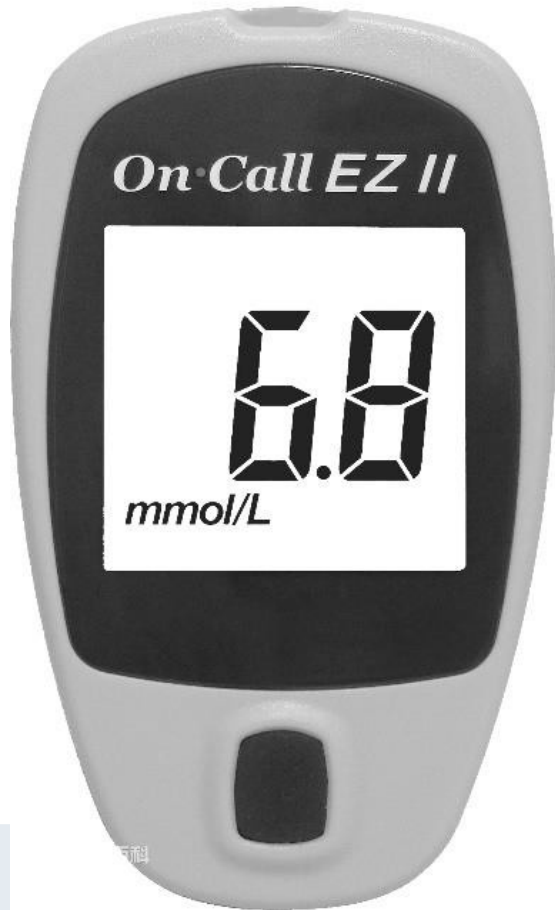   **Calculating body mass index (BMI)**

    Drug dosage

    Nutrients

INFORMATION SEARCHING and COMMUNICATION

    Likert 5 level scale

Samples

On·Call EZ II

6.8

mmol/L

A. On the left is a blood glucose measurement.

It is ____ mmol/L.

B. Normal fasting blood glucose was lower than 6.1 mmol/L, and 2 hours after meal was lower than 7.8 mmol/L as normal

    B1:If this is the result of 2 hours postprandial blood glucose,

    is the result normal?

        a. yes   b. no   c. I don't know.

