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Effects of Modified Hatha Yoga in Industrial Rehabilitation on Physical Fitness and Stress of Injured Workers

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Abstract *Purpose* The purpose of this study was to assess the effects of 8 weeks of modified hatha yoga training on physical fitness and stress level in injured workers. *Methods* Eighteen male and female injured workers, age between 18 and 55 years, participated in this study. They were divided into two groups: an additive hatha yoga training to routine industrial rehabilitation program group (HYG: n = 9) and a control group with no yoga training (CG: n = 9). A modified hatha yoga protocol was designed for this population by two certified yoga instructors, approved by a physical therapist, and conducted for 1 h, three times weekly for 8 weeks. Physical fitness variables including flexibility of lower back and hamstrings, hand grip strength and lung capacity and scores of sensitivity to stress were evaluated at the time of recruitment and after 8 weeks of intervention. *Results* The values of all physical fitness variables and stress scores were no significant difference between the two groups at baseline. Significant post-yoga improvements for HYG group were noted in flexibility, hand grip strength, and vital capacity ($p < 0.05$). In contrast, there was no significant change in the CG group. Stress scores did not change as a result of hatha yoga training. *Conclusion* An 8-week modified hatha yoga training experience exerted therapeutic effects on physical fitness variables including flexibility of lower back and hamstrings, hand grip strength and vital capacity, but not on stress level in injured workers. These findings indicate that hatha yoga can be a beneficial adjunct to routine physical therapy treatment in industrial rehabilitation programs.

Keywords Respiration · Flexibility · Hand grip strength

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Introduction

After rapid economic growth, occupational injuries are one of the most important issues within the workplace in Thailand. Hundreds of people are killed in industrial accidents every year, and the number of disabling injuries is staggering. In 2009, the Thai Workmen's Compensation Fund reported that out of the total cases of employees who experience a work-related injury, 597 employees died from a workplace accident and 148,839 employees suffered from an illness (leave from work, loss of organs, and disability) [1]. The impact of work-related injury was not only on workers' health, but also losses in productivity, time at work and workers in the workforce and in economic activity. Long-term consequences of work-related injury have been associated with an increased risk of mortality, deconditioning as well as psychological damage [2–4].

At present, the focus of industrial rehabilitation programs (IRP) are on functional capacity with the aim to quickly return injured workers to a healthy and employable condition. In clinical practice, exercise is a major part of physical therapy (PT) treatment in IRP [5]. However, current PT practice may not be sufficient to halt the deterioration of physical function and to minimize the decreases in flexibility and activity tolerance, as well as to minimize the overall disability and stress of the injured

worker [3–5]. Therefore, developing an adjunct or alternative exercise, that is widely available, easy implemented, and able to promote physical fitness, psychological performance and self-efficacy of exercise among injured workers would be help achieve the goal of PT treatment in IRP.

Yoga is well known as a mind–body exercise and has been used for thousands of years. Hatha yoga, is the most popular branch of yoga; consisting of physical postures (the *asanas*), controlled respiration (the *pranayama*), and deep relaxation (the *meditation*) [6]. There is strong scientific evidence demonstrating its beneficial effects on improvement of physical fitness including lower back/hamstring flexibility [7–9], handgrip strength [10–13], vital capacity [14, 15] and psychological [6, 16] variables in both healthy and non-healthy subjects. Furthermore, recent controlled studies of yoga for particular populations have used modified hatha yoga, with some poses modified by using props to support body regions, performed in seated positions or selected based on therapeutics' purpose, to meet the specific needs of subjects who are limited in their physical and functional abilities [10, 11, 17–19]. As yoga therapy grows in popularity, an increasing number of rehabilitation teams, including physical and occupational therapy are modifying therapeutic yoga into their practice. Galantino et al. [8] studied a 6-week modified hatha yoga protocol for chronic low back pain patients and found significant improvement in balance and flexibility as well as decreased disability and depression in the yoga group of this population. In another study, Garfinkel et al. [10] found that 8 weeks modified hatha yoga-based intervention for patients with carpal tunnel syndrome improved grip strength and reduced pain. Raub et al. [15] also reported the potential health benefits of hatha yoga on lung functions in people with musculoskeletal and cardiopulmonary disease.

To the best of the author's knowledge, there are no studies measuring the therapeutic effects of combined modified hatha yoga with IRP on physical fitness and stress level in the injured workers. The current study tests the hypothesis that participating in 8 weeks modified hatha yoga in addition to IRP can help improve physical fitness and reduce stress levels in injured workers.

Methods

Participants

Eighteen male and female workers with injuries, between 18 and 55 years of age, participated in this study. They were divided into two groups: modified hatha yoga group (HYG: n = 9) and control group (CG: n = 9). Participants were recruited from injured workers who underwent inpatient rehabilitation programs in the Industrial Rehabilitation Center (IRC), Ministry of Labor, Thailand. Their types of injury were diagnosed by the medical committee of the IRC. Inclusion criteria were (1) the onset of injury occurred within the last 6 months, (2) normal vision and hearing, and (3) the levels of disability was categorized as Corset 3.1; G82 (Paraplegia) and Z89 (Acquired absence of limb) as classified by International Classification of Diseases (ICD) [20]. Participants were excluded if they were taking medication classified in the group of antidepressants and antihistamine, or if they had attention deficit disorder. The study was approved by the local Ethics Committee on Human Experimentation of Mahidol University, Thailand.

