PL Sullivan 蘇麗文
FY Wong 黃欣欣
SS Chan 陳肇始

Psycho-educational intervention for achieving and maintaining adequate dietary calcium intake in pre-menopausal Chinese women

Key Messages

1. A psycho-educational intervention programme developed for pre-menopausal Chinese women effectively improved their knowledge, attitudes, self-reported behaviours, stages of behavioural change, and dietary calcium intake.
2. This is the first report of a calcium education programme developed based on a theoretical framework comprised of the Systems Approach Model for Designing Instruction, PROCEED, Health Belief Model, and the Transtheoretical Model.
3. Health education programme designers should consider using a theoretical framework incorporating an instructional design model to design, implement, and evaluate instructional programmes.
4. The psycho-educational intervention programme and the instructional materials can be converted into a self-instructional programme after modification.

Department of Nursing Studies, The University of Hong Kong, Pokfulam, Hong Kong
PL Sullivan, FY Wong, SS Chan

HCPF project number: 216034

Principal applicant and corresponding author:
Prof Patricia L Sullivan
Department of Nursing Studies, Li Ka Shing Faculty of Medicine, The University of Hong Kong, 21 Sassoon Road, Pokfulam, Hong Kong SAR, China
Fax: (852) 2818 4469
E-mail: pat@pdi.hk

Introduction

Hong Kong women have an inadequate calcium intake and health problems related to a low dietary calcium intake, such as osteoporosis, are increasing dramatically with age. Health education programmes can promote dietary calcium intake.[1] Atheoretical health education programmes have focused on knowledge acquisition, while factors relating to the maintenance of behavioural change have been largely ignored.[2] Health behaviour theories provide frameworks for programme development, research, and evaluation. Theoretically based health education programmes have been found to both positively affect attitudinal and behavioural change and improve knowledge.[3]

The PRECEDE-PROCEED Model, the Health Belief Model (HBM), and the Transtheoretical Model (TTM) have often been used in health education studies. The PRECEDE-PROCEED has been an effective means of modifying the predisposing, enabling, and reinforcing factors associated with behavioural change[4]; the HBM has been effective for increasing the awareness and frequency of prevention behaviours, knowledge, and health beliefs[1]; and the TTM has been effective for monitoring stages of behavioural change and tailoring health messages that result in health behaviour change.[5] Instructional design models, such as the Systems Approach Model for Designing Instruction (SAMDI), have been used as a means of conceptualising the instructional process. They have been found effective for changing knowledge, attitudes and behaviours as well as providing a systematic basis for the subsequent analysis, evaluation, refinement, and replication of instructional programmes.[6]

Objective

The purpose of the study was to develop and test a psycho-educational intervention aiming to achieve and maintain an adequate dietary calcium intake in pre-menopausal Chinese women. An eclectic theoretical framework, comprising the SAMDI, PROCEED, HBM, and TTM, was used to guide the development, implementation, evaluation, and refinement of the intervention (Fig). In relation to dietary calcium, it was hypothesised that the intervention would result in higher knowledge; more positive attitudes; more health-related behaviours; higher stages of behavioural change; and the achievement and maintenance of an adequate intake for those pre-menopausal Chinese women who received it compared to those who did not.

