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Behavior determinants among cardiac rehabilitation patients receiving educational interventions: an application of the health action process approach

Gabriela Lima de Melo Ghisi[1,2], Sherry L. Grace[2,3], Scott Thomas[1], Paul Oh[2].

[1]Exercise Sciences Department, Faculty of Kinesiology & Physical Education, University of Toronto, Toronto, Canada.

[2]Cardiac Rehabilitation and Prevention Program, Toronto Rehabilitation Institute, University Health Network, Toronto, Canada.

[3]School of Kinesiology and Health Science, York University, Toronto, Canada.

Corresponding author at:

Toronto Rehabilitation Institute. 347 Rumsey Road, Toronto, Ontario - M4G 1R7

Tel: (416) 597-3422 x. 5223 Fax: (416) 425-0301

email: gabriella.meloghisi@uhn.ca or/and gabriela.meloghisi@utoronto.ca

Abstract

Objectives: To (1) test the effect of a Health Action Process Approach (HAPA) theory-based education program in cardiac rehabilitation (CR) compared to traditional education on patient knowledge and HAPA constructs; and, (2) investigate the theoretical correlates of exercise behavior among CR patients receiving theory-based education.

Methods: CR patients were exposed to an existing or HAPA-based 6 month education curriculum in this quasi-experimental study. Participants completed a survey assessing exercise behavior, HAPA constructs, and knowledge pre and post-program.

Results: 306 patients consented to participate, of which 146 (47.7%) were exposed to the theory-based educational curriculum. There was a significant improvement in patients' overall knowledge pre- to post-CR, as well as in some HAPA constructs and exercise behavior, regardless of curriculum ($p<0.05$). Path analysis revealed that knowledge was significantly related to intention formation, and intentions to engage in exercise were not directly related to behavior, which required action planning.

Conclusions: The theoretically-informed education curriculum was not associated with greater knowledge or exercise behavior as expected. Education in CR improves knowledge, and theoretical constructs related to exercise behavior.

Practice implications: Educational curricula should be designed to not only increase patients' knowledge, but also enhance intentions, self-efficacy, and action planning.

1. Introduction

For people with chronic conditions, health behavior change can prevent further morbidity and mortality [1]. For persons with Coronary Artery Disease (CAD), one of the most common chronic diseases, secondary prevention requires multiple behavior changes such as exercise, dietary change, smoking cessation and medication adherence, necessitating patient understanding and persistence to optimize health outcomes [2-6]. Indeed, a recent systematic review demonstrated the benefits of educational interventions in CAD patients, with regard to patients' knowledge and behavior change [5]. Findings from a meta-analysis demonstrated the effectiveness of patient education in CAD patients in again improving self-management behaviors [7-9], but also for health-related quality of life, and potentially reducing healthcare costs [10] and recurrence of acute events [7].

Cardiac rehabilitation (CR) is a comprehensive secondary prevention program, of which patient education is a core component [11]. Indeed, American and Canadian Cardiovascular Societies include education as a structural quality indicator for CR [12,13]. However, patient knowledge in CR has only scantly been investigated, and the impact of the education on behavior change has not often been considered. In fact, no CR educational program has been standardized or evaluated to our knowledge.

Herein, the development and evaluation of an evidence and theoretically-based education curriculum is described. The CR education program incorporated the use of manuals, patient-oriented didactics, and a small-group format [5]. The Health Action Process Approach (HAPA) was the theoretical orientation to promote health behavior change [14,15], as it integrates the basic concepts of social-cognitive health behavior models and considers post-intentional factors leading to behavior adoption [1,16-18].

According to the HAPA model, changing health-related behaviors requires two separate processes, involving motivation and volition, respectively. First, the motivational phase is the process in which an individual forms an intention to either adopt a precautionary action or change risk behaviors in favor of others, in part on the basis of self-beliefs. Second, in the volition phase, change must be planned, initiated, and maintained, and relapses must be managed. In addition, self-regulation plays a critical role in these processes [16]. A recent overview covering seven empirical studies [19] has demonstrated the universal applicability of the HAPA for a number of health behaviors and for diverse samples from various cultures, including exercise adherence after CR [20].

Therefore, the present study: (1) tests the effect of a theory-based CR education program compared to a traditional one on knowledge and HAPA constructs; and, (2) investigates the theoretical correlates of exercise behavior change among CR patients receiving the theory-based educational intervention. The chosen behavior was exercise, because it is also a core component of CR, and is associated with reduced symptoms, lower recurrence rates, and lower mortality in cardiac patients [21-25].

To test the second objective, the HAPA model was tested, as shown in Figure 1. In the pre-intentional motivational phase, it was hypothesized that risk awareness, outcome expectancies and task self-efficacy are determinants of intention formation. According to Sniehotta, Scholz, & Schwarzer [26] the starting point for the motivational phase is some level of risk awareness, for example feeling vulnerable to a (recurring) cardiac event. Positive and negative outcome expectancies are deliberated: if the pros outweigh the cons of a behavior change, one prerequisite for an intention is accomplished. Task self-efficacy – the perceived capability of implement successfully alternative behaviors – is recognized as the major determinant of intention formation [27,28]. Finally, it was also hypothesized in this phase that knowledge would be positively correlated with intention, which has been reported in previous studies with cardiac patients [2,29,30].

A second set of hypothesis concerned the post-intentional volition phase. Social-cognitive models of behavior propose that intention is the most proximal and powerful predictor of subsequent behavior [31-33]. However, good intention does not necessarily guarantee corresponding actions and is seldom successful alone [34]. In the current study it was hypothesized that intention would be correlated with planning, which may lead to behavior change. Planning was divided into two sub-constructs: action planning and coping planning [26]. It was also hypothesized that task and scheduling self-efficacy could influence planning, and maintenance self-efficacy could directly influence behavior.

2. Methods

2.1 New Educational Curriculum Development

The new education curriculum was developed by a multi-disciplinary committee of 16 experts from the CR program. The aim of this curriculum was to enable patients to take charge of their medical condition, respond appropriately to changes in their health, and enact strategies to improve their risk factors.

The development of the curriculum consisted of the following phases: problem definition, theoretical foundation, needs analysis (including a literature search and environmental scan), program goals/educational objectives, sequencing instruction, instructional strategy/design and methods/materials development, and evaluation of instruction/materials and learning for health outcomes (which is presented in this study). Constructive theory [35] and adult learning principles [36,37] were the foundations for curriculum development and delivery. As outlined above, the HAPA model [16] was embedded in the curriculum to promote behavior change.