Samples

Exercise is an effective way to control the symptoms of diabetes. The effect of exercise on reducing fasting blood glucose is similar to that of metformin. It can reduce blood glucose by 1.5-2 mmol/L and postprandial blood glucose by 3 mmol/L, which is stronger than metformin.
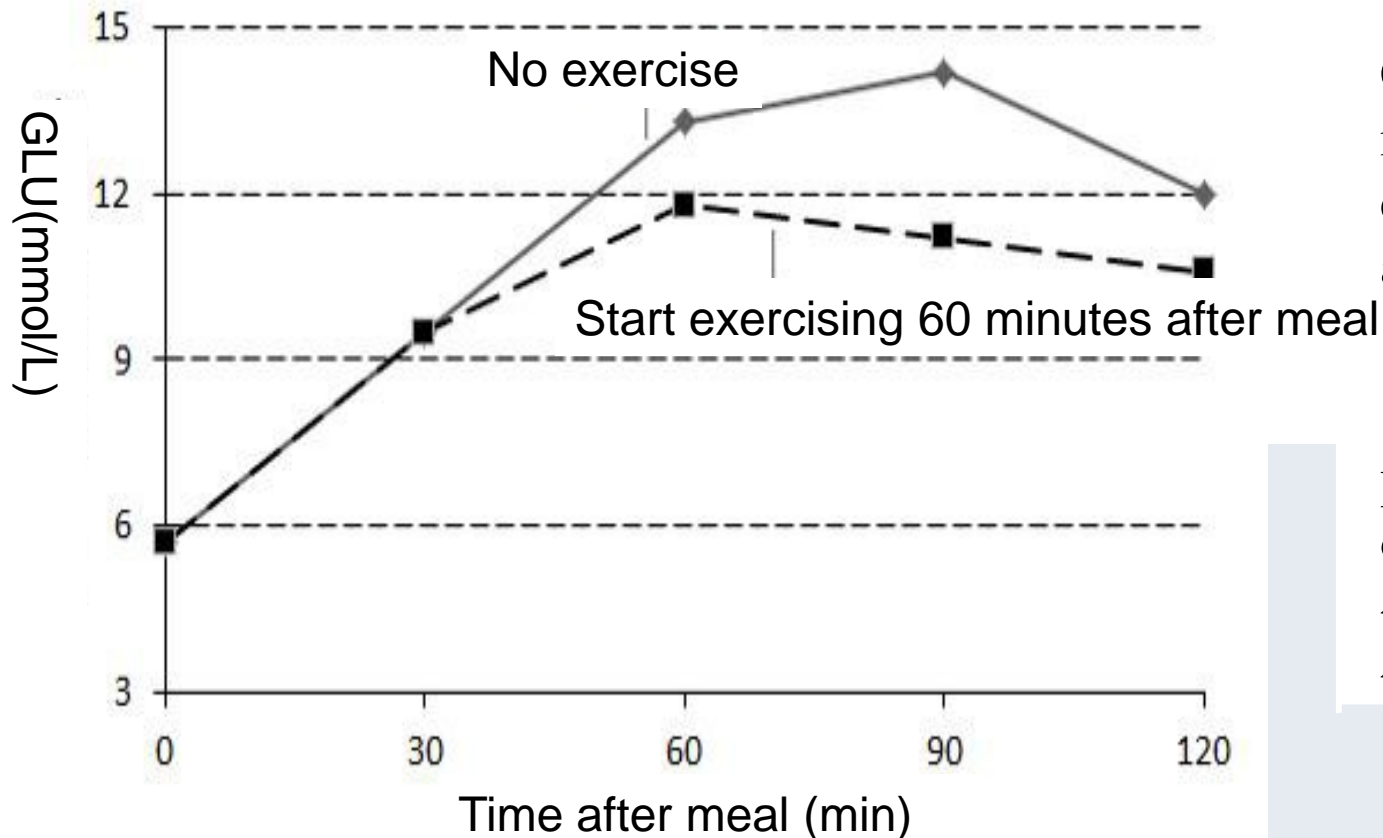
C. Reading the chart above, how many minutes after a meal does blood sugar begin to drop in those who start exercising 60 minutes after a meal?

   a. 30min   b. 60min   c. 90min
   d.120min   e. I don't know

D. After reading the above picture and the text, 90 minutes after eating, the blood glucose of the exercise group was_____mmol/L lower than that of the non exercise group.

Samples

ITEMS	Never	Seldom	Occasionally	Often	Always
Do you often ask others to help you see the hospital's various documents (prescription, hospitalization notice, instructions, home care guidance)?					
When you want to know about the disease, can you find it from books, magazines and newspapers?					
When you want to know about the disease, can you find it on the Internet?					
Can you clearly describe your condition or needs with your doctor?					
Do you understand when the doctor tells you about the disease?					

RESULTS ▶

Classical Test Theory (CTT)

- The difficulty of each item ranged from 0.32 to 0.88,
- The discrimination was in the range of 0.27-0.91.
- EFA：Six factors were extracted by exploratory factor analysis, explaining 65.5% of variance.
- CFA：The goodness of fit indexes of confirmatory factor analysis was as follows: TLI = 0.861, CFI = 0.875, SRMR = 0.065, RMSEA = 0.069.
- The total Cronbach's α coefficient was 0.934（0.740-0.956）.

