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Original article

Multi-group Causal Model of Health Literacy and Behaviors on Family Well-being among Thai Adults at Risk of Non-Communicable Diseases (NCDs)

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Running title

Health Literacy and Behaviors on Family Well-being

Highlights

- Health literacy and attitude are the key factors of the health behaviors and well-being.
- Health literacy and characteristic development are improving the sustainable well-being.
- The health providers should use this study results for designing NCDs prevention.

Abstract

Background: We aimed to develop a causal model of family well-being by mediating health literacy (HL) and to compare models between spouses in men and women and in urban and rural communities.

Study design: A cross-sectional study.

Methods: The samples included 2000 spouses at risk of non-communicable diseases (NCDs) by stratified random sampling in 2018. Data were collected by Likert questionnaires with reliability of 0.79-0.93, using to analyze via confirmatory factor analysis (CFA), and multi-group structural equation modeling (SEM).

Results: A causal model in overall group was consistent with an empirical data. Causal factors had direct effects on health behavior including social norm, positive attitudes, psychology capital, and HL (β=0.11, 0.14, 0.30, and 0.41, P<0.05 respectively). Health behavior and positive attitudes toward health had direct effects on family well-being (β=0.36 and 0.42, P<0.05, respectively). All factors could predict health behavior and family well-being of variance 70% and 50%. Invariance analysis of models showed no difference between spouses in men and women. In addition, mean comparison of latent variables showed that the positive attitudes toward health in women were lower than men. Moreover, HL and positive attitudes toward health of spouses in urban were lower in rural communities.

Conclusion: Thai adult families in urban showed higher risk with NCDs. Therefore, health providers improved the first priority of HL and positive attitude which were the main causal factors.

Keywords: Psychological factors; Social norm; Healthy behavior; Health literacy; Well-being

Introduction

WHO highlighted concern about the growing incidence of non-communicable diseases (NCDs) worldwide, reporting that globally 70% of deaths each year are attributable to NCDs and the main four NCDs are cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes accounting for 80% of all NCD deaths[1].

The developing health literacy **(**HL**)** is regarded core to improve health and well-being. It is defined as cognitive and social skills which determine the motivation of individuals to access, understand and use information in ways which maintain good health[2]. Individuals with adequate levels of HL displayed more appropriate health behavior and better health outcomes than those with inadequate HL[3,4]. Patients with high HL could control their blood sugar levels 2.03 times better than patients with low HL[5]. Patients' levels of education and disease knowledge were influenced by their HL and their HL influenced their health behavior[6]. WHO in Shanghai emphasized to increase HL globally[7]**.** Worldwide surveys of population HL confirmed that it was problematic with low levels found in 32.5% of the population of USA[8], New Zealand (56.2%)[9], Bulgaria (62.1%), Spain (58.3%), Austria (56.4%), Germany (46.3%), Greece (44.8%), Poland (44.6%), Ireland (40%), the Netherlands (28.7%)[10], and Japan (25.3%)[11]. Particularly low HL are reported among the elderly, lower levels of education, indigenous people, and in rural communities[12,13]. In Western cultures, social norms are an important factor influencing their health behavior[14]. In an Asian collectivist culture the family plays a role in developing HL[15]. In Thailand, from 2000 to 2014, hypertension prevalence increased fivefold and diabetes by 11%[16]. In 2014, Thais had the second highest rate of obesity in Association of Southeast Asian Nations[17]. In 2016, a national survey conducted among 15,278 Thai adults found that 49% had low HL, 5.5% high HL, and 63% unhealthy behavior[18].

The definition of well-being is taken from positive psychology as "a positive state of living, meaning to pursue one's goals, and satisfy with one's life"[19]. Character strengths influenced their well-being[20,21]. Psychological capital is defined as “an individual’s positive psychological state by having self-efficacy, optimism, hope and resilience to attain success” [22]. The pathway model of health guided the choice of variables to be included in the current study[23]. From this model relevant variables were the use of healthcare services, having healthy behavior, self-monitoring, attitudes, social norms, self-efficacy, and HL. The Individual and Family Self-management Theory model-(IFSM) analyzed the causes of health outcomes and well-being also guided the choice of variables such as self-efficacy, social support, community culture, and family and individual context variables[24]. The variables and their predicted relationships are shown in Figure 1.

The aims of the study were to develop a causal model of family well-being and to compare models by moderating between spouses in urban and rural areas, and in men and women.