The curriculum included: 24 weekly group education sessions strategically sequenced in accordance with the CR program learning outcomes, a comprehensive education workbook, and individual care plans. Each topic contains educational content, learning activities, learning assessments, behavioral-based action planning, and assessment of patients' motivation and confidence to incorporate change into their lifestyle. It was delivered by an interdisciplinary team of exercise leaders, nurses, a dietitian, a psychologist, a social worker and physicians.

2.2 Design and Procedure

This study was quasi-experimental in design, with assessments undertaken pre and post-CR. Random assignment of study participants was not possible, because patients were allocated to educational curriculum based on their choice of class (i.e. based on their preferred time in the day or evening). Ethics approval was obtained from the review board at the hospital where the CR program was located. Data were collected between April 2013 and May 2014.

Patients were informed about the study during their first cardiopulmonary exercise stress test by a technician. They were also provided with information to take home and consider if desired. Consenting patients were then allocated to an education curriculum based on their choice of class.

Participants were invited to complete a self-administered survey in paper format (pre-CR survey). The survey included sociodemographic items, and psychometrically-validated scales to assess exercise, HAPA constructs, and knowledge. Clinical data based on the comprehensive intake assessment were extracted from electronic patient records.

CR participants in both groups were offered weekly supervised exercise classes for 24 weeks, and provided a home exercise prescription for the other days of the week. The education sessions in both models were offered prior to exercise each session. The duration of the traditional educational classes was 1 hour and the new curriculum less than 30 minutes. The traditional educational program was also provided by an interdisciplinary team of healthcare providers from the program. Similar to the theoretically-informed curriculum, topics covered include exercise safety, nutrition, risk management, medications, stress management, and lifestyle, presented in a less comprehensive manner when compared to the new curriculum. Education was delivered in large and small group sessions, lectures, a workbook, online videos, and in pamphlet form. There were no other differences in the program elements to which participants were exposed.

Between the 22nd and 24th weeks of CR, patients were approached during their CR class to complete the post-CR survey. It again assessed exercise, HAPA constructs, and knowledge as per the initial survey. Electronic patient records were reviewed to ascertain degree of CR participation and completion.

2.3 Participants

This study included CR patients (with heart disease or multiple cardiovascular risk factors) recruited from the largest CR program in Toronto, Canada. The exclusion criteria were: lack of English-language proficiency, and any visual, cognitive or psychiatric condition that would preclude the participant from completing the surveys.

Sample size was based on the Ding, Velicer & Harlow's rule of a minimum of 100 participants to run structural equation modeling [38]. Anticipating a retention rate of 70%, a minimum of 145 participants per group were required to achieve a final sample size of 100 per group. Patients were approached consecutively until the required sample size was achieved.

2.4 Measures

Clinical characteristics extracted from medical records included: CR referral indication and cardiac risk factors. Patients self-reported their sociodemographic characteristics, which included highest educational attainment. Health literacy was measured pre-CR using two questionnaires: the Medical Term Recognition Test (METER)[39] and the Newest Vital Sign (NVS)[40].

Knowledge was assessed pre- and post-CR using the Coronary Artery Disease Education Questionnaire (CADE-QII) [41], which assesses patients' knowledge in 5 domains: their medical condition, risk factors, exercise, nutrition, and psychosocial risk (item stems shown in Table 3). Each of the 31 items has 4 response options, of which one is most correct (scored 3), one is somewhat accurate (scored 1), and two are incorrect (scored 0). These scores are summed, with a maximum score of 93.

The target behavior was exercise, measured pre- and post-CR. Exercise behavior was self-reported by 2 questions: "How often do you usually walk in a week?" (never, less than 3-4 times, more than 3-4), and "How much time do you spend exercising per week? (in hours)". Guidelines recommend cardiac patients engage in exercise most days of the week, and accumulate 150 minutes (or 2.5 hours)[3].

2.4.1 HAPA constructs

All constructs from the HAPA model were assessed pre- and post-CR using the psychometrically-validated scales outlined in Table 1. Risk awareness refers to the quality and quantity of an individual's perceived susceptibility to a health threat; it is usually assessed along the dimensions of vulnerability and severity [16]. Outcome expectancies are subjective beliefs about contingencies of behavioral consequences [18]. Intention refers to motivation towards a goal or target behavior in terms of direction and intensity [18]. Action planning refers to concrete plans about when, where, and how to implement an intended behavior; it is a proven strategy in health behavior change [20]. Coping planning refers to the anticipation of barriers and the design of alternative actions that help to attain one's goal despite impediments [18].

Finally, 3 types of self-efficacy were measured: task, scheduling, and maintenance. Task self-efficacy is the perceived capability of a person to implement a certain behavior and facilitates goal-setting. Scheduling self-efficacy relates to managing one's schedule to accommodate the behavior. Finally, maintenance self-efficacy describes optimistic beliefs about one's capability to deal with barriers that arise while continuing exercise. The scales to measure these constructs are also shown in Table 1 [19,42-46].

2.5 Statistical Analysis

SPSS Version 21.0[47] was used, and the level of significance was set at 0.05 for all tests. Firstly, descriptive statistics were used to describe participants' sociodemographic and clinical characteristics by educational curriculum type, to ascertain if there were any differences which may impact the subsequent findings.

To test the first objective, the mean CADE-QII scores were examined by item, subscale and overall. Next, regression models were computed to investigate differences in overall post-CR knowledge (dependent variable) based on educational curriculum (independent variable), while adjusting for pre-CR knowledge. Where significant, changes in subscales and individual items were tested. Similarly, regression models were computed to investigate differences in HAPA constructs post-CR based on educational curriculum, while adjusting for pre-CR values.

Finally, to test the second objective, the exercise variable was examined. Outliers were identified and excluded from the descriptive and path analysis. The program IBM SPSS AMOS 20[48] was used to conduct the path (regression) analysis, to establish the best-fitting model for the relationship among the HAPA variables in the theory-based education group. A maximum likelihood estimation procedure was used to generate the parameter estimates (e.g. regression weights). Model fit was evaluated by consulting various indices: chi-square (χ^2); root mean square error of approximation (RMSEA); the comparative fit index (CFI); Tucker-Lewis index (TLI); and goodness-of-fit index (GFI). CFI and TLI values above .90 and RMSEA values less than .08 indicate an adequate fit [49]. Where the fit indices indicated that the hypothesized model did not provide an adequate fit to the data, the modification indices (MI) were considered to identify any areas of misfit in the model. The parameter with the largest MI value was freed only if it made substantive sense; if it was not meaningful then the parameter with the next largest MI value was considered. The regression coefficients were examined only after a good-fitting model was identified.

