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Introduction

Strengthening periodontal disease patients to adherence to preventive behaviors at home and reduce dental plaque is indispensable in the treatment of periodontal disease. Protection motivation (PM) theory has been widely used to predict protective behaviors based on two factors: threat appraisal and coping appraisal. This study is the first to apply artificial intelligence (AI) platform as intervention tool to the protection motivation for the field of oral health education.

Objective

We aimed to examine the effects of AI dental monitoring (DM) on PM and dental plaque in patients with periodontal disease.

Methods

Study Design : A randomized control trial ,single-blinded

Participants : The patients aged 35~65,newly diagnosed with the stage III periodontitis were randomly assigned to AI (AI; n = 28), AI & human counseling (AIHC; n =29), and control (CG; n =28) groups in 2019-2022.

Outcome variables : Data were collected including protection motivation (PM)and plaque control record (PCR). PM scored range from 7-70 points, total 7 items, the higher the score, the greater the motivation.

Intervention : All participants received nonsurgical periodontal treatment and oral hygiene instruction, whereas the patients in the AI and AIHC group received additional (a) AI and (b) AI with human counseling over 6 months, respectively.

Data collection : The PM score were collected by administrated questionnaire and the PCR were collected by observation method at baseline 1-,3-and 6-month follow-ups.

Data analysis : A mixed-design analysis of variance model analyzed the follow-up effects over time.

Result

The AI and AIHC exhibited respectively greater improvement in level of PM ($\beta = 2.97$ and 2.99 , ES = 0.50 and 0.69) at the 1-month follow-up than the CG did. The AI and AIHC respectively increase in level of coping appraisal ($\beta = 2.59$ and 3.10 , ES = 0.49 and 0.65) at the 3-month follow-up than the CG did. The AI and AIHC exhibited greater improvement in PCR [$\beta = -16.66$ and -23.65 , effect size (ES) = 0.92 and 1.35] at the 6-month follow up than the CG did.

Conclusion

Using AI DM at home had a positive effect on the level of PM and plaque control in patients with periodontitis.