Methods

Study design
This study was conducted from September 2001 to July 2003. A randomised pre-test/post-test control group design was used to test the hypotheses. The target population was healthy pre-menopausal Chinese women, between 30 and 50 years of age, who speak and read Chinese. Exclusion criteria were being pregnant, breastfeeding, or menopausal; investigated for, and/or diagnosed with osteoporosis or bone loss; and/or on medication for chronic health conditions.
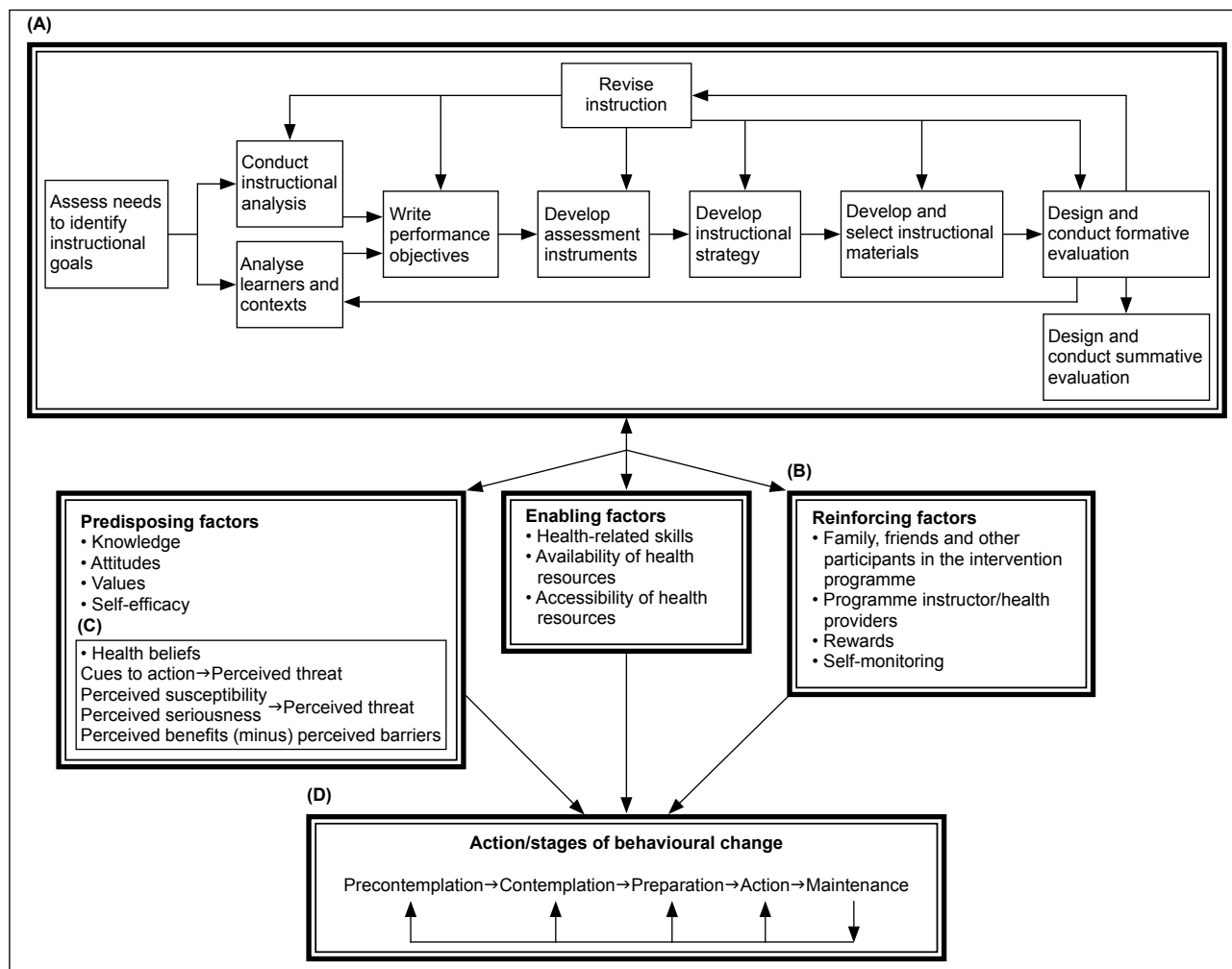
Fig. Theoretical framework
Sources: (A) Dick Walter, Lou Carey, James O Carey. The systematic design of education. 5th ed. Published by Allyn and Bacon, Boston, MA. Copyright © 2001 by Pearson Education. Reprinted by permission of the publisher. (B) Lawrence W Green, Marshall Kreuter. Health promotion planning: an educational and ecological approach. 3rd ed. 1999. With permission of the Mc-Graw-Hill Companies. (C) Ralph J DiClemente, John L Peterson. Preventing AIDS: theories and methods of behavioral interventions. 1994. Page 11, Fig 1: Schematic diagram of the components of the health belief model. With kind permission of Springer Science and Business Media. (D) James O Prochaska, John C Norcross. Systems of psychotherapy: a transtheoretical analysis. A transtheoretical analysis. 3rd ed. 1994. Reprinted with permission of Wadsworth, a division of Thomson Learning: www.thomsonrights.com.