3. Results

3.1 Respondent Characteristics

A flow diagram of study participation is presented in Figure 2. Overall, significantly more males (77.8%) agreed to participate in this study than females (22.2%;$p<.001$), as well as those with higher educational attainment ($p<.001$).

Three hundred and six patients consented to participate, of which 146 (47.7%) were exposed to the theoretically-based curriculum. Sociodemographic and clinical characteristics of the sample overall and by curriculum are shown in table 2. There were no significant differences in participant characteristics or HAPA-constructs pre-CR by curriculum. METER and NVS mean scores showed that both groups had functional and adequate health literacy, respectively.

Overall, 173(56.5%) participants completed the post-CR survey. Participants who completed the post-CR survey were significantly older than those who were lost to follow-up ($p=0.002$). No other differences in sociodemographic or clinical characteristics were observed.

3.2 Change in knowledge

Knowledge pre-CR did not differ significantly by curriculum. There was a significant increase ($p<.001$) in overall knowledge from pre- to post-CR in the overall sample, as well as in participants exposed to both curricula. As shown in table 3, the increase in knowledge appeared on all subscales overall and by curriculum. Contrary to hypotheses, there were no significant differences by curricula in any type of knowledge (overall, domains or items).

As shown in table 3, individual items, knowledge scores improved on 22 items in the overall sample (6 items from medical condition, 6 from exercise, 4 from risk factors, 3 from nutrition, and 3 from the psychosocial risk subscale). Participants exposed to the traditional curriculum improved their knowledge significantly on 16 items, particularly related to exercise (6 items), risk factors and medical condition (3 items each). Finally, participants exposed to the theoretically-based curriculum improved their knowledge significantly on 17 items, particularly related to risk factors, nutrition, and exercise (4 items each).

3.3 Change in HAPA constructs

Table 4 displays mean HAPA construct scores pre- and post-CR, overall and by curriculum. Results show significant increases in risk awareness, psychological and physical outcomes expectancies, task self-efficacy, and action and coping planning, overall and by both curricula from pre to post-CR. Patients exposed to the traditional curriculum also significantly improved scheduling self-efficacy, and patients exposed to the theoretically-based curriculum improved social outcome expectancies. Significant differences among groups post-CR were observed in social outcome expectancies, with patients exposed to the theoretically-based curriculum reporting significantly higher scores.

3.4 Exercise behavior

Participants reported a significant increase in hours of exercise per week from pre- to post-CR, overall and by group (Table 4). In addition, the frequency of walking per week increased significantly from pre- to post-CR, again in the overall sample, as well as in participants exposed to both curricula. Exercise did not differ significantly by curricula.

3.5 Knowledge and Theoretical Determinants of Exercise Behavior

3.5.1 Preliminary Analysis

The means and standard deviations of the HAPA variables in the theoretically-based curriculum are presented in table 4. Overall, Pearson correlations confirmed the expected pattern of associations as proposed in Figure 1. Specifically, risk awareness psychological outcome expectancies, task self-efficacy, and total knowledge were positively related to intention. Task self-efficacy, scheduling self-efficacy, intention and total knowledge were positively related to action planning. Task self-efficacy, scheduling self-efficacy, and intention were positively related to coping planning. Scheduling self-efficacy, maintenance self-efficacy, and action planning were positively correlated to behavior. A correlation matrix is presented in table 5.

3.5.2 Path analysis

The proposed model illustrated in Figure 1 was tested only in the theoretically-based curriculum, and results demonstrated unsatisfactory fit (chi-square=323.14, df=50, CFI=0.31, GFI=0.68, RMSEA=0.20[0.18, 0.22]). The model was then modified, guided by theory and modification indices. All types of self-efficacy and outcome expectancies, and action and coping planning were correlated with each other, which has been previously described as a way to simplify the model [16]. In addition, knowledge was correlated to task and maintenance self-efficacy, since self-efficacy has emerged as a highly effective mediator of motivation and learning [50]. Knowledge was also correlated to action planning [26] since the theoretically-based curriculum had a strong action planning component. As self-efficacy is a key factor influencing intention, the other factors from the motivational phase – risk awareness and all types of outcome expectancies – were correlated.

This modified model (see Figure 3) yielded satisfactory fit across indices (chi-square= 66.98, df=34, CFI=0.92, GFI=0.93, RMSEA=0.084[0.05, 0.11]). All correlations were significant ($p<.001$): task self-efficacy with knowledge ($r=0.20$), scheduling self-efficacy ($r=0.41$), and maintenance self-efficacy ($r=0.39$); scheduling self-efficacy with maintenance self-efficacy ($r=0.42$); maintenance self-efficacy with knowledge ($r=0.26$); risk perception with social ($r=0.32$), psychological ($r=0.33$), and physical ($r=0.40$) outcome expectancies; physical outcome expectancies with psychological ($r=0.47$) and social ($r=0.40$); psychological and social ($r=0.38$), and action and coping planning ($r=0.45$). In the modified model the following associations were significant: knowledge was positively related to intention ($\beta=0.23, p=0.04$), task self-efficacy to action planning ($\beta=0.30, p<0.001$) and behavior ($\beta=0.30, p=0.002$), intention to action planning ($\beta=0.32, p<0.001$) and coping planning ($\beta=0.28, p<0.001$), and scheduling self-efficacy to coping planning ($\beta=0.25, p=0.003$).

4. Discussion and Conclusions

4.1 Discussion

The present study provides evidence that education in CR is effective in improving knowledge, changing theoretical constructs related to behavior and enhancing exercise. Despite the fact that the sample was highly educated and health-literate, there was a significant increase in patients' overall knowledge from pre- to post-CR in the overall sample. Knowledge improved significantly across all 5 domains. However, contrary to expectation, the theoretically-based educational curriculum did not result in improvements in knowledge, HAPA-related constructs (except outcome expectancies) or exercise behavior when compared to the traditional curriculum. This may be related to the fact that patients were already knowledgeable, and the traditional curriculum was effective.