项目反应理论

- 采用等级反应模型（graded response model，GRM），边际极大似然估计法（MML item parameter estimation）

- 区分度的范围是0~3，区分度大于0.5比较理想

- 难度的范围是-3~3，小于-2.5为极低难度，-2.5~-1.5为低难度，-1.5~1.5为中等难度

- 信息函数峰值在0.2以上比较好

- 一般区分度＜0.5和信息函数峰值＜0.2的题目可以考虑删除

项目反应理论tem Response Theory

The results of IRT showed that the discrimination of each item was in the range of 1.210 - 3.375, the difficulty was in the range of - 3.081- 0.819, and the peak value of information function was in the range of 0.387 - 2.837.

| Item	a(>0.5)	b(-3~3)	c(>0.2)	Item	a(>0.5)	b(-3~3)	c(>0.2)
1	1.478	-1.742	0.545	16	1.791	0.452	0.800
2	1.246	-0.292	0.387	17	2.144	-0.111	1.139
3	1.288	-0.481	0.413	18	2.073	0.276	1.068
4	2.201	-0.585	1.211	19	2.600	0.412	1.690
5	1.210	-1.368	0.439	20	2.481	0.289	1.521
6	1.380	-1.170	0.559	21	1.861	0.554	0.864
7	2.527	-0.948	1.589	22	1.617	0.576	0.653
8	1.914	-0.744	0.913	23	1.580	-1.674	0.790
9	1.856	-0.719	0.856	24	1.708	-0.405	0.729
10	1.718	-3.081	0.735	25	3.375	-0.437	2.837
11	1.809	-1.526	0.815	26	3.264	-0.308	2.604
12	2.022	-1.650	1.019	27	2.773	-0.016	1.921
13	1.434	-2.715	0.512	28	2.461	-0.014	1.514
14	1.705	-2.647	0.725	29	2.918	-0.076	2.103
15	2.078	0.566	1.078	30	1.401	0.819	0.491
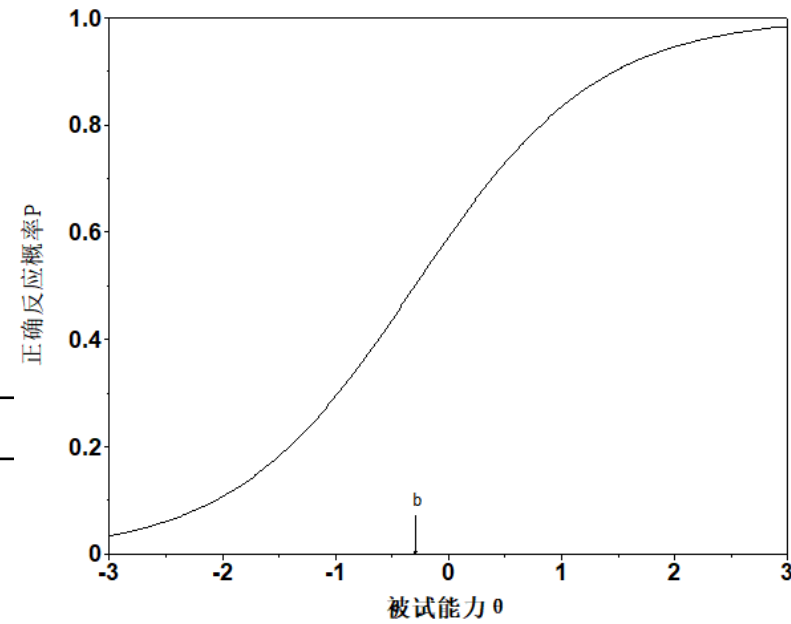
ICC of item2
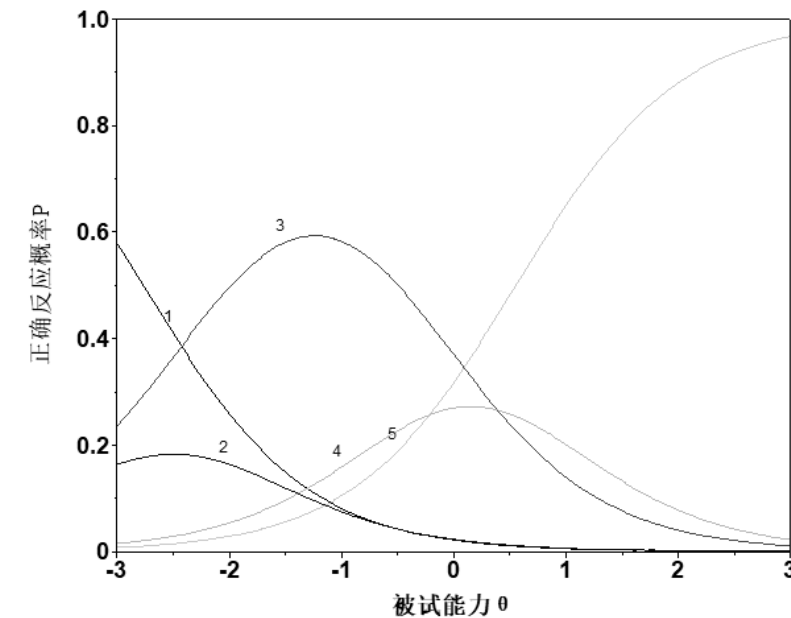
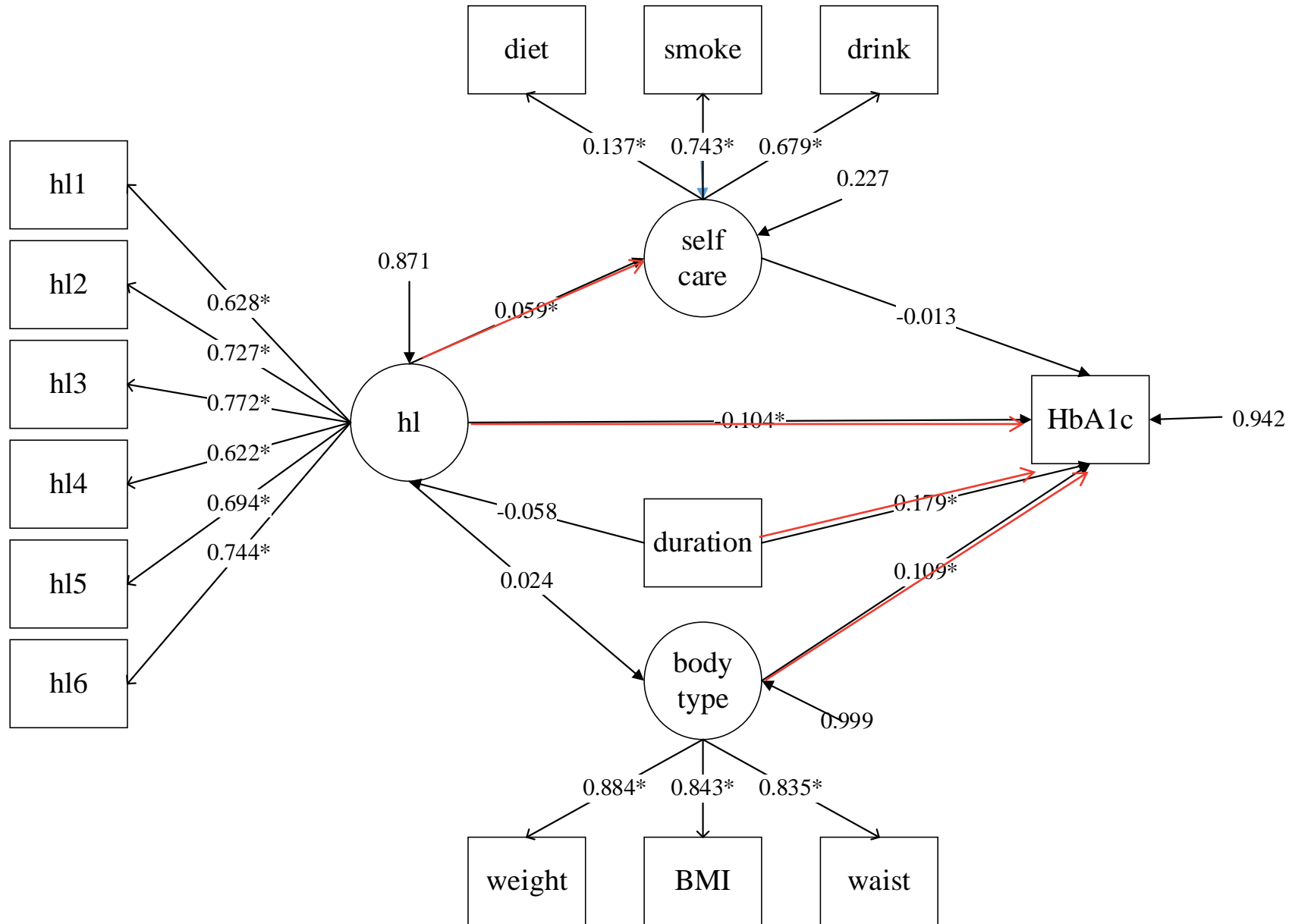ICC of item 6