Methods

Data for this cross-sectional study were collected via a survey designed to assess the variables identified in the literature review as being relevant to HL and health behaviour. The Thai adult participants with 35-59 yr old were selected through a quota-stratified random sampling technique to make sure that both women and men from both urban or suburban and rural communities near the country's borders were selected equally. A previous survey[18] identified ten provinces covering the north, south, northeast, and central Thailand where levels of HL were low and risks of NCDs were high. Data were used to randomly select 200 people from each province via the public health database, giving a total sample of 2000 adults, equally divided between rural and urban areas and men and women. Data were collected between Jan and Apr 2018. The sample size was based on the size required to confirm a causal model, between 100 and 200 people in each group[25]. The research assistants contacted participants by leading of the Village Health Volunteers (VHVs) to set up times to meet with them in their own homes.

The survey was administered by four well-trained research assistants to ensure that meaningful data could be collected even if literacy levels were low or if there were difficulties in understanding any of the questions. Husbands and wives completed the survey separately

The Thai Adults Health Questionnaire was developed as a culturally appropriate measure of HL and health behavior. The HL elements were based on the General Health Literacy Scale[13] developed with an Australian population with a very well-developed health care system so was not totally applicable to the Thai context. This scale was modified to assure cultural relevance in Thailand[18]. For this study, it was expanded further to make a more comprehensive assessment of HL, health status and associated health behavior. These additional components were informed by reviewing the literature on HL models[13,23].

The questionnaire began with demographic information relating to age, gender, educational level, primary employment, years married or cohabiting, record of any medical problems, and checklist of symptoms relating to NCDs. Next competency in dealing with health-related issues, perceived ease of access to information and services, verification processes used for knowledge and services, communication, management of own and family health, availability of social support, social norms including health-related cultural wisdom and their influence, family role models, attitudes towards health-related behaviours and an assessment of the well-being of the family. All items were rated on a five-point Likert scale and scores were summated.

The questionnaire was assessed for breadth and relevance of content and cultural match by five experts in the field of health behavior, and psychology with high levels of agreement reached. The

content analysis of items with index of item-objective congruence (IOC) were between 0.80-1.00. The internal reliability of the questionnaire was satisfactory with Cronbach's alpha values ≥0.70 and the construct validity by the second confirmatory factor analysis (CFA) was satisfactory with factor loading of items ≥0.40[26].

Pre-analysis checks were carried out on the data set on missing data, outliers, linearity, skewness, kurtosis, *P*-value >0.05 and multivariate normality[25]. Can you give details of what you found from the screening or reassurances that the data set was fine? Demographic descriptive data was computed for all the variables. Then Confirmatory factor analysis (CFA) and multi-group structural equation modeling (MSEM) was computed to test the generated causal relationship model's applicability and to compare the latent variable mean by using LISREL program. Moreover, statistical values included the absolute fit index, Chi-Square ($\chi 2$) Goodness of Fit Index: GFI ≥0.90, Root Mean Squared Error Approximation: RMSEA ≤0.05, SRMR ≤0.05, NNFI GFI ≥0.90 [Incremental fit index], and adjusted goodness of Fit Index: AGFI ≥0.90, and $\chi 2$/df ≤5. [Parsimony fit indices][26].

Documented assent was obtained from all participants who could not provide written consent. The study was approved by the IRB of Srinakharinwirot University (Certificate of approval no. SWUEC/E-264/2560).

Results

The mean age of the rural sample was males =47.04, SD=7.56; females=45.99, SD=7.45, and the urban sample was males =48.45, SD=7.37; females=47.00, SD=7.17. The modal values for occupational group was farmers (33.8%), for education was elementary education (54.5%), and the duration of living together was 21–25yrs (18.7%). In terms of health risk for NCDs, 75.6% of the sample were not exercising and were overweight. High levels of health literacy were reported in 26% of the sample while 58.5% had levels rated as being inadequate but good levels of family well-being were reported by 61.0% of the sample. The demographics for each sample are shown in Table 1. The mean and standard derivation for each variable were computed. Cronbach's alphas were calculated for each scale and subscale and were satisfactory between 0.77-0.94. The construct validity by CFA with factor loading of items were between 0.45 and 0.87 (Table 2).