In the pre-intentional motivation phase it was hypothesized that, among CR patients receiving the theory-based educational intervention, task self-efficacy, followed to a lesser extent by risk awareness and outcome expectancies, would be positive predictors of intention. None of these associations were supported. Although this analysis failed to identify these relations, positive correlations were found between all these mediators and intention formation. This predictive pattern differs from the one observed by Renner et al[51], where it was observed that middle-aged and older adults are motivated to engage in physical activity only due to task self-efficacy. Results from our study are similar to those reported by Caudroit, Stephan, & Le Scanff[52] who identify risk awareness as a determinant of intention formation to exercise among older adults. According to these authors, older adults become motivated to engage in physical activity because they feel at risk for future health problems and disease. This can be translated to our sample of CR patients, who are strongly driven by a secondary prevention program, aimed to decrease health risks and avoid further events.

A second and complementary set of hypothesis concerned the post-intentional volition phase. It was hypothesized that, intention would be correlated to planning (action and coping), which may lead to behavior change. It was also hypothesized that task and scheduling self-efficacy could influence planning and maintenance self-efficacy could influence directly behavior. The results partially confirmed this hypothesis and revealed that intention was positively related to action and coping planning, which was correlated to behavior. These findings suggest that when CR patients become motivated to engage in physical exercise, their intentions were not directly translated into action. This result is in line with Reuter et al[53] who found that planning is necessary to bridge the intention-behavior gap, but stands in contrast with research conducted by Renner et al[51] and Caudroit et al[52] among older individuals where intentions directly translated into action without preparatory strategies of approaching the activity.

Furthermore, it was hypothesized that knowledge was related to intentions. This hypothesis was confirmed via regression analysis, and knowledge was also positively correlated to action planning, task and maintenance self-efficacy. According to health behavior models, knowledge of the negative health consequences of a behavior is a necessary condition for behavior change [54,55]. However, knowledge alone is not sufficient to promote behavior change. Individuals who perceive themselves to have an increased risk of CAD are more likely to change their intentions and adopt behaviors that reduce their risk than those who do not [56-58].

Caution is warranted when interpreting these results. The chief limitation is potential selection bias. The results are specific to a small, well-educated sample of cardiac patients who attend a comprehensive CR program at a single center. Future research should examine the interplay of HAPA constructs in a larger cohort of cardiac patients with lower educational levels and from multiple centers to confirm results obtained in the present study. Second, low retention was also observed (however, not compared to other CR programs). However, given the fairly low rate of program completion observed, it is not likely the sample was biased towards highly-adherent patients. Third, results are only generalizable to patients who are referred and attend CR programs, which are a low proportion of cardiac outpatients [59]. Fourth, the behavior assessed in the study was self-reported, which can introduce social desirability bias and over-reporting. The use of objective assessment tools such as accelerometers should be undertaken. In addition, there are other behaviors that should be changed which were not considered in this study (e.g. diet, medication use, smoking). Fifth, multiple comparisons were undertaken, which inflates error rates. Therefore, the greater outcome expectancies in the social domain among participants exposed to the theoretically-based education curriculum should be interpreted with caution, and replication is warranted. Sixth, the design was not randomized, and therefore unmeasured factors may explain the findings. Finally, a study assessing these outcomes in CAD patients not receiving education is warranted (control group), to ascertain whether the improvements in knowledge identified herein are robust.

4.2 Conclusion

Knowledge, theoretically-related constructs, and exercise behavior improved following participation in CR with education. The theoretically-informed education curriculum was not associated with greater knowledge or exercise behavior as expected, although it was associated with greater outcome expectancies. Path analysis of HAPA constructs in patients exposed to the theoretically-informed educational curriculum revealed that only knowledge was a significant motivational construct leading to intention formation. Intentions to engage in exercise were not directly translated into behavior, needing especially action planning, which was related to self-efficacy.

4.3 Practice implications

Healthcare providers delivering CR educational programs should consider the design of their curriculum, and how it promotes heart-health promoting behaviors and adherence among their patients. In particular, providers should support patients in action planning.

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Table 1 – Description of psychometrically-validated scales administered to assess HAPA constructs

Construct	**Subtype**	**Number of items**	**Stem**	**Response options**
Risk awareness	Vulnerability	4	"If I keep my lifestyle the way it was prior to my heart problem"	1= "very unlikely" to 7= "very likely".
	Severity	4	"How severe (serious) are the following health-related problems if I don't exercise regularly?"	1= "not severe at all" to 7= "very severe"
Outcome expectancies	Social	4	"If I exercise regularly…"	1= "very unlikely" to 7= "very likely".
	Psychological	5	"If I exercise regularly…"	1= "very unlikely" to 7= "very likely".
	Physical	6	"If I exercise regularly…"	1= "very unlikely" to 7= "very likely".
Intention		2	" I will try" and " I will intend"	1= "definitely false" to 7= "definitely true"
Self-efficacy	Task	6	"Assuming you were very motivated, how confident are you that you could physically do the following amounts of exercise in one session without stopping over the next 6 months"?	1= "not confident at all" to 7= "very confident"
	Scheduling	6	"Assuming that you are very motivated, in the next 6 months, how confident are you that you can fit your exercise prescription into your weekly schedule"?	1= "not confident at all" to 7= "very confident"
	Maintenance	13	"Assuming you were very motivated, how confident are you that you will do your exercise prescription over the next 6 weeks if…"	1= "not confident at all" to 7= "very confident"
Planning	Action planning	6	"I already have concrete plans…"	1= "strongly disagree" to 7= "strongly agree".
	Coping planning	4	"I already have concrete plans regarding…"	1= "strongly disagree" to 7= "strongly agree".

Table 2 – Sociodemographic and Clinical Characteristics of Participants, Overall and by Educational Curriculum.