Test Information and Measurement Error
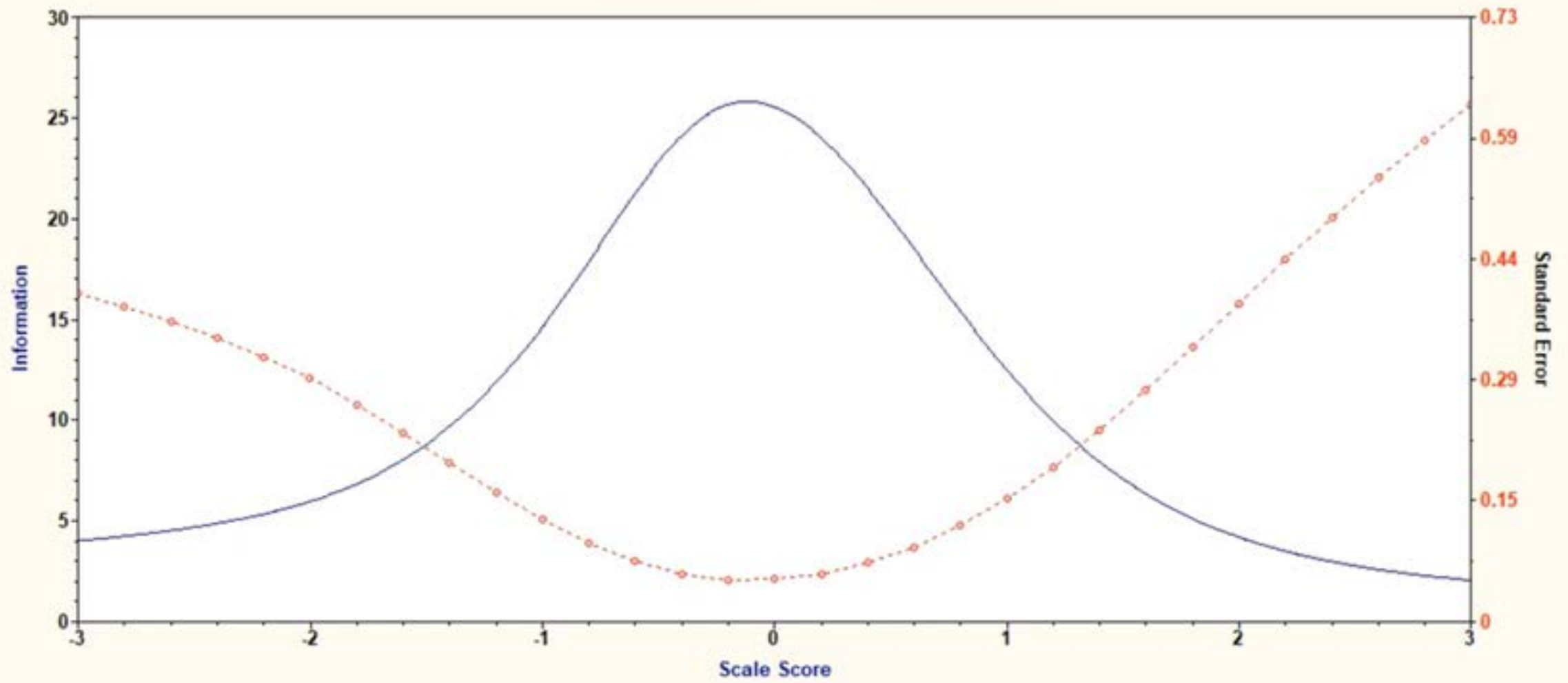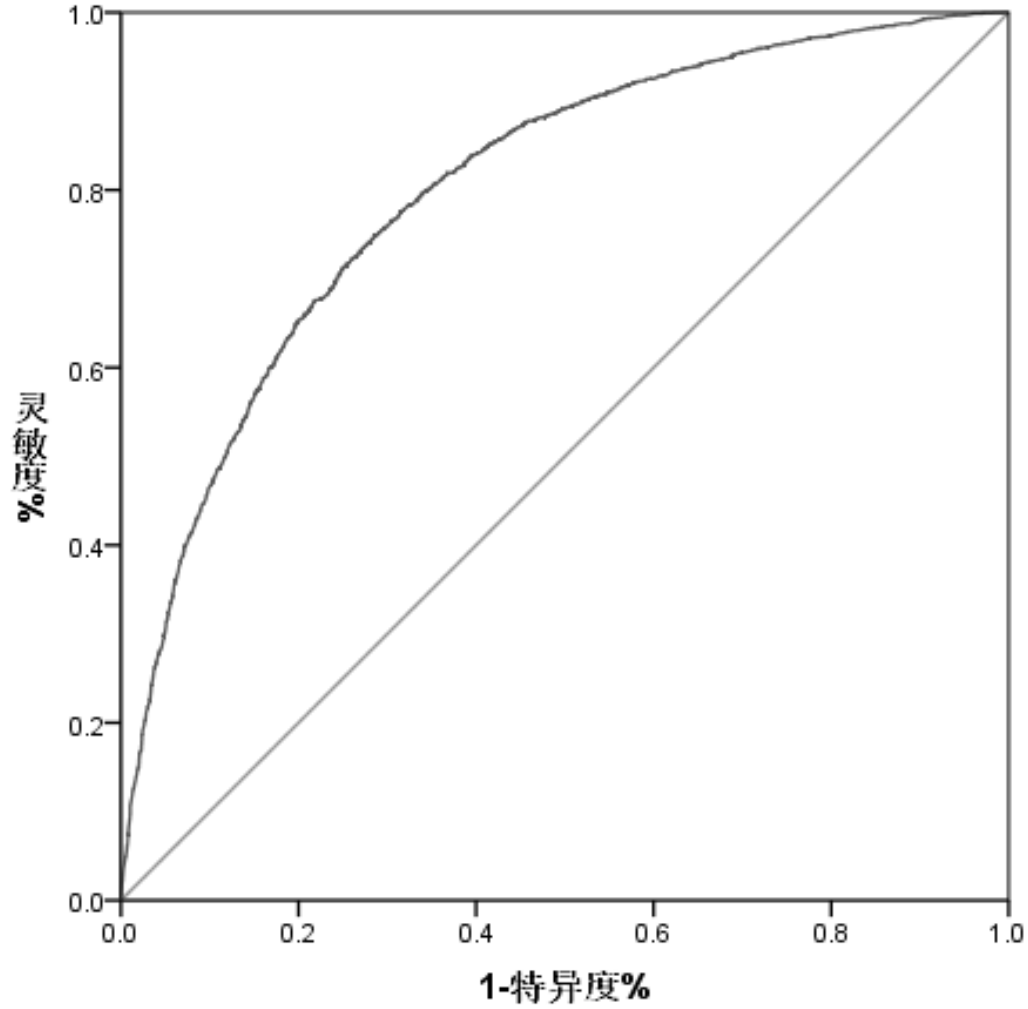
HL-DM ROC

- The area under the ROC curve (AUC) was 0.803.

- Sensitivity 72.3% specificity 74.0%.

- The cutoff was at 20 points.

Structural Equation Model(SEM)

Discussion ▶

The skills-based measure of HL-DM has acceptable discrimination, reliability and validity.

Health literacy of patients directly affects their HbA_{1C} level.

Thanks