The results of the hypothesis testing with empirical data showed that the influence and test statistical significance were not significant. The researchers adjusted the model by allowing tolerances to measure if the variables were related. The adjusted model results were as follows:

1) Testing the adjusted model A causal relationship model of social norm and psychology capital affected to health behavior and family well-being by mediating HL in overall group was consistent

with the empirical data χ^2= 228.57, df= 67 (p-value= 0.00), χ^2/df= 3.41, RMSEA= 0.03, SRMR= 0.02, GFI= 0.99, NNFI= 99, and AGFI = 0.97). In addition to the other finding, causal factors had direct effects on health behavior including social norm, positive attitudes, psychology capital, and HL (β=0.11, 0.14, 0.30, and 0.41, *P*<0.05 respectively). Besides, health behavior, and positive attitudes had direct effects on family well-being (β=0.36. and 0.42, *P*<0.05 respectively). Total causal variables had indirect effects on family well-being such as psychology capital, social support, HL, social norm, and positive attitudes were 0.16, 0.15, 0.15, 0.06, and 0.05, *P*<0.05 respectively. All factors could predict health behavior and family well-being of variance 70% and 50% (Figure 1 and Table 3).

2) Differences in responding in the model between male and female spouses and between urban and rural respondents were examined by testing the invariance of causal models and comparing the means of the latent variables. The results indicated no differences in the causal models between men and women ($\Delta\chi^2$= 13.22, Δ df= 10, *P*-value= 0.21). In terms of the direct and indirect influences of the causal factors on health behavior, and family well-being there were no difference between male and female spouses. There were statistically significant differences in the causal models between spouses in the urban and rural communities ($\Delta\chi^2$= 93.31, Δ df= 10, *P*=0.001). These differences in effect size and factor loading on some of the paths in the causal model are shown in Figure 2.

3) Comparison of the means of the latent variables showed that positive attitudes toward health in women was lower than in men (d= 0.06, SE= 0.03, t-value= 2.08, *P*<0.05). There were no significant differences in the mean scores between men and women for social support, social norms, psychological capital, HL, health behavior and family well-being (Table 4). There were significant difference in mean scores HL (d= 0.11, SE= 0.02, *t*-value=5.64), positive attitudes toward health (d= 0.10, SE= 0.03, *t*-value= 3.34), and family well-being (d= -0.09, SE= 0.03, *t*-value= 2.93) of spouses in urban were lower in rural communities (Table 5).

Discussion

We found that all factors could high predict health behavior, and family well-being of Thai adult families in communities. According to logic model[23] and systems theory related family well-being analyzed causes of health behavior and health outcome such as quality of life or well-being was conducted by transferring health literacy[24]. In this model of overall group, 70% of health behavior and 50% of family well-being could be explained by the all factors. HL had highest directly influenced on health behavior, psychology capital, positive attitudes, and social norm, respectively. The spouses both men and women had HL, psychology capital, positive attitudes, and social norm in positive way or higher level and realized their health. They became participated in health activities and maintained

self-care in higher level too. HL directly influenced health behavior of diabetes patients[5], critical HL influenced obesity preventive behaviors, motivation, and functional HL were associated with diet in type 2 diabetes people[27]. Including, health literacy development, the activities focused on ways of searching for correct health information, health information access skills, using social media safely, and exchanging health information would improve self-care behavior and encouraging patients to take action on self-care[28]. Additionally, health literacy had indirect effect on well-being measured by participating in social activities[18]. Needed health knowledge and understanding had indirect effect on participating in social activities by mediating managing their health condition, media literacy, appropriated decisions, and maintaining in health behaviors.

Psychological capital affected directly health behavior and indirectly family well-being (β =0.30, 0.16 respectively). Psychological capital refers to an individual's positive psychological strengths which lead to behavior change[22]. Therefore, psychological capital is an individual's positive characteristics such as self-efficacy, hope, optimism, and resilience developed and used for motivated individual to work effectively. Developing psychological capital such as hope, efficacy, resilience, and optimism in college students significantly increased their positive health[29]. Supported study highlights the association between psychological factors (Positive and negative affect, life satisfaction, optimism, self-esteem, self-efficacy, and self-regulation) and frequent attendance in primary care of 7,446 people with aged 40 and above in German. This is consistent with relevant research in Thailand[30].