Characteristic	Overall (N=306)	Traditional (n=160; 52.3%)	Theoretically -Based (n=146; 47.7%)	Test statistic*
Sociodemographic				
Age, years (mean±SD)	63.92±11.83	63.58±11.66	64.30±12.04	63.46
Sex, n (%)				0.40
Female	68 (22.2%)	37 (23.1%)	31 (21.2%)	
Male	238 (77.8%)	123 (76.9%)	115 (78.8%)	
Highest Educational Attainment, n (%)[§]				4.77
Less than high school	20 (6.5%)	14 (8.8%)	6 (4.1%)	
High School	40 (13.1%)	24 (15.0%)	16 (11.0%)	
Trades Certificate	11 (3.6%)	5 (3.1%)	6 (4.1%)	
College	62 (20.3%)	32 (20.0%)	30 (20.5%)	
University	166 (54.2%)	80 (50.0%)	86 (58.9%)	
Health Literacy, (mean±SD)[†]				
METER	35.19±5.83	35.64±5.31	34.69±6.35	2.40
NVS	4.50±1.72	4.29±1.81	4.74±1.58	2.29
Clinical, n (% yes)[‡]				
Referral Indication				
Heart Failure	18 (5.9%)	9 (5.6%)	9 (6.2%)	0.20
Cardiomyopathy	14 (4.6%)	8 (5.0%)	6 (4.1%)	0.37
Stroke/Transient Ischemic Attack	29 (9.5%)	16 (10.0%)	13 (8.9%)	0.84
Valvular Heart Disease	39 (12.7%)	21 (13.1%)	18 (12.3%)	0.92
Peripheral Vascular Disease	11 (3.6%)	5 (3.1%)	6 (4.1%)	0.46
Chronic Obstructive Pulmonary Disease	16 (5.2%)	8 (5.0%)	8 (5.5%)	0.19
Angina	10 (3.3%)	3 (1.9%)	7 (4.8%)	1.41
Arrhythmia	28 (9.2%)	14 (8.8%)	14 (9.6%)	0.23
Myocardial Infarction	113 (36.9%)	60 (37.5%)	53 (36.3%)	0.22
Coronary Artery Bypass Graft Surgery	71 (23.2%)	43 (26.9%)	28 (19.2%)	1.60
Percutaneous Coronary Intervention	117 (38.2%)	56 (35.0%)	61 (41.8%)	1.22
Risk factors				
Hypertension	144 (47.1%)	72 (45.0%)	72 (49.3%)	0.75
Type I Diabetes	21 (6.9%)	13 (8.1%)	8 (5.5%)	0.42
Type II Diabetes	51 (16.7%)	24 (15%)	27 (18.5%)	0.81
Depression	9 (2.9%)	5 (3.1%)	4 (2.7%)	0.20

Sleep Apnea	26 (8.5%)	15 (9.4%)	11 (7.5%)	0.58
Smoking history	104 (34.0%)	54 (33.8%)	50 (34.2%)	0.09
Smoking, years (mean±SD)	7.95±13.92	7.90±14.2	8.01±13.6	29.14

SD indicates standard deviation, METER Medical Term Recognition Test (maximum = 40), NVS Newest Vital Sign (maximum = 5).

*Chi-square or t-tests as appropriate for differences between groups (no significant differences - p<.05 - between traditional and new educational curriculum).

§Self-reported.

†Assessed via pre-survey (pre-CR).

‡Extracted from electronic patients records.

Table 3 – Total, subscale and item knowledge scores at pre- and post-CR in overall sample, and by curriculum

Knowledge scores (mean±SD)		**Overall (N=306)**			**Traditional (n=160)**			**Theoretically-Based (n=146)**			
	Maximum possible score	Pre-CR	Post-CR	t*	Pre-CR	Post-CR	t*	Pre-CR	Post-CR	t*	t§
Total Knowledge	93	64.72±17.35	75.68±12.27	10.22[c]	65.14±17.65	75.29±13.27	7.73[c]	64.25±17.08	76.12±11.11	6.67[c]	0.03
Subscales											
Medical Condition	21	15.24±4.77	17.12±3.98	5.33[c]	15.31±4.89	17.09±4.09	4.12[c]	15.15±4.65	17.15±3.88	3.45[b]	0.34
Risk Factors	15	9.49±3.32	11.26±2.66	6.54[c]	9.43±3.43	11.08±2.87	4.10[c]	9.56±3.20	11.47±2.41	5.22[c]	0.73
Exercise	21	15.70±5.18	18.57±3.05	7.83[c]	15.79±5.21	18.63±2.93	6.73[c]	15.60±5.14	18.51±3.20	4.31[c]	0.71
Nutrition	21	14.07±4.66	16.84±3.39	7.07[c]	14.27±4.66	16.69±3.42	5.17[c]	13.84±4.65	17.01±3.37	4.83[c]	0.35
Psychosocial Risk	15	10.23±3.64	11.86±2.56	5.33[c]	10.34±3.70	11.80±2.69	3.90[c]	10.10±3.60	11.93±2.42	3.62[b]	0.04
Items											
Medical Condition											
1. Coronary Artery Disease is:	3	2.17±1.27	2.49±1.07	2.90[b]	2.13±1.28	2.54±1.06	2.59[a]	2.22±1.27	2.43±1.10	1.50	1.01
2. Angina (chest pain or discomfort) occurs:	3	2.58±1.00	2.75±0.77	2.42[a]	2.62±0.95	2.87±0.16	2.74[b]	2.53±1.05	2.62±0.94	1.03	2.26
3. In a person with coronary artery disease, which of the following is a usual description of angina?	3	2.42±1.09	2.53±0.95	0.63	2.49±1.02	2.46±1.01	0.98	2.33±1.16	2.62±0.94	1.91	0.94
4. A heart attack occurs:	3	2.36±1.10	2.66±0.82	2.62[b]	2.38±1.10	2.58±0.90	1.00	2.35±1.11	2.75±0.72	2.60[b]	1.22
5. The best resources available to help someone understand his/her medications are:	3	2.29±1.06	2.45±0.93	2.41[a]	2.32±1.09	2.42±0.97	1.00	2.27±1.04	2.49±0.90	1.58	0.31
6. Medications such as aspirin (ASA) and clopidogrel (Plavix™) are important because:	3	1.90±1.13	2.18±1.06	2.58[a]	1.79±1.15	2.07±1.05	1.91	2.02±1.09	2.31±1.07	1.73	1.35

