



# Psychometric properties of the indicators of professional competence for exercise instructors for elderly people

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## ABSTRACT

Physical exercise and activity may prevent cognitive decline and neurodegenerative diseases, and promise mastery experience, self-persuasion, and diminution in negative sentimental states in elderly people. This study was to examine the validity of the indicators of professional competence for exercise instructors of the elderly (IPCEIE). We have reported to use the Delphi technique and the analytic hierarchy process (AHP) to develop the IPCEIE with 72-item (IPCEIE-72) (three second-orders: knowledge, skill, and attitude). However, to date there has been no study of the validity of psychiatry IPCEIE. A convenience sample of 145 exercise instructors ( $46.36 \pm 14.64$ ) was self-administered data from structural questionnaire. The total score of the three dimensions reflect the overall IPCEIE status (i.e., third-order factor). However, factor structures of the IPCEIE have not been examined. Therefore, the main purpose of this study was to examine 10-factor first-order models, 3-dimensions second-order models, and one third-order model of the IPCEIE using confirmatory factor analysis (CFA). We also examined 83-item of the original IPCEIE (IPCEIE-83) to compare with the IPCEIE-72. The IPCEIE-72 showed an unaccepted model ( $\chi^2/df=6.516$ , CFI=0.92, NNFI=0.91, and RMSEA=0.196) and all 72 items had sufficient factor loadings (0.59-0.86). Comparing to the original IPCEIE, the IPCEIE-83 also resulted a good model fit ( $\chi^2/df=5.462$ , CFI=0.93, NNFI=0.92, and RMSEA=0.176) and all 83 items had sufficient factor loadings (0.59-0.85). In summary, both the IPCEIE-72 and IPCEIE-83 had satisfactory construct validity in the one third-order model of the IPCEIE, but there did not converge in 3-dimensions second-order models of the IPCEIE-72. Therefore, we suggested that future users may use the IPCEIE-83 to capture the multiple dimensions of IPCEIE with management skill items although some exercise experts did not think there are needed.

## Keywords

IPCEIE, Confirmatory factor analysis, Elderly people

## Introduction

Physical health has an important effect on both objective and subjective quality in late life [1]. Previous studies and current evidence show, physical health in terms of chronic illnesses, functioning, disability, sensory impairment, alcohol abuse, frailty, and falls are absent from elderly people who may experience a better quality of life. In contrast, elderly people with worse physical health may have a poor quality

of life or live short [2]. Therefore, improving and maintaining physical health, may play a major role in maintaining quality of life in old age. Exercise is one of methods to keep and maintain physical health for elderly people. For example, physical exercise and activity may elevate peripheral brain-derived neurotrophic factor (BDNF) in healthy humans by acute and chronic aerobic exercise [3] and prevent cognitive decline and neurodegenerative diseases in elderly people through nonpharmaceutical

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intervention [4]. Coelho and colleagues (2014) used a controlled design to explore the effects on BDNF levels of elderly people with Alzheimer's disease by acute aerobic and they found that aerobic exercise increases BDNF plasma levels for Alzheimer's and healthy elderly people. They suggested BDNF levels had association with level of physical activity [5]. Burzynska and colleagues (2014) explored the relationship between physical activity, cardiorespiratory fitness and neural correlates in later life and they found that health elderly people participate in physical activity are important in maintaining white matter [6]. On the other hand, physical exercise and activity promise mastery experience, self-persuasion, and diminution in negative sentimental states [7]. However, some barriers limit to engage in exercise for elderly people, for example, they do not have friends, place, poor athletic skills, lack of motivation [8], lack of information and understanding, lack of guidance and communication, general misunderstanding related to exercise, even do not know proper physical fitness etc [9,10]. All of these factors may result in being decreasingly interest to participate in exercise, disengage in sociology, and lead to lonely life [11,12].

The concepts of the indicators of professional competence for exercise instructors of the elderly (IPCEIE) are practical as a guiding principle for exercise instructors to using in exercising class among elderly people [13]. The IPCEIE enables exercise instructors to improve their knowledge, attitude, management, plan, and ability to coping with elderly people in exercise class. On the other hand, elderly people also could obtain the benefit from the exercise instructors, such as increase of self-assurance, physical health, social participant, and quality of life.

The IPCEIE is an instrument designed to convey a standard in multidimensional constructs. The original development of the IPCEIE was based on the elderly people exercise from several researchers [13,14]. They suggested that exercise instructors should with ten professional competences when they conduct exercise for elderly people. Followed by this study, they developed the IPCEIE by using Grounded Theory and confirmed the professional competency of exercise instructors for the elderly that contains five factors which are professional knowledge, professional skill, professional attitude, personality traits, and communication skills [14].