Procedures

After giving informed consent, participants were randomly allocated to two groups (HYG and CG) using purposive sampling strategies for all groups. The demographic data of the participants including age weight, height, sex and type of injury was recorded. The physical fitness and stress assessments were evaluated at the time of recruitment and after 8 weeks. The Yoga group trained a specific set of modified hatha yoga for 60 min three times weekly for 8 weeks. For the rest of the day, both groups were instructed to continue with their routine rehabilitation programs in IRC throughout the course of the study.

Yoga Intervention

The yoga training was performed in the morning at the same time of day (8:00 a.m.–9:00 a.m.). The first week of training was an adaptation week. Participants did not have any experience in yoga or meditation. The hatha yoga training program was modified by two certified yoga instructors and approved by PT in IRC. Yoga postures were selected based on capabilities of participant to ensure safety and minimize risk of re-injury. Taking into account the physical disability of the individuals in the groups, postures were modified when necessary using props to support body regions in order for the selected postures to be performed correctly by the individuals without impairing body mechanics [17]. In addition, the program included only basic sitting, kneeling and lying yoga poses. This program consisted of a set of breath control (the *pranayama*), physical postures (the *asana*) and deep relaxation (the *meditation*) (Table 1). The combination of postures requires lengthy contractions of all major muscle groups, including a range of motion of the joints in the leg, spine, and upper body. In addition, individuals focused on breathing when moving slowly from one pose to another and during relaxation. This routine was conducted using

Table 1 Details of modified hatha yoga training (60 min daily)

Purpose
a. To increase vital capacity
b. To increase flexibility of hamstrings and lower back muscle
c. To increase upper body and arm strength
d. To reduce stress
Pranayama (Diaphragmatic breathing exercise)—10 min
Ujjayi Pranayama (Conqueror Breath in sitting posture)
Asana (postures)—45 min
1. Janu Sirsasana (Head to knee in sitting posture)
2. Paschimottanasana (Bending forward in sitting posture)
3. Virasana (Hero posture)
4. Bhujangasana (Cobra posture)
5. Makarasana (Crocodile posture)
6. Balasana (Child's posture)
7. Supta Baddha Konasana (Reclining Bound Angle posture)
8. Savasana (Corpse posture)
Relaxation and meditation (Egyptian posture)—5 min

DVD player for demonstration and performed in a silent room.

Physical Fitness Assessments

Seated resting heart rate (RHR) and blood pressure (BP) were recorded for each participant. Flexibility of lower back and hamstrings was measured using a sit and reach box [21]. Participants sat with their heels firmly against the testing box. Participants kept their knees extended and placed their right hand over the left, with the long fingers even, and reached forward as far as they could by sliding their hands along the measuring board. A tape measure on top of the measuring board indicated in centimeters (cm) how far beyond the toes each individual reached. The score (in cm) is the greatest distance contacted by the fingertips past the toes. Three trials were performed, and the average was used for data analysis. A handgrip dynamometer (Takei, model T.K.K.5401, Japan) was used for testing hand and forearm muscle strength. Participants were asked to stand (except participants with paraplegia were tested on wheelchair) and keep their arms raised pointing sideways, with the elbow extended, and parallel to the ground. In this position the hand grip strength was assessed. Right hand dominant was tested in 3 trials, spaced 10 s apart, and the maximum reading was used for analysis. Participants with upper extremities amputation used the intact hand for testing. The values were represented in relative grip strength by dividing to body weight in kg. A Spiro-pet Portable Spirometer (model T-20, Japan) was used to measure vital capacity. After demonstration, all participants were tested in sitting position. Three readings were taken and the highest reading was noted. The values were divided by body weight and represented in milliliter (ml) per kg.

Stress Assessments

Each participant was assessed for their stress levels using Suanprung Stress Test (SPST), one of the most widely used for evaluating stress in Thai population [22–24] and has been shown to have high reliability and validity with Cronbach's alpha of 0.7 [22]. To measure scores of sensitivity to stress, SPST-60 Part 1 was used in this study and consists of 12 questions (total score range 0–48). Higher scores were related to greater sensitivity to stress. The test was completed individually, although an investigator was present to provide assistance if required.

Statistical Analysis

Statistical analysis was conducted using SPSS version 17.0 (Statistical Package for the Social Sciences, version 17.0, SSPS Inc, Chicago, IL, USA). Data for subject characteristics were reported as the mean ± SD. Data for physical fitness variables and stress level were reported as the mean ± SEM. As the data were normally distributed, the physical fitness variables and means stress score data were analyzed with repeated measures analyses of variance (ANOVA) with one between-subjects factor, viz., groups (with two levels, i.e., CG and HYG groups) and one within-subjects factor, viz., assessments (with two levels, i.e., pre- and post-assessment). Post-hoc analyses for pair wise comparisons between mean values were done with Bonferroni adjustment. Significance was accepted at the $p < 0.05$ level.