7. The “statin” medications, such as atorvastatin (Lipitor™), rosuvastatin (Crestor™), or simvastatin (Zocor™), have a beneficial effect in the body by:	3	1.51±1.27	2.08±1.19	4.51[c]	1.59±1.25	2.15±1.16	3.93[c]	1.43±1.29	1.99±1.21	2.38[b]	1.23
Risk Factors											
1. The risk factors for heart disease that can be changed are:	3	2.30±1.08	2.55±0.91	2.24[a]	2.24±1.09	2.42±1.00	0.81	2.36±1.06	2.70±0.77	2.68[b]	1.98
2. The actions that can be taken to control cholesterol levels include:	3	2.45±1.05	2.77±0.74	3.00[b]	2.40±1.09	2.71±0.83	2.36[a]	2.51±1.00	2.83±0.63	1.87	0.80
3. The actions that can be taken to control blood pressure include:	3	2.48±1.01	2.73±0.76	3.55[b]	2.51±1.02	2.73±0.80	2.64[a]	2.45±1.00	2.74±0.70	2.42[a]	0.13
4. The first step towards controlling a risk factor (such as blood pressure or cholesterol) is:	3	0.55±0.94	0.78±1.11	1.83	0.59±0.94	0.81±1.11	1.25	0.49±0.93	0.75±1.11	1.34	0.45
5. The actions to prevent developing diabetes include:	3	1.72±1.34	2.42±1.11	5.94[c]	1.69±1.35	2.41±1.12	3.85[c]	1.76±1.33	2.44±1.11	4.53[c]	0.06
Exercise											
1. What are the important parts of an exercise prescription?	3	2.63±0.95	2.85±0.62	2.49[a]	2.63±0.94	2.86±0.61	2.37[a]	2.62±0.96	2.84±0.64	0.98	0.38
2. For a person living with heart disease, it is important to do a cardiovascular warm-up before exercising because:	3	2.12±1.16	2.44±0.95	3.68[c]	2.09±1.20	2.41±0.95	3.06[b]	2.15±1.11	2.47±0.95	2.10[a]	0.19
3. The pulse can be found:	3	2.32±1.12	2.49±0.97	1.15	2.28±1.16	2.56±0.91	1.98	2.37±1.08	2.41±1.03	0.42	1.17
4. Three things that one can do to exercise safely outdoors in the winter are:	3	1.94±1.30	2.73±0.73	7.36[c]	1.99±1.28	2.71±0.75	5.85[c]	1.89±1.32	2.75±0.72	4.58[c]	0.14
5. The benefits of doing resistance training (lift weights or elastic bands) include:	3	2.17±1.19	2.59±0.87	3.85[c]	2.21±1.16	2.59±0.91	3.26[b]	2.13±1.23	2.59±0.83	2.14[a]	0.24
6. If a person gets chest discomfort during a walking	3	2.35±1.08	2.77±0.68	4.53[c]	2.31±1.11	2.88±0.51	5.27[c]	2.40±1.05	2.65±0.81	1.07	2.46

exercise session, he or she should:											
7. How does a person know if he/she is exercising at the right level?	3	2.16±1.24	2.70±0.81	4.41[c]	2.28±1.18	2.62±0.93	2.34[a]	2.03±1.30	2.79±0.65	3.92[c]	1.30
Nutrition											
1. What is the best source of omega 3 fats in food?	3	2.33±1.20	2.51±1.03	1.36	2.34±1.19	2.53±1.05	1.63	2.32±1.22	2.49±1.01	0.34	0.39
2. Trans fat are:	3	1.67±1.41	2.41±1.12	5.42[c]	1.73±1.41	2.43±1.11	4.67[c]	1.61±1.41	2.38±1.15	2.95[b]	0.43
3. What is one good way to add more fibre to your diet:	3	2.19±1.17	2.47±0.95	1.68	2.26±1.13	2.42±1.00	0.40	2.11±1.20	2.53±0.90	2.07[a]	0.71
4. Which of the following foods has the most salt:	3	2.66±0.91	2.82±0.65	0.84	2.66±0.91	2.82±0.63	1.50	2.66±0.91	2.81±0.67	0.55	0.19
5. What combination of foods can help lower blood pressure?	3	2.55±0.96	2.77±0.72	1.72	2.58±0.96	2.77±0.72	2.01	2.52±0.97	2.77±0.73	0.13	0.19
6. When reading food labels, what should one look at first?	3	1.48±0.99	2.22±1.01	8.35[c]	1.47±0.98	2.18±1.05	6.38[c]	1.50±0.99	2.26±0.97	5.37[a]	0.22
7. How many servings of fruits and vegetables should adults consume?	3	1.18±1.40	1.62±1.40	2.29[a]	1.23±1.42	1.49±1.41	0.38	1.12±1.37	1.77±1.39	2.81[b]	1.14
Psychosocial Risk											
1. Which of the below are effective stress management techniques?	3	2.48±1.03	2.66±0.84	1.42	2.42±1.07	2.69±0.81	1.76	2.55±0.98	2.63±0.87	0.19	0.70
2. What stresses have been related to increased risk for heart attacks?	3	1.79±1.40	2.29±1.22	3.47[b]	1.86±1.38	2.26±1.23	2.47[a]	1.71±1.43	2.32±1.21	2.43[a]	0.17
3. Which of the following describes your best option for reducing your risk from depression:	3	2.67±0.91	2.84±0.62	2.10[a]	2.69±0.89	2.81±0.71	0.95	2.66±0.93	2.88±0.48	2.05[a]	0.57
4. It is important to recognize “sleep apnea” because:	3	2.01±1.37	2.63±0.91	5.90[c]	2.06±1.35	2.60±0.95	4.24[a]	1.95±1.40	2.67±0.87	4.07[c]	0.26

5. “Chronic stress” is defined as:	3	1.27±1.26	1.43±1.22	0.75	1.31±1.29	1.43±1.26	0.37	1.23±1.22	1.43±1.18	0.71	0.10

SD indicates standard deviation.

*Paired t-tests for differences between groups

Significant differences between traditional and new educational curriculum: [a]p<.05; [b]p<.01; [c]p<.001).

§ Adjusted for pre-CR scores

Table 4 – HAPA constructs and exercise behavior pre- and post-CR in overall sample, and by curriculum