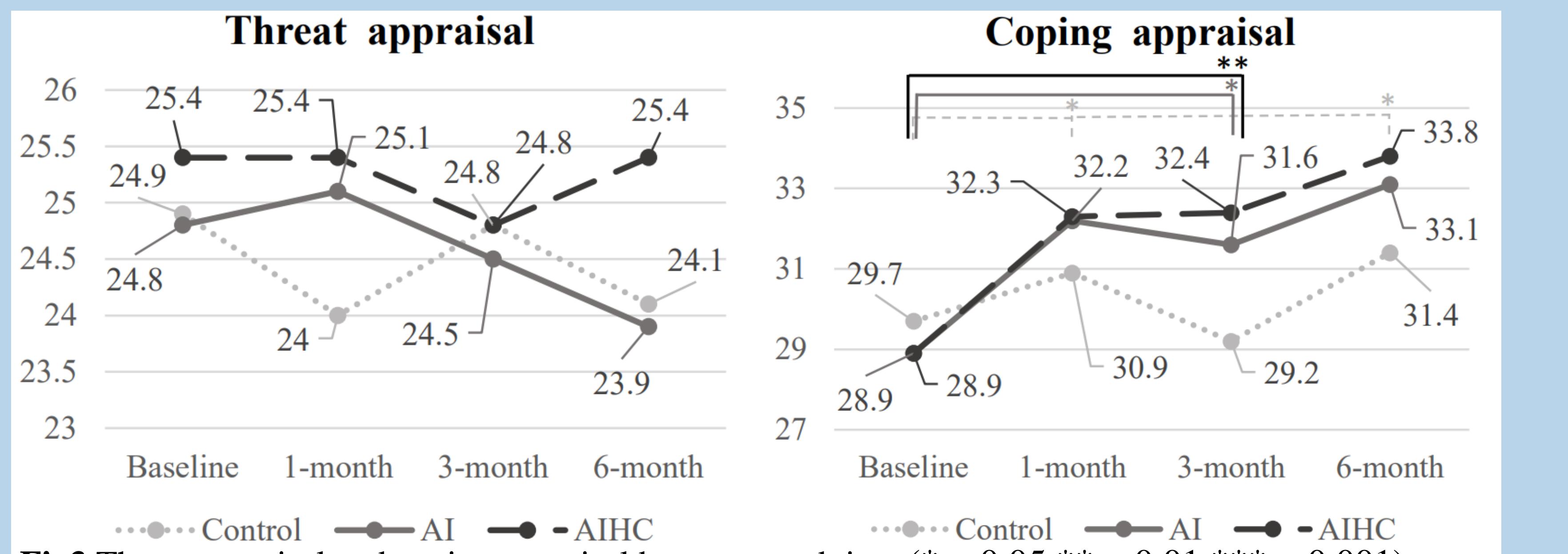


Fig3.Threat appraisal and coping appraisal by group and time. (*p<0.05, **p<0.01, ***p<0.001)

Protection Motivation Theory(PMT)

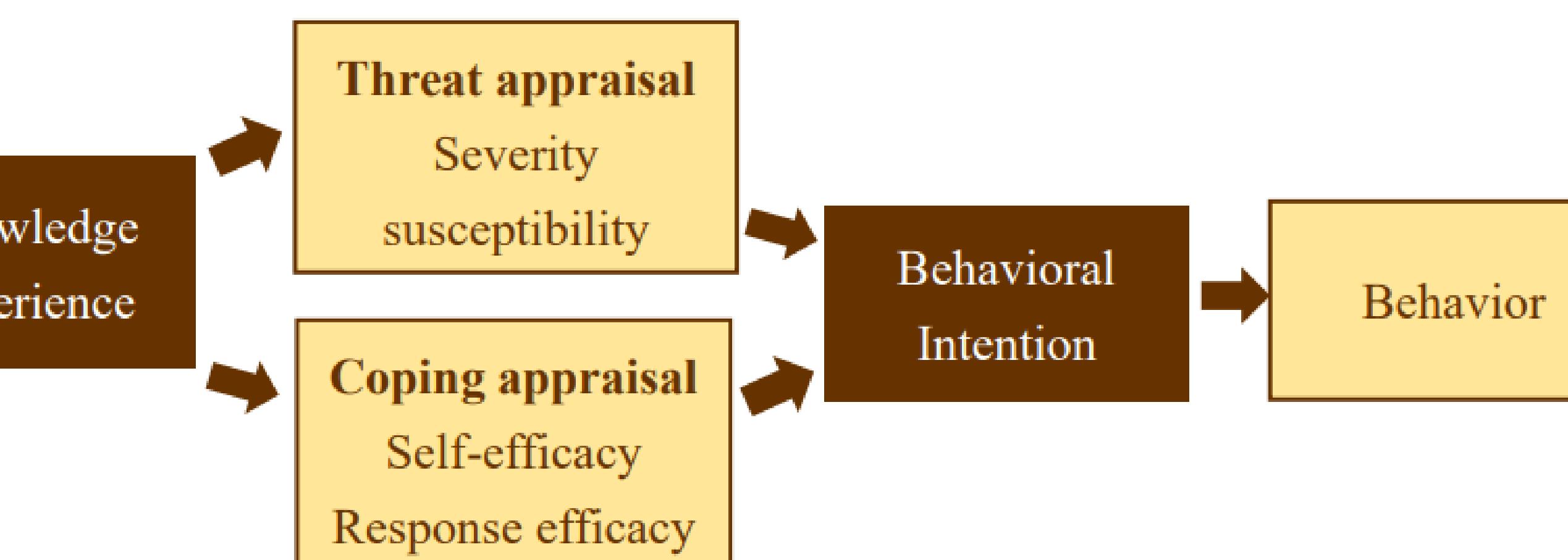


Fig1.Protection motivation theory(PMT)