Study instruments

The Dietary Calcium Questionnaire (DCQ), a 3-day Dietary Record (3-DDR), the Food Consumption Aiding Tool for Chinese Diets (FCAT-CD), and a sample of a completed 3-DDR (S3-DDR) were developed. All tools were developed in English and Chinese. The DCQ was a 100-item, criterion-referenced, multiple-choice, self-administered instrument based on the major constructs of the PROCEED, HBM, and TTM, designed to measure knowledge, attitudes, self-reported behaviours, and stages of behavioural change related to dietary calcium. The 3-DDR was a self-administered form for recording dietary intake for 3 whole days, including two weekdays and one weekend day, that was used to assess participants' dietary calcium intake. The FCAT-CD was a series of colour digital photographs of food portions in scale with food and measuring utensils commonly used in Chinese diets, used by participants to estimate portion sizes. The S3-DDR was a sample of a completed 1-day dietary record given to participants to demonstrate how to complete

the 3-DDR. All tools were assessed for psychometric characteristics, including content validity and test-retest reliability, and were found to be adequate.

Psycho-educational intervention

Development of this psycho-educational intervention was guided by the SAMDI. It was made up of a needs assessment, instructional goal development, instructional analysis, analysis of learners and context, development of performance objectives, assessment instruments, instructional strategies and materials, and formative and summative evaluation. Elements of the PROCEED, HBM, and TTM were incorporated into the instructional programme design. The intervention consisted of four 90-minute sessions incorporating lectures and group discussions, conducted as one session per week over 4 consecutive weeks. The sessions were in Chinese and were taught by a registered dietician. Session 1 focused on dietary calcium and health problems related to dietary calcium and

its deficiency; session 2 on the attitudes, health beliefs and values conducive to achieving and maintaining an adequate dietary calcium intake; session 3 on the skills needed to initiate an adequate dietary calcium intake; and session 4 on the coping, reinforcing, and self-monitoring skills needed to achieve and maintain it.

Main study

The study was conducted in two rounds due to a high attrition rate in the first round. In round one, subjects were recruited from a local women's club and a health clinic. They were either approached in person or by phone. In round two, the recruitment network was expanded to 12 women's centres and clinics and a labour union, and a call for participants was included in two Chinese newspapers. Randomised numbers for 0 (control) and 1 (experimental) were generated using Microsoft Excel 2000 beforehand. Those who agreed to participate were randomly assigned to either the control or experimental group according to the sequence of their recruitment and the randomised numbers of "0" and "1" on the list. A convenience sample of 614 pre-menopausal Chinese women aged 30 to 50 years, who met the inclusion and exclusion criteria, was randomly assigned to the experimental (n=339) and control (n=275) groups.

All participants attended an introductory session. The purpose of the study was explained and consent forms were signed. All participants completed the DCQ at the introductory session. They were also given the 3-DDR with the S3-DDR to complete at home and return within a week. The intervention was delivered to the experimental group 1 week after the introductory session. No intervention was provided for the control group. Immediately following the completion of the intervention, the experimental group completed the DCQ and they were given the 3-DDR with the S3-DDR to complete at home. A packet containing a copy of the DCQ, 3-DDR, and the S3-DDR was mailed to the control group. Individual dietary calcium reports (IDCR) indicating the amount of calcium consumed and its adequacy at the pre-test was mailed to all participants 2 months before the 3-month post-test. The same packet and IDCR of immediate and 3-month post-tests, were mailed to both groups 3 months and 6 months after the intervention, respectively. The IDCR of the 6-month post-test was mailed to all participants within 2 weeks of completion. The control group also received two pamphlets that summarised the content of the intervention.

Ethical considerations

Ethical approval for this study was obtained from the Ethics Committee of the Faculty of Medicine, the University of Hong Kong. Written consent was obtained from all participants before data collection. Confidentiality and participants' rights to withdraw from the study were assured.