		Overall (n=306)			**Traditional (n=160)**			**Theoretically-Based (n=146)**			
	Maximum possible score	Pre-CR	Post-CR	t*	Pre-CR	Post-CR	t*	Pre-CR	Post-CR	t*	t§
Constructs (mean±SD)											
Risk Awareness	**7**	5.16±1.36	5.62±1.17	4.65[c]	5.16±1.41	5.62±1.23	3.47[b]	5.15±1.31	5.63±1.10	3.08[b]	0.06
Outcome Expectancies											
Social	**7**	4.45±1.51	4.65±1.48	1.53	4.48±1.55	4.34±1.58	0.72	4.42±1.47	4.95±1.30	2.91[b]	2.73[b]
Psychological	**7**	5.68±1.32	6.07±1.03	3.66[c]	5.70±1.44	6.01±1.14	2.59[a]	5.66±1.18	6.13±0.88	2.74[b]	0.76
Physical	**7**	5.14±1.32	5.58±1.81	3.36[b]	5.16±1.44	5.39±1.36	2.03	5.12±1.18	5.79±2.19	2.68[b]	1.44
Self-efficacy											
Task	**7**	5.09±1.72	5.75±1.49	5.08[c]	4.97±1.80	5.67±1.56	3.98[c]	5.21±1.64	5.84±1.42	3.15[b]	0.64
Scheduling	**7**	5.20±1.68	5.61±1.48	2.27[a]	5.13±1.70	5.63±1.46	2.30[a]	5.27±1.65	5.58±1.51	0.47	0.29
Maintenance	**7**	5.20±1.26	5.44±1.27	1.21	5.15±1.37	5.30±1.28	0.55	5.25±1.14	5.60±1.24	0.95	1.49
Intention	**7**	6.30±1.17	6.34±1.08	0.53	6.35±1.24	6.26±1.19	0.33	6.32±1.09	6.42±0.93	1.14	0.89
Planning											
Action	**7**	4.81±1.57	6.03±1.00	9.43[c]	4.68±1.60	6.00±0.88	7.47[c]	4.96±1.45	6.07±1.04	5.87[c]	0.44
Coping	**7**	4.27±1.62	5.18±1.42	6.40[c]	4.27±1.73	5.10±1.58	4.28[c]	4.27±1.50	5.27±1.21	5.05[c]	0.71
Behavior											
Weekly physical exercise, hours (mean±SD)	**-**	4.91±5.90	8.05±13.24	2.97[c]	5.26±6.97	7.45±6.01	2.23[a]	4.55±4.52	8.73±13.35	4.95[c]	0.67
Walking 3-4 times per week or more, n (%)	**-**	204 (68.7%)	147 (85.5%)	3.85[c]	104 (67.5%)	82 (89.1%)	3.47[b]	100 (69.9%)	65 (81.3%)	2.00[a]	1.43

SD indicates standard deviation.

*Paired t-tests for differences between groups

Significant differences between traditional and new educational curriculum: [a]$p<.05$; [b]$p<.01$; [c]$p<.001$).

§ Adjusted for pre-CR scores

Table 5 - Pearson’s correlation matrix for HAPA constructs and exercise behavior post-CR (n=81)

Constructs	1	2	3	4	5	6	7	8	9	10	11	12
1. Risk Awareness	1	0.32**	0.33**	0.37**			0.27**	0.20*§		0.17*		
2. Outcome Expectancies Social		1	0.38**	0.40**			0.18*		0.23**	0.18*		
3. Outcome Expectancies Psychological			1	0.47**	0.21*		0.30**	0.22**§	0.26**	0.20**		0.19*
4. Outcome Expectancies Physical				1			0.17*		0.20*	0.17*		
5. Task Self-efficacy					1	0.44**	0.41**	0.27**§	0.46**§	0.33**§	0.37**	0.27**
6. Scheduling Self-efficacy						1	0.45**	0.44**	0.43**§	0.44**§	0.27**§	
7. Maintenance Self-efficacy							1	0.52**	0.58**	0.53**	0.19*§	0.32**
8. Intention								1	0.48**§	0.43**§		0.28**§
9. Action Planning									1	0.61**	0.20*§	0.26**§
10. Coping Planning										1		
11. Exercise Behavior											1	
12. Total Knowledge												1

Only significant correlations are shown: *$p<0.05$ **$p<0.01$

§ Correlation included in hypothesized model.