Furthermore, the IPCEIE was produced 83-item (first-order), 11-factor (second-order), and 3-factor (third-order) as **Table 1**. Later than using the Delphi technique and the analytic hierarchy process (AHP) [15], researchers identified 3 third-order factors (professional knowledge, professional skills, and professional attitude), 10 second-order factors (teaching attitude, exercise knowledge, professional growth, exercise safety, personal characteristics, exercise instructor, gerontology knowledge, communicative competence, curriculum design, and motor skill), and 72 first-order items. However, to our knowledge, no researches have yet examined the factor dimensions (i.e., first-, second-, third-order models) of both the IPCEIE-83 and the IPCEIE-72. Therefore, the aim of this research was to assess the construct validity of the IPCEIE-83 and the IPCEIE-7.

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## Methods

### ■ Participants and Ethics

The IPCEIE was developed using qualitative methods, however, no studies have evaluated the construct validity using CFA. Therefore, this research used a convenience sampling strategy to recruit participants in northern Taiwan from September 2014 to May 2015. We visited various northern Taiwan urban districts that had established elderly exercise classes (Health Village, the Tai Chi Chuan Association, and the Elder Academy) and collected data from eligible exercise instructors via the self-administered questionnaire. Eligible participants needed to meet the following criteria by (1) being an exercise instructor of elderly people with more than 2-years' experience, (2) having at least an elementary level of education, and (3) being of an age of at least 25 but no more than 70 years. The total of 204 participants met the inclusion criterion and agreed to complete the questionnaire. Upon reviewing the participants' answers, we found that we could only accept 145 (71%) as the remainder had not been filled out completely.

This research was approved by the Research Ethics Committee of National Taiwan University (NTU-REC No.: 201407ES013). Participants obtained informed consent and the participants' records/information were anonymized and de-identified prior to analysis in this research. In keeping with the Personal Information Protection Act of Taiwan, the personal data collected will continue be kept confidential and

**Table 1: The items and dimensions of the IPCEIE-83 and the IPCEIE-72.**

Third-order	Second-order	First-order	Note*
<b>Knowledge</b>	<b>Gerontological knowledge</b>	1. Elderly physiology	
		2. Elderly psychology	
		3. Elderly sociology	deleted
		4. Elderly nutrition	
		5. Physical activity and aging	
		6. Common diseases in elderly	
		7. Successful aging	
		8. Benefit policy in aging	deleted
		9. Health maintenance in aging	
	<b>Exercise knowledge</b>	10. Sport pedagogy	
		11. Sport psychology	
		12. Sports anatomy	
		13. Sport coaching methods	
		14. Physical fitness	
		15. Protection from Exercise Injury	
		16. Exercise management	deleted
		17. Exercise physiology	
		18. Sports mechanics	
<b>Professional Skill</b>	<b>Curriculum design</b>	19. Arranging curriculum systematically	
		20. Design curriculum innovation	
		21. Design elderly physical activity curriculum	
		22. Design teaching media	deleted
		23. Design exercise for elderly with chronic diseases	
		24. Design exercise fitness for elderly	
	<b>Exercise skill</b>	25. Design exercise of preventing fall for elderly	
		26. Design goals for each exercise steps	
		27. Knowing well exercise kinematics for elderly	
		28. Knowing well exercise action skills for elderly	
	<b>Exercise safety</b>	29. Knowing well exercise action technology for elderly	
		30. Knowing well sport equipment's and use	
		31. Doing Physical examination for elderly	
		32. Evaluating exercise ability of elderly	
	<b>Exercise guidance</b>	33. Preventing sport injure	
		34. Dealing sport injure	
		35. Doing CPR	
		36. Evaluating safety of exercise environment	
37. Explaining exercise goals clearly			
<b>Management skill</b>	38. Explaining exercise skill		
	39. Demonstrating standard action		
	40. Speaking clearly instruction		
	41. Creating good atmosphere for learning		
	42. Evaluating physical fitness efficiency		
	43. Providing different exercise guidance methods		
	44. Having recruiting members ability	deleted	
45. Maintaining sport equipment's ability	deleted		
46. Having marking ability	deleted		