Positive attitudes toward health and social norm had influenced health behavior. The theory of planned behavior was strongly supported in this study by positive attitudes and subjective norm as predictors of health behavior[14]. These findings correspond with the study effectiveness of a TPB that found sexual and reproductive health behavior reduced risk increased from 64.1 to 93.1 after the educational intervention on attitude, subjective norms, parental control, and behavioral control[31]. Another social factor in this study was social support directly influenced on HL. Social support was the strongest predictor of interactive and critical health literacy of 650 Chinese students in 7-9 yr[32]. Social support had direct effect on depression in 170 of Military Medical University soldiers, in order to improve the psychosocial health status of these soldiers[33].

Comparison of effect sizes and latent variable averages in causal relationship models between heterogeneous married couples in men and women had no difference and no invariance models significantly. These factors such as social support, social norms, psychological capital, and positive attitude toward health have influence on health behavior and family well-being by mediating health literacy, predicted in the same amount of men, women and overall group. Thus, gender had no interaction with all latent variables in this model. Social support similarities in predictors of

depression between old males and females in community[31]. However, the common factors, which were living alone, dependency in daily activity, BMI, and physical activity, were not predictors of depressive symptoms in both genders. Hence, implement of this results for improving healthy behavior and well-being may be designed by the same activities for development in men and women group. While, invariance of causal models was found between spouses in urban and rural areas, and HL, positive attitudes toward health and family well-being of spouses in urban were lower in rural communities. That means many urban areas in Thailand begin to change to be urban areas. However, urban medicine had not been described and resolved clearly. Therefore, unhealthy behaviors including cognitive and social skills of people in urban areas were lower than rural. This result was consistent with the population-based survey with 3297 Chinese adults in Shaanxi Province where the prevalence of metabolic syndrome (MS) in urban, urban and rural was difference[35]. The prevalence of MS, of raised fasting glucose and raised blood pressure were significantly higher in rural residents than in urban counterparts. The semi-urban prevalence of MS showed no difference from the urban prevalence. Unlike our findings, the previous study revealed the prevalence of MS in urban was higher than rural areas in China. Different from the report, no significant difference in the prevalence of MS was observed between semi-urban and urban areas in this study, suggesting that the gap between urban and semi-urban areas seems to be closed due to urbanization in Shaanxi Province[34]. The two areas as urban or semi-urban and rural communities face a similar background such as NCDs prevalence and socio-psychological risk factors partly explained by lifestyle differences. Considering the high prevalence of NCDs in Thai adults and the developing intervention strategies were needed to address the rural-urban disparities.

Conclusion

The majority of the Thai adult families had health risk with no exercising and overweight, and inadequate HL level. All factors; psychology capital, social support, HL, social norm, and positive attitudes could predict health behavior of variance 70%. Moreover, health behavior and positive attitudes had direct effects on family well-being. There was no difference of causal relationship model of HL and family well-being between spouses in men and women, while HL and positive attitudes toward health of spouses in urban were lower in rural communities.

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Conflict of interest

This work is original and has not been published elsewhere nor is it currently under consideration for publication elsewhere. The authors declare no conflict of interest.

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Table 1: Comparison of Sample demographics between the rural and urban populations and men and women

	Men (n=1000)		**Women (n=1000)**		**Urban (n=1000)**		**Rural (n=1000)**	
Demographics	n	%	n	%	n	%	n	%
Age (yr)								
35-40	214	21.4	266	26.6	212	21.2	268	26.8
41-45	168	16.8	185	18.5	179	17.9	174	17.4
46-50	198	19.8	204	20.4	197	19.7	205	20.5
51-55	216	21.6	211	21.1	223	22.3	204	20.4
56-59	204	20.4	134	13.4	189	18.9	149	14.9
Educational level								
None	47	4.7	42	4.2	25	2.5	64	6.4
Elementary	551	55.1	539	53.9	526	52.6	564	56.4
Middle school	125	12.5	150	15.0	133	13.3	142	14.2
High school or certificate	157	15.7	124	12.4	149	14.9	132	13.2
Associate degree	50	5.0	51	5.1	58	5.8	43	4.3
Bachelor's degree or higher	70	7.0	94	9.4	109	10.9	55	5.5
Occupation								
Agricultural	363	36.3	314	31.4	325	32.5	352	35.2
Shopkeeper	219	21.9	223	22.3	115	11.5	327	32.7
Government official	82	8.2	85	8.5	88	8.8	79	7.9
Employee or workers	105	10.5	117	11.7	163	16.3	59	5.9
Not in paid employment	231	23.1	261	26.1	309	30.9	183	18.3
Time couples married/cohabiting (yr)								
0-5	84	8.4	78	7.8	49	4.9	113	11.3
6-10	109	10.9	112	11.2	89	8.9	132	13.2
11-15	122	12.2	137	13.7	138	13.8	121	12.1
16-20	145	14.5	151	15.1	168	16.8	128	12.8
21-25	190	19.0	184	18.4	186	18.6	188	18.8
26-30	181	18.1	168	16.8	207	20.7	142	14.2
>30	169	16.9	170	17.0	163	16.3	176	17.6