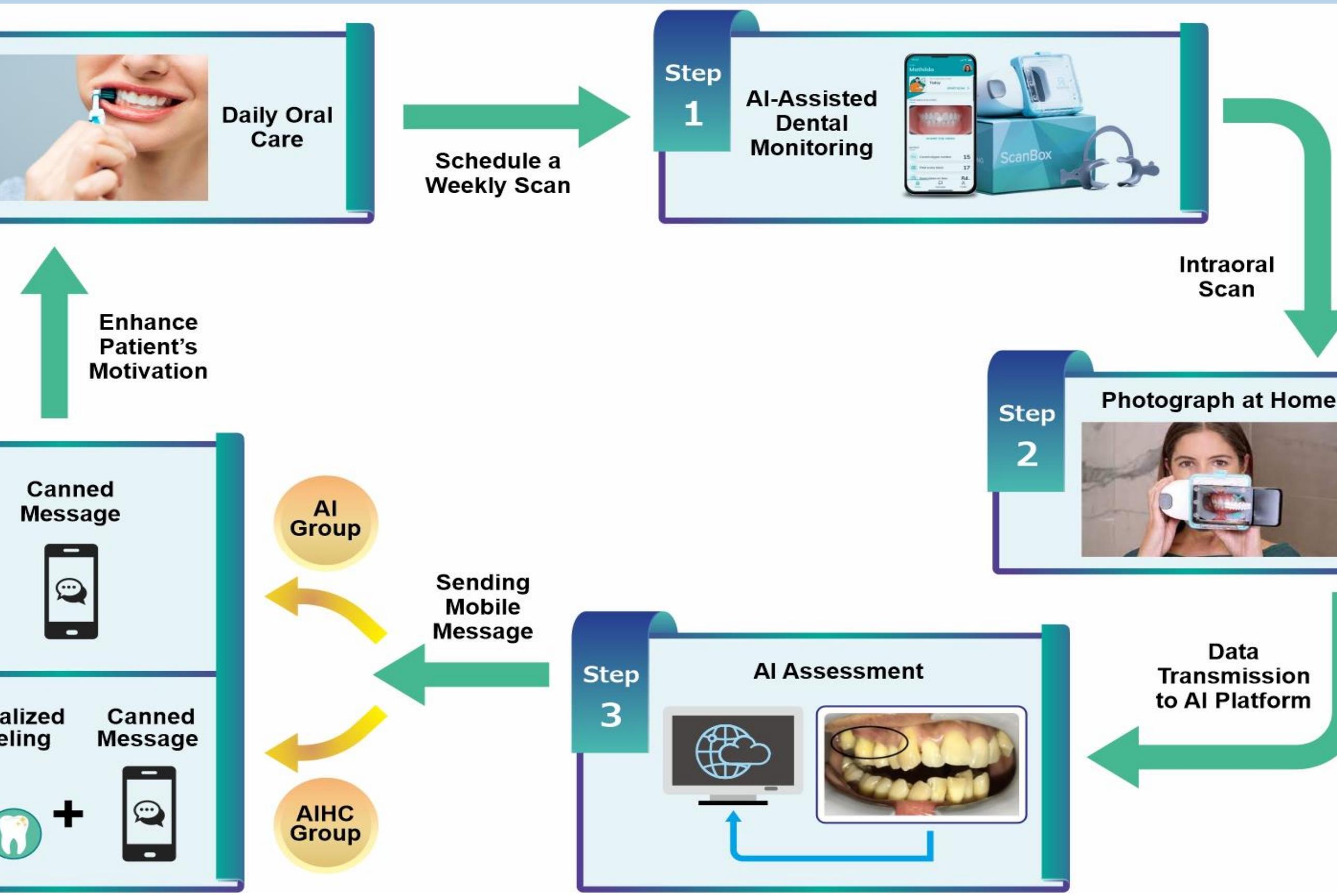


Fig2. Flow chart of AI dental monitoring platform intervention (Shen KL et al.,2022)