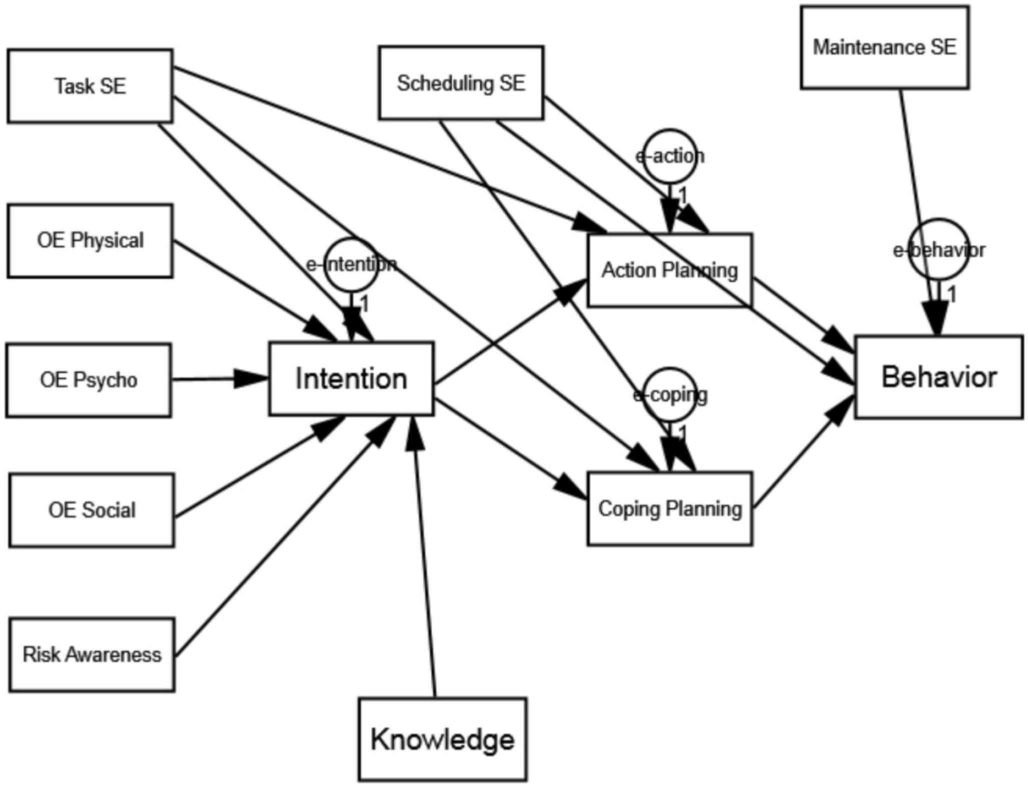
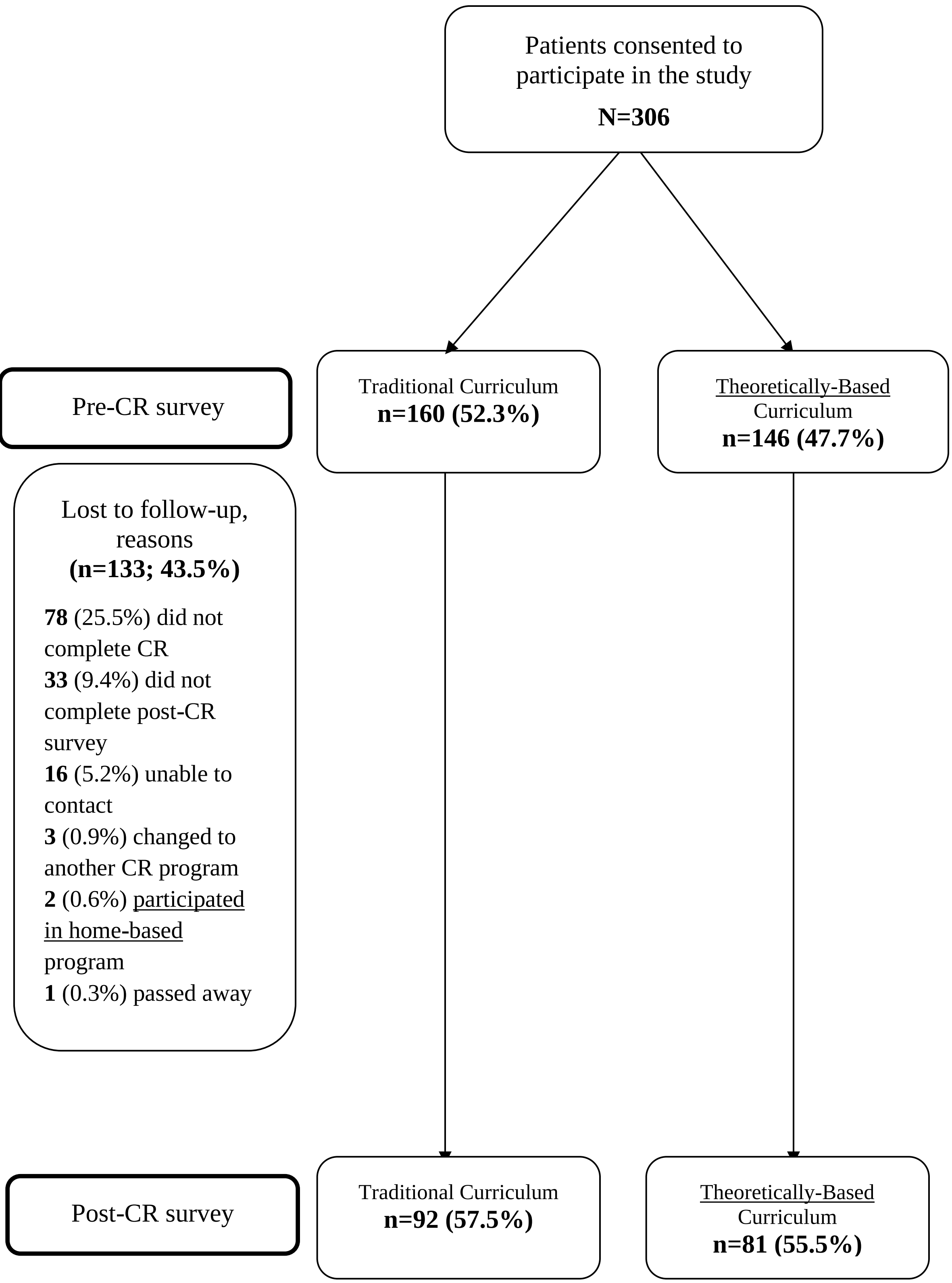


Figure 1 – Model of the relationship between HAPA constructs, knowledge and exercise behavior. SE indicates self-efficacy, OE outcome expectancies, e- errors.

Figure 2 – Flow diagram of study participants



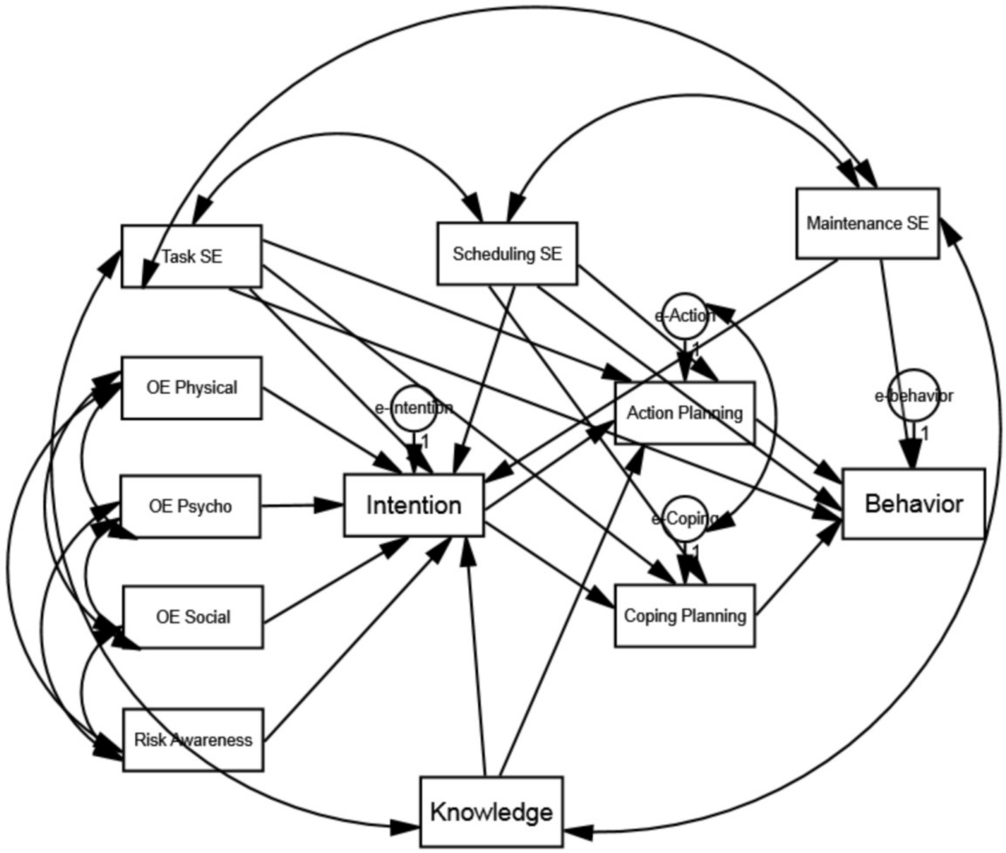


Figure 3 – Modified model of the relationship between HAPA constructs, knowledge and exercise behavior. SE indicates self-efficacy, OE outcome expectancies, e- errors.