		47. Having planning activity ability	deleted
		48. Having leading ability	deleted
		49. Having financial management ability	deleted
		50. Having computer ability	deleted
	<b>Communication skill</b>		
		51. Encouraging elderly	
		52. Sharing feeling to elderly	
		53. Using appropriate voice	
		54. Using body language	
		55. Having explaining ability	
		56. Having listening skill	
		57. Solving conflict ability	
		58. Having interacting ability	
		59. Using appropriate words	
		60. Using other dialogue (Taiwanese or Hakka )	
	<b>Professional Attitude</b>		
	<b>Teaching attitude</b>		
		61. Starting class on time	
		62. Treating elderly equally in class	
		63. Caring elderly	
		64. Keeping privacy of elderly	
		65. Respecting elderly	
		66. Observing physical condition of elderly	
		67. Admitting the errors of exercise guidance	
		68. Being vibrancy	
		69. Being passion for work	
	<b>Professional growth</b>		
		70. Keeping on job training	
		71. Knowing new information	
		72. Keeping self-learning exercise skills	
		73. Keeping good apparel appearance	
		74. Keeping health shapely appearance	
		75. Keeping well fitness	
	<b>Personal characteristic</b>		
		76. Being service	
		77. Being optimistic concept	
		78. Being patient	
		79. Being affinity	
		80. Being empathy	
		81. Being under stress	
		82. Being benevolent	
		83. Being good characteristic	
*Professional experts suggested deleted items from the IPCEIE-83, and then became the IPCEIE-72.			

secure until its destruction upon the publication of this research.

### Instruments and data analyses

The IPCEIE was created in accordance with the previous literature, the Grounded Theory and the Delphi technique [14,15]. The original IPCEIE included 83 items (11-factor), followed by the professional group's opinions changed to 72 items (10-factor). We examined validity of the IPCEIE-83 and the IPCEIE-72 with a five-point Likert-type scale (1=Strongly Disagree,

2=Disagree, 3=Uncertain, 4=Agree, 5=Strongly Agree). First, we examined the first-order factor dimensions (i.e., 11-factor model) of the IPCEIE. After that the 3 second-factor models were assessed if the 11 second-factor was supported. Following the 3 second-factor models resulted in acceptable; the third-order model was examined.

Data were recorded on SPSS for Windows version 18.0 to do descriptive analyses [16] and internal consistency (Cronbach's alpha) [17]. The LISREL 8.8 software [18] was used to examine confirmatory factor analysis (CFA)

with goodness-of-fit indices for validating the one dimensional construct of items. This research used criterion that included the relative chi-square criterion ( $\chi^2/df \leq 5.0$ ) [19,20], comparative fit index ( $CFI \geq 0.9$ ) [21,22], non-normed fit index ( $NNFI \geq 0.9$ ) [19], and the root mean square error of approximation ( $RMSEA \leq 0.05$ ) [23].  $RMSEA \leq 0.05$  with an upper limit of the 90 percentage confidence interval between 0.100 and 0.15 was reflected on an acceptable model fit [24].

**Results**

A total of 145 participants ( $46.36 \pm 14.64$ ) met the criteria of this research, 52.4% were male, 38.6% had university level education, and more information showed in **Table 2**. The

total reliability of the IPCEIE-83 was 0.979 and 3-factor reliability was that gerontological knowledge was 0.932, professional skill was 0.968, and professional attitude was 0.959. Cronbach's  $\alpha$  of the 11 factors were from 0.857 to 0.948 (**Table 3**).

The IPCEIE with 72-item showed an unaccepted model ( $\chi^2/df=6.516$ ,  $CFI=0.92$ ,  $NNFI=0.91$ , and  $RMSEA =0.196$ ) and all 72 items had sufficient factor loadings (0.59-0.86). However, some first-order and second-order models did not converge, although third-order model had an accepted model ( $\chi^2/df=3.61$ ,  $CFI=0.96$ ,  $NNFI=0.94$ , and  $RMSEA=0.14$ ).

The IPCEIE with 83-item resulted an unaccepted model ( $\chi^2/df=5.46$ ,  $CFI=0.93$ ,  $NNFI=0.92$ , and

**Table 2: Characteristics of the participants (N=145).**

Characteristic	N	%	Mean	SD
<b>Age</b>	145		46.36	14.64
<b>Gender</b>				
Female	69	47.6		
Male	76	52.4		
<b>Education</b>				
Elementary school	2	1.4		
Junior high school	25	17.2		
Senior high school	16	11.0		
College	12	8.3		
University	56	38.6		
Master	30	20.7		
PhD	4	2.8		
<b>Teaching recreational sport</b>				
Tai chi chuan	43	29.7		
Wai dan chuan	38	26.2		
Yang sheng exercise	15	10.3		
Fitness exercise	22	15.2		
Others	27	18.6		

**Table 3: Cronbach's  $\alpha$  of the IPCEIE-83.**

Dimension	First-order	Second-order	Third-order
The IPCEIE			0.979
Knowledge		0.932	
Gerontological knowledge	0.900		
Exercise knowledge	0.901		
Skill		0.968	
Curriculum design	0.857		
Exercise skill	0.917		
Exercise safety	0.908		
Exercise guidance	0.905		
Management skill	0.916		
Communication skill	0.920		
Attitude		0.959	
Teaching attitude	0.924		
Professional growth	0.896		
Personal characteristic	0.948		