Plaque Control Record

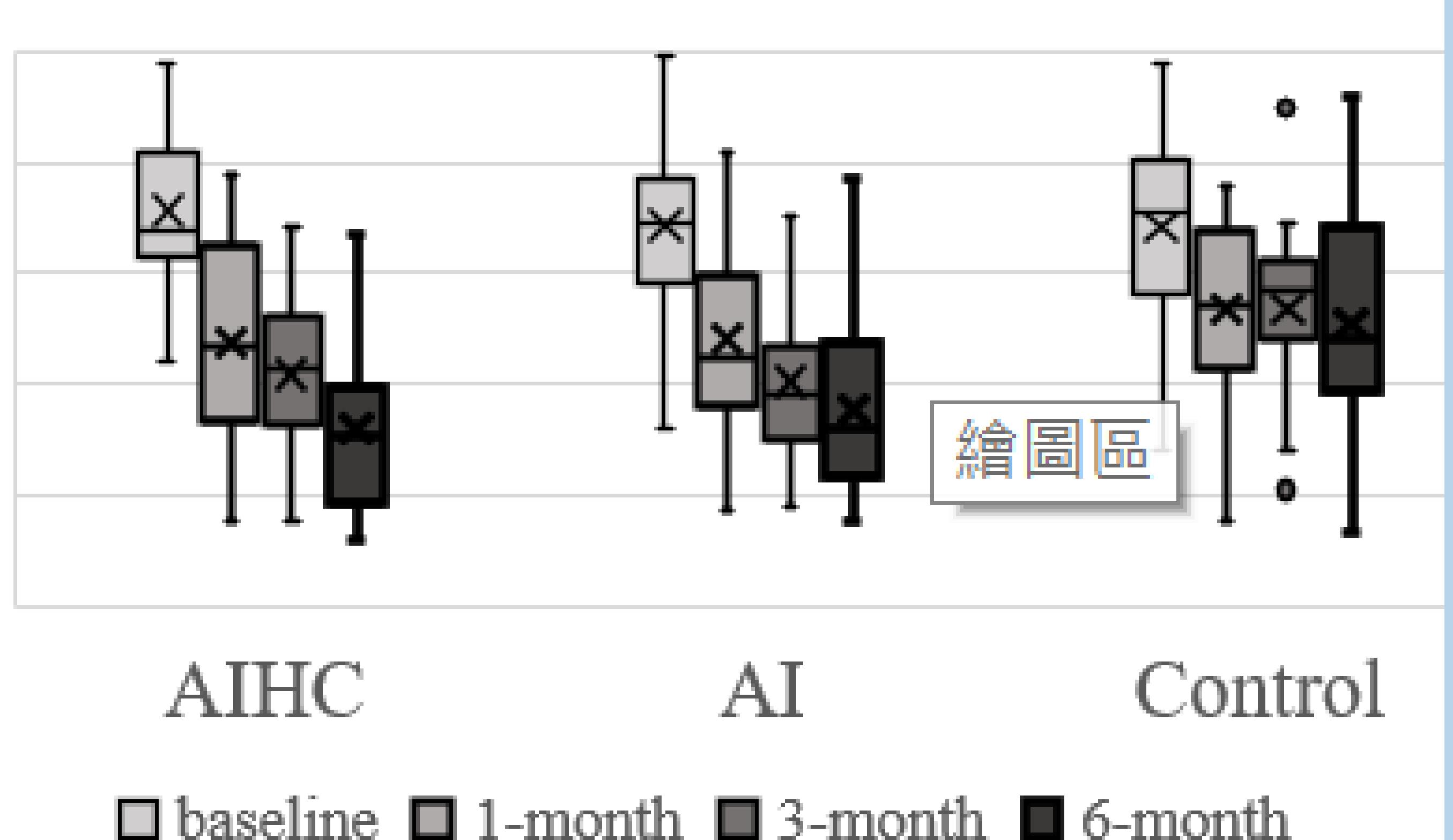


Fig4.Boxplots of plaque control record (PCR) by group and time.

Table 1. Baseline information among AI group, AI & counseling group and control group

Variables	Control group		AI group		AI & counseling group		P value
	n	%	n	%	n	%	
Ages (M±SD)	52.4±9.4		50.6±7.8		51.3±9.5		0.200
Gender							0.628
Man	11	39.3	14	50.0	11	37.9	
Woman	17	60.7	14	50.0	18	62.1	
Education level							0.345
Under senior high	8	28.6	7	25.0	10	34.5	
University	17	60.7	12	42.9	13	44.8	
Graduate school	3	10.7	9	32.1	6	20.7	
PCR (%)	68.4±17.5		68.7±16.1		71.3±14.0		0.945
PM	54.7±7.5		53.8±6.6		54.6±6.1		0.872

P value was difference between groups, using Fisher's exact test and Kruskal-Wallis test.
Plaque control record=PCR; PM=Protection Motivation

Table 2. Regression-estimated differences in oral hygiene index among AI group, AI & counseling group and control group.