Table 2: Means and standards deviation of each latent variable and its constituent scales and Cronbach's alphas for each scale

Variables	Rural		Urban		Cronbach's α	Factor loading
	Mean	SD	Mean	SD		
Latent variable; HL was measured by 5observable variables						
Access to health information and services	3.64	0.81	3.76	0.69	0.82	0.46-0.75
Understanding of health information and services	3.59	0.86	3.76	0.73	0.83	0.51-0.80
Verification of health information and services	3.73	0.73	3.78	0.72	0.77	0.57-0.78
Communication skill	3.78	0.73	3.75	0.70	0.89	0.49-0.78
Self-health management	3.30	0.70	3.24	0.65	0.79	0.66-0.78
Social support	3.81	0.75	3.81	0.70	0.89	0.61-0.83
Social norms	3.87	0.72	3.69	0.69	0.83	0.66-0.87
Positive attitudes toward health	3.77	0.72	3.74	0.63	0.84	0.58-0.84
Psychological capital was measured by 4 observable variables						
Hope	3.91	0.76	3.88	0.72	0.93	0.72-0.79
Optimism	3.89	0.70	3.91	0.73	0.94	0.65-0.86
Self-efficacy	3.82	0.75	3.81	0.70	0.93	0.60-0.81
Resilience	3.95	0.76	3.95	0.69	0.93	0.70-0.80
Health behavior was measured by 2 observable variables						
Self-care	3.47	0.89	3.69	0.71	0.87	0.45-0.79
Participation in health activities	3.55	0.90	3.68	0.89	0.87	0.75-0.75
Family well-being was measured by 3 observable variables						
Health status of family members	4.07	0.75	4.08	0.69	0.89	0.65-0.77
Parents' integrity	4.12	0.82	4.10	0.76	0.89	0.67-0.85
Family relationships	4.08	0.82	4.16	0.80	0.88	0.77-0.86

Table 3: Influence coefficient (β) in the adjusted model effected on health behavior and family well-being by mediating HL in overall group

	Psychological capital (R2= 0.40)			**Health literacy (R2= 0.55)**			**Health behavior (R2= 0.70)**			**Family well-being (R2= 0.50)**		
Causal variables	**DE**	**IE**	**TE**	**DE**	**IE**	**TE**	**DE**	**IE**	**TE**	**DE**	**IE**	**TE**
Social support	0.63	0.00	0.63	0.34	0.19	0.53	0.00	0.41	0.41	0.00	0.15	0.15
Social norms	0.00	0.00	0.00	0.16	0.00	0.16	0.11	0.07	0.18	0.00	0.06	0.06
Psychological capital	0.00	0.00	0.00	0.30	0.00	0.30	0.30	0.13	0.43	0.00	0.16	0.16
Health literacy	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.41	0.00	0.15	0.15
Positive attitude	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.14	0.42	0.05	0.47
Health behavior	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.36

DE = Direct effect, IE = Indirect effect, TE =Total effect

Table 4: Comparison of the latent variable average in causal relationship model affected to health behavior and family well-being by mediating HL between spouses in men and women

Latent variables	**Average difference (d)**	**Standard error (SE)**	***t*-value**
Social support	0.05	0.03	1.90
Social norms	0.04	0.03	1.46
Psychological capital	0.02	0.03	0.82
Health literacy	0.01	0.02	0.70
Positive attitude toward health	0.06	0.03	2.08*
Health behavior	0.02	0.03	0.75
Family well-being	0.02	0.03	0.68

*$P<0.05$, Average difference = Mean of latent variable in men - Mean in women group

Table 5: Comparison of the latent variable average in causal relationship model affected to health behavior and family well-being by mediating HL between spouses in urban and rural communities