Data analysis

Santé (Hopkins Technology, Hopkins MN, 1995), a nutrient analysis programme, was used to analyse the amount of

Table 1. Experimental and control group demographics

	Experimental (n=49)	Control (n=103)	P value
Age-group (years)			
30-39	5 (10%)	34 (33%)	<0.01
40-50	44 (90%)	69 (67%)	
Marital status			
Married	38 (78%)	85 (83%)	0.47
Single/widowed/ divorced/separated	11 (22%)	18 (17%)	
Educational level			
Primary school/ secondary school/ technical institution	45 (92%)	88 (85%)	0.27
University or above	4 (8%)	15 (15%)	
Working status			
Full-time/part-time	30 (61%)	66 (64%)	0.73
Retired/housewife/ unemployed	19 (39%)	37 (36%)	
Monthly household income (HK$)			
<$5000-$15 000	15 (31%)	35 (34%)	0.74
>$15 000	33 (67%)	68 (66%)	
Missing	1 (2%)	-	

dietary calcium consumed. Statistical analysis of the DCQ was conducted using the Statistical Package for the Social Sciences (Windows version 11.5.1; SPSS Inc, Chicago, US). Fisher's exact test was used to examine associations between groups and demographic factors. A two-way ANOVA was used to examine differences in knowledge and attitude scores, stages of behavioural change, and self-reported dietary calcium intake between the groups, and a one-way ANOVA was used to examine differences in pre-tests and post-tests within the same group. A logistic regression was used to compare the self-reported behaviours between the groups. Friedman and Chi squared tests were performed to assess the change in self-reported behaviours between the pre-tests and post-tests in the same group and the Wilcoxon signed ranks test was used to identify those post-tests in which significant changes had occurred. Analyses were conducted at a significance level of $P<0.01$.

Results

Demographics

All aspects of the study were completed by 49 women in the experimental group and 103 in the control group. There were no significant differences in marital status, education level, working status, and monthly household income between the two groups; however, the control group was found to be significantly younger than the experimental group ($P<0.01$) [Table 1].

Knowledge, attitudes, stages of behavioural change, dietary calcium intake, and self-reported behaviours

Controlling for the effect of age, no significant difference between the experimental and control group was found at the pre-test for knowledge [$F_{(1,136)}=0.73$, $P=0.39$], attitude [$F_{(1,135)}=0.02$, $P=0.90$], stage of behavioural change [$F_{(1,131)}=2.46$, $P=0.12$], and dietary calcium intake [$F_{(1,145)}=28.04$, $P=0.76$]. After the intervention, the experimental group scored significantly higher than

Table 2. Knowledge, attitudinal scores, stages of behavioural change and dietary calcium intakes in experimental and control groups*

Parameter†	Experimental group	Control group	P value
Knowledge score			
P0	14.05 (3.05)	13.78 (3.23)	0.39
P1	20.04 (2.14)	13.61 (3.14)	<0.001
P2	19.14 (2.16)	14.43 (2.97)	<0.001
P3	19.10 (2.25)	14.67 (3.08)	<0.001
Attitudinal score			
P0	103.77 (9.81)	102.19 (7.74)	0.90
P1	108.48 (9.76)	101.38 (7.00)	<0.001
P2	109.82 (9.64)	101.23 (7.01)	0.001
P3	109.46 (11.27)	100.81 (8.23)	<0.001
Stages of behavioural change			
P0	3.00 (0.83)	2.69 (0.93)	0.12
P1	3.38 (0.89)	2.81 (0.85)	0.004
P2	3.38 (0.84)	2.96 (0.84)	0.029
P3	3.60 (0.95)	2.92 (0.93)	<0.001
Dietary calcium intake (mg/day)			
P0	574.14 (271.60)	582.66 (244.11)	0.760
P1	840.85 (346.18)	575.40 (233.99)	<0.001
P2	911.73 (323.10)	677.63 (339.81)	<0.001
P3	904.81 (355.50)	707.48 (239.83)	0.001