Variables	β	95%CI	ES ^d	P value
Plaque control record (PCR)				
Group (AI group) ^a	-5.5	(-19.33,8.36)	0.437	
Group (AIHC group) ^a	2.8	(-10.43,16.13)	0.674	
Time(1-month) ^b	-10.4	(-21.76,0.89)	0.071	
Time (3-month) ^b	-10.4	(-21.68,0.98)	0.073	
Time (6-month) ^b	-6.6	(-17.91,4.75)	0.255	
Group (AI group)×Time(1-month) ^c	-4.8	(-20.44,10.79)	0.40	0.545
Group (AI group)×Time (3-month) ^c	-10.4	(-25.97,5.26)	0.51	0.194
Group (AI group)×Time (6-month) ^c	-18.9	(-34.50,-3.28)	0.94	0.018
Group (AIHC group)×Time (1-month) ^c	-9.8	(-24.81,5.16)	0.60	0.199
Group (AIHC group)×Time (3-month) ^c	-26.6	(-41.58,-11.60)	1.43	0.001
Group (AIHC group)×Time (6-month) ^c	-31.4	(-46.38,-16.40)	1.40	<0.001
Threat appraisal (3-30)				
Group (AI group) ^a	-0.12	(-1.74,1.50)	0.885	
Group (AIHC group) ^a	0.39	(-1.26,2.03)	0.644	
Time(1-month) ^b	-1.16	(-2.40,0.09)	0.068	
Time (3-month) ^b	-0.32	(-1.62,0.98)	0.632	
Time (6-month) ^b	-1.34	(-2.70,0.03)	0.055	
Group (AI group)×Time(1-month) ^c	1.35	(-0.36,3.05)	0.49	0.121
Group (AI group)×Time (3-month) ^c	-0.34	(-2.16,1.49)	0.07	0.718
Group (AI group)×Time (6-month) ^c	0.48	(-1.50,2.45)	0.44	0.635
Group (AIHC group)×Time (1-month) ^c	1.22	(-0.48,2.92)	0.51	0.159
Group (AIHC group)×Time (3-month) ^c	-0.26	(-2.06,1.54)	0.02	0.778
Group (AIHC group)×Time (6-month) ^c	1.18	(-0.80,3.16)	0.67	0.243
Coping appraisal (4-40)				
Group (AI group) ^a	-0.77	(-3.17,1.62)	0.527	
Group (AIHC group) ^a	-0.77	(-3.12,1.59)	0.524	
Time(1-month) ^b	1.52	(0.00,3.04)	0.049	
Time (3-month) ^b	-0.11	(-1.70,1.48)	0.890	
Time (6-month) ^b	2.01	(0.35,3.69)	0.018	
Group (AI group)×Time(1-month) ^c	1.77	(-0.31,3.84)	0.47	0.095
Group (AI group)×Time (3-month) ^c	2.59	(0.38,4.79)	0.49	0.021
Group (AI group)×Time (6-month) ^c	1.41	(-1.02,3.83)	0.26	0.255
Group (AIHC group)×Time (1-month) ^c	1.65	(-0.43,3.74)	0.34	0.119
Group (AIHC group)×Time (3-month) ^c	3.10	(0.86,5.33)	0.65	0.007
Group (AIHC group)×Time (6-month) ^c	2.37	(-0.05,4.79)	0.42	0.055

^a Reference group: Control Group

^b Reference group: Baseline

^c Reference group: Control Group ×Baseline

^d Effect size (ES) calculated and as the mean difference of change between baseline and 1-, 3- and 6-month follow-up measurement between the AI group, AI & counseling group (AIHC) and control group.