Latent variables	**Average difference (d)**	**Standard error (SE)**	***t*-value**
Social support	0.00	0.03	-0.01
Social norms	-0.02	0.03	-0.67
Psychological capital	0.00	0.02	0.17
Health literacy	0.11	0.02	5.64*
Positive attitude toward health	0.10	0.03	3.34*
Health behavior	0.03	0.03	1.03
Family well-being	0.09	0.03	2.93*

* $P<0.05$, Average difference=Mean of latent variable in rural - urban spouses

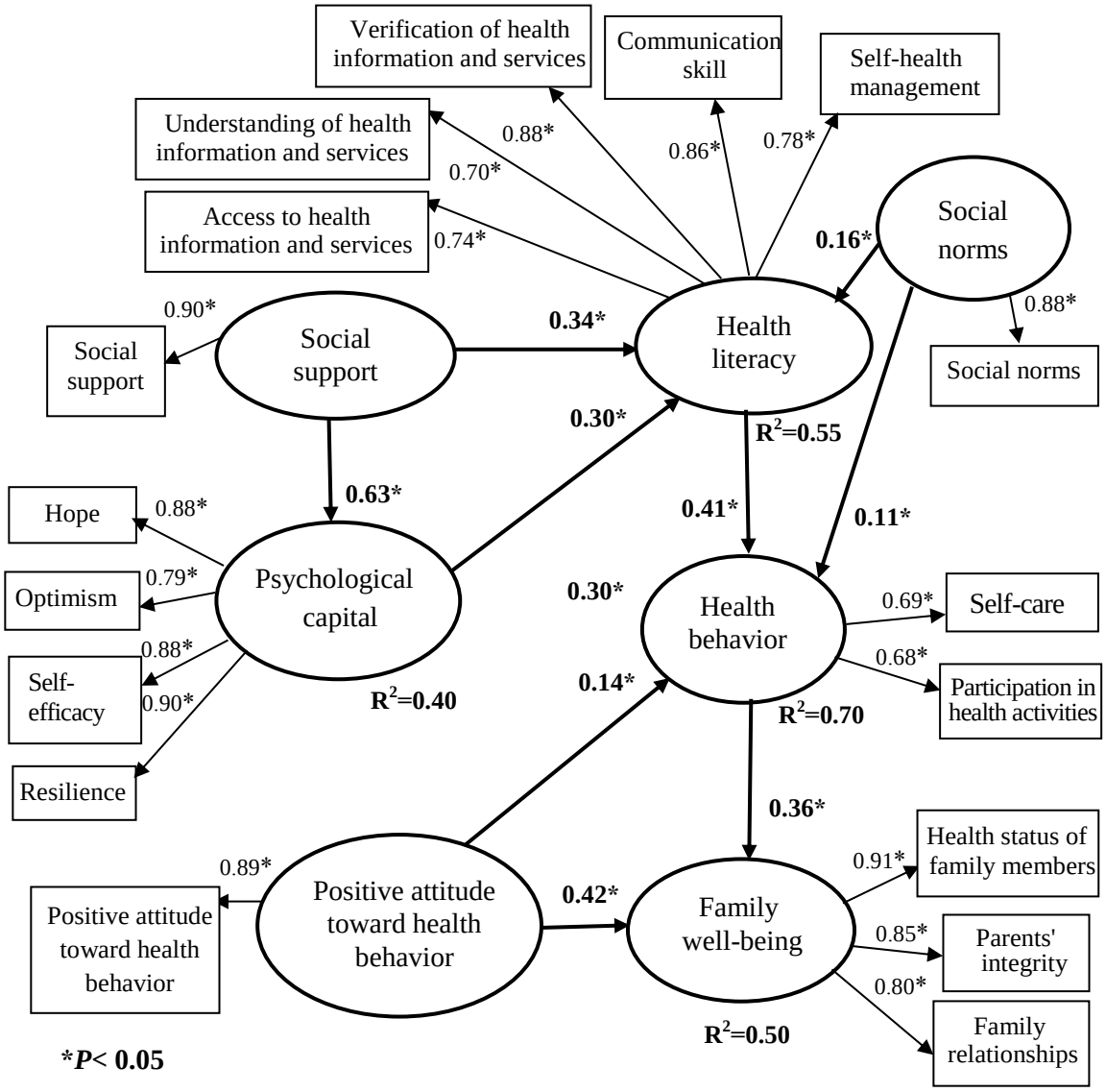

Figure 1: Causal relationship model of social norm and psychology capital effected on health behavior and family well-being by mediating HL of spouses at risk of NCDs, in overall group (n=2000)