**Table 4: Results of fit indices for the first-, second-, and third-order models.**

Index	First-order CFA with 72-item	Gerontology knowledge subscale (2-order)	Professional skill subscale (2-order)	Professional attitude subscale (2-order)	The IPCEIE-72 (3-order)
$\chi^2$	228.07	The model did	The model did	The model did	115.60
df	35	not converge.	not converge.	not converge.	32
$\chi^2/df$	6.516				3.613
CFI	0.92				0.96
NNFI	0.91				0.94
RMSEA	0.196				0.135
Index	First-order CFA with 83-item	Gerontology knowledge subscale (2-order)	Professional skill subscale (2-order)	Professional attitude subscale (2-order)	The IPCEIE-83 (3-order)
$\chi^2$	240.34	The model was	6.74	The model was	130.56
df	44	saturated, the fit	6	saturated, the fit	41
$\chi^2/df$	5.462	was perfect.	1.348	was perfect.	3.184
CFI	0.93		1.00		0.96
NNFI	0.92		0.99		0.95
RMSEA	0.176		0.049		0.123

RMSEA=0.18) and all 83 items had sufficient factor loadings (0.59-0.85); however, first-order, second-order, and third-order ( $\chi^2/df=3.18$ , CFI=0.96, NNFI=0.95, and RMSEA=0.12) models met the criteria and were a good fit of this research sample as illustrated in **Table 4**.

**Discussion**

This research is the first study to employ CFA determines the factor structures of the IPCEIE in exercise instructors. We examined the IPCEIE-72 and the IPCEIE-83 models (i.e., first-order, second-order, and third-order) to determine their robust for advance application and validation. First, we examined both the models of the IPCEIE both with 72-item and with 83-item; however, these two models presented insufficient models. Although CFI and NNFI showed a good fit, but the relative chi-square criterion and RMSEA did not meet criteria. Finally, both the IPCEIE-72 and the IPCEIE-83 in third-order had accepted models, and the IPCEIE-83 presented a better model than the IPCEIE-72 because the IPCEIE-83 has 11 more items of support.

We then examined the three second-order subscales of the IPCEIE-72 and found that they did not converge. In our previous paper, a group of 11 professional exercise experts suggested the deletion of items such as ‘Elderly sociology’, ‘Benefit policy in aging’, ‘Exercise management’, ‘Design teaching media’, ‘Having recruiting members ability’, ‘Maintaining sport equipment function’, ‘Having marketing ability’, ‘Having planning activity ability’, ‘Having leadership ability’, ‘Having financial management ability’, and ‘Having computer skills’. After 11 items were

deleted, the IPCEIE-83 became IPCEIE-72. However, we considered that these items regarding management skill in organizing elderly people for exercise physical and leisure activities to be important. Finally, the results confirmed our thinking and most exercise instructors agreed that these items were very important in their work. Alternatively, three second-order subscales of the IPCEIE-83 had very good support in these models. These results suggested that the 11 items should not be deleted, especially the ‘elderly sociology’ item. These findings confirmed our view that exercise benefits not only physical health but it also promotes social relationships and mood improvement for elderly people [12].

Third-order models of both the IPCEIE-72 and the IPCEIE-83 then were shown to have a good model-fit. The IPCEIE-83 model was better than the IPCEIE-72 model because the IPCEIE-72 lacked one second-order factor (Management skill). This result showed that most exercise instructors supported the management skill factor in this scale. This also supported our assumption that elderly people need to be guided, lead, and managed in group exercise to prevent physical performance loss, and social isolation [9].

One limitation of this research is that maximum likelihood (ML) failed to converge to second-order models in the IPCEIE-72 because of the small sample size. The ML might have difficulty converging under some of the sample conditions selected because the lower rates of non-convergence for this method resulted in a smaller sample size. The ratio of sample size is 5 to 1 for free parameters [25]. Although this research did not meet this goal, lower sample sizes can be used in the following 3 conditions:

(1) models with no latent variables, (2) all loadings are fixed (usually to one), and (3) with simpler models [25]. A second limitation of this research is the homogeneity of the population in exercise instructors. Further researchers might find different results if they use a heterogeneous population for example: fitness trainers, developers with community-based elderly groups, etc.

### Conclusion

In summary, both the IPCEIE-72 and IPCEIE-83 had satisfactory construct validity in the one third-order model, but they did not converge in 3-dimensional second-order models of the IPCEIE-72. Therefore, we suggest that

further users (i.e. exercise instructors, fitness trainers, and program developers in communities or senior centers, case managers, social workers in long-term care facilities) use the IPCEIE-83 to capture the multiple dimensions of IPCEIE with management skill items although we acknowledge that a few of the exercise experts did not agree they were needed.

### Conflict of Interest

*The authors declare that there is no conflict of interest regarding the publication of this paper.*

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