* Values are shown in mean (standard deviation); analyses were conducted at a significance level of $P<0.01$

† P0 denotes pre-test, P1 immediate post-test, P2 3-month post-test, and P3 6-month post-test

the controls on knowledge [$F_{(1,138)}=59.73$, $P<0.001$; $F_{(1,138)}=24.50$, $P<0.001$; $F_{(1,141)}=37.46$, $P<0.001$], attitude [$F_{(1,128)}=15.27$, $P<0.001$; $F_{(1,137)}=12.71$, $P=0.001$; $F_{(1,136)}=14.56$, $P<0.001$], and dietary calcium intake [$F_{(1,145)}=28.04$, $P<0.001$; $F_{(1,146)}=13.80$, $P<0.001$; $F_{(1,146)}=12.62$, $P=0.001$] on the immediate, 3-month and 6-month post-tests. For stages of behavioural change, the experimental group was at a significantly higher stage on immediate [$F_{(1,129)}=8.47$, $P=0.004$] and 6-month post-tests [$F_{(1,139)}=1.29$, $P<0.001$], compared with the control group (Table 2).

For self-reported behaviours, the only significant difference between experimental and control groups was in the frequency of accessing web sites on dietary calcium before the intervention (odds ratio=6.30; 95% confidence interval, 1.74-22.82). After the intervention, significantly higher percentages of participants in the experimental group, compared to the controls, reported using intellectual, coping and self-monitoring skills; identifying goals, the availability and accessibility of health resources; receiving social support; and trying to achieve and maintain an adequate calcium ($P<0.01$).

The experimental group was also found to have a significant improvement in knowledge and attitudinal scores and dietary calcium intake at the immediate, 3-month and 6-month post-tests compared with the controls ($P<0.01$).

Discussion

The psycho-educational intervention was effective at improving women's knowledge, attitudes, self-reported behaviours and stages of behavioural change relating to dietary calcium and achieving and maintaining an adequate dietary calcium intake for at least 6 months. The intervention has the potential, therefore, to help prevent calcium deficiency among pre-menopausal Chinese women and thus lower their risk of osteoporosis. The control group showed a significant improvement in knowledge, stages of behavioural change, and dietary calcium intake on the post-test compared with the pre-test. Nonetheless, the difference in the number of knowledge questions correctly answered between the pre-test and the 6-month post-test was less than one, their stages of behavioural change were at the contemplation stage and their dietary calcium intake did not meet the recommended daily intake of 800 to 1000 mg on the post-tests.

Limitations

Participant retention was a problem. To motivate participants and enhance retention, the same sessions were delivered at different times and locations in the main study. Free dietary calcium counselling, lucky draws, and attendance certificates were also incorporated to encourage completion of the programme. To overcome the high attrition rate, a more effective promotion plan to introduce the study on web sites and newsletters, and public education through the media and pamphlets should be considered in the future.

Conclusions

These findings have implications for theory, research, and health education practice. As the intervention programme was based on the SAMDI, it may also be relevant to other populations after refinement. To overcome attendance barriers, it can be converted into a self-instructional programme and placed on the internet.

Acknowledgement

References

1. Sedlak CA, Doheny MO, Jones SL. Osteoporosis prevention in young women. Orthop Nurs 1998;17:53-60.
2. Rankin SH, Stallings KD. Patient education issues, principles, practices. 2nd ed. Philadelphia: Lippincott; 1990.
3. Dunn S. Reactions to educational techniques: copying strategies for diabetes and learning. Diabet Med 1986;3:419-29.
4. Franuenknecht M, Brylinsky JA, Zimmer CG. Health athlete 2000: planning a health education initiative using the PRECEDE model. J Health Educ 1998;29:312-8.
5. Finckenor M, Byrd-Bredbenner C. Nutrition intervention group program based on preaction-stage-oriented change processes of the Transtheoretical Model promotes long-term reduction in dietary fat intake. J Am Diet Assoc 2000;100:335-42.
6. Manias E, Bullock S, Bennett R. Formative evaluation of a computer-assisted learning program in pharmacology for nursing students. Comput Nurs 2000;18:265-71.