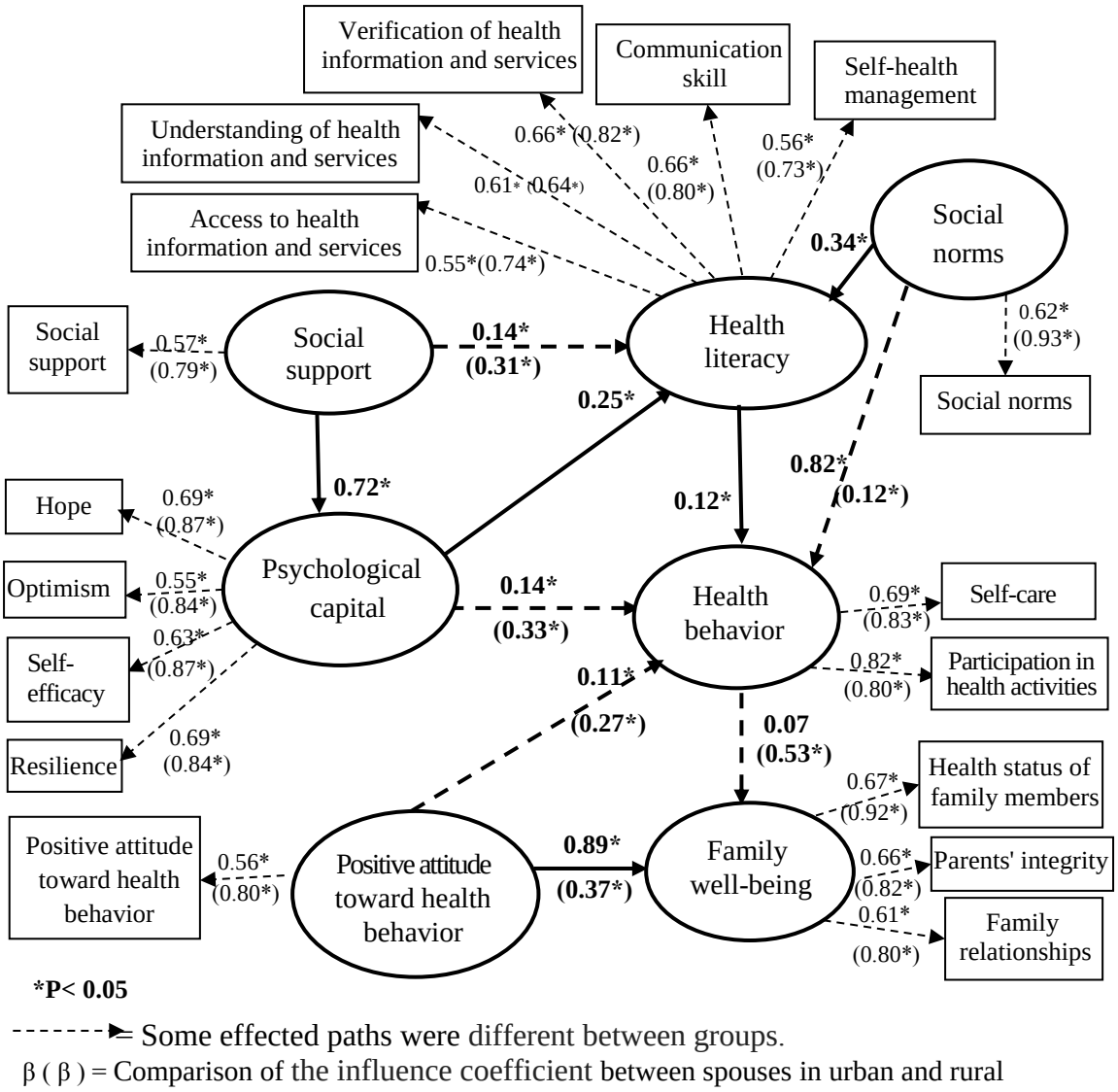

Figure 2: Results of influence coefficient estimation in comparison of the causal relationship model affected to health behavior and family well-being by mediating HL between spouses in urban (n=1000) and rural (n=1000).