Results

Subject characteristics of each group are shown in Table 2. The age (year), body weight (kg) and height (cm) of participants were not different between groups. Both groups were matched for type of injuries.

Table 3 shows the results of the physical fitness assessment in CG and HYG groups at pre- and post-assessment. The repeated measures ANOVA showed no significant difference between the two groups at baseline. There was a significant difference in flexibility of lower back and hamstrings, hand grip strength and vital capacity between assessments ($p < 0.05$). Post-hoc analyses by pair wise comparisons with Bonferroni adjustment showed a significant increase in the values obtained in the flexibility of lower back and hamstrings, hand grip strength and vital capacity for the HYG group on post- compared to pre-assessment ($p < 0.05$). In contrast, there was no significant change in the CG group. For the results of stress

assessment, the repeated measures ANOVA showed no significant difference between the two groups. The means stress score before yoga was 24 in HYG and 25 in CG. This decreased to 20 in HYG and 23 in CG post yoga intervention but did not reach statistical significance (Table 3).

Discussion

The major finding of this study provides evidence that modified hatha yoga training can exert a positive and significant therapeutic effect on physical fitness as determined by increases in flexibility of lower back and hamstrings, hand grip strength and lung capacity for injured workers. No effect of modified hatha yoga was found on the stress levels of injured workers. Although previous studied have reported similar beneficial effects on improving the health-related aspects of physical fitness after hatha yoga training either in healthy or non-healthy subjects [7–9, 14, 25], our study is the first to assess this effect for injured workers.

Our results showed that 8-week hatha yoga training significantly increased flexibility of lower back and hamstrings. The increased range of motion (ROM) can most likely be attributed to the static stretching nature of the *asanas* [26]. Interestingly, we found a 82 % increase in HYG, which was greater than the 6 % increase in CG that only participated in the routine rehabilitation programs. A previous study found 14 % increases in normal healthy subjects after 8 weeks of hatha yoga practice [26]. A possible explanation for this matter may be the reduction of trunk flexibility in injured workers resulting from their physical deconditioning following injury at baseline [27], causes the large differences in % change compare to normal healthy subjects. Whereas, improved flexibility of lower back and hamstrings in HYG group but not in CG group indicated improved joint mobility of combining modified hatha yoga with industrial rehabilitation programs in injured workers. This finding is in agreement with the other studies which showed the therapeutic effect of modified hatha yoga to improve flexibility for people with musculoskeletal disorders [8, 9, 18, 19].

Hand-grip strength is influenced by effort, integrity of motor neuronal pathways, muscle mass in the lower arm and contractility. Hand-grip strength increased significantly in HYG and this result may be derived from holding static postures in the *asanas* [26]. While a few investigators have found conflicting results [7, 28], other studies are in agreement with the present findings and also reported significant improvement in hand-grip strength resulting from yoga training either in a healthy [12, 13] or diseased populations [10, 11, 15, 29]. In an earlier study a modified hatha yoga program which focused on simple stretching

Table 2 Subject characteristics of control (CG) and hatha yoga (HYG) group

Variables	CG	HYG
Age (year)	36 ± 13	44 ± 11
Weight (kg)	61 ± 10	69 ± 10
Height (cm)	164 ± 12	163 ± 7
Sex		
Male	5	4
Female	4	5
Type of injuries		
Paraplegia	2	2
Acquired absence of finger(s), unilateral	2	2
Acquired absence of hand and wrist	2	2
Acquired absence of upper limb above wrist	2	2
Acquired absence of foot and ankle	1	1

All values are presented as mean ± SD; n = 9

Table 3 Physical fitness variables and means stress score in control (CG) and hatha yoga (HYG) group pre- and post-assessment

Variables	CG		HYG	
	Pre-	Post-	Pre-	Post-
Physical fitness variables				
Resting Heart Rate (bpm)	73 ± 2	72 ± 2	66 ± 2	66 ± 3
Systolic BP (mmHg)	116 ± 5	116 ± 5	120 ± 5	119 ± 5
Diastolic BP (mmHg)	74 ± 3	77 ± 4	76 ± 3	79 ± 4
Flexibility (cm)	7.20 ± 5.59	8.02 ± 4.40	8.87 ± 1.88	15.00 ± 2.21*
Hand grip strength	0.42 ± 0.05	0.39 ± 0.05	0.44 ± 0.05	0.50 ± 0.06*
Vital capacity (ml/kg)	28.11 ± 4.20	27.51 ± 3.83	28.65 ± 3.63	36.94 ± 2.80*
Means stress score	25 ± 3	23 ± 2	24 ± 2	20 ± 2

All values are presented as mean ± SEM; n = 9

* Significantly different from pre-assessment, $p < 0.05$, Post-hoc analyses with Bonferroni adjustment comparing pre- and post-assessment

and postural alignment improved in hand-grip strength in patients with carpal tunnel syndrome over an 8-week period [10]. In another study the hand- grip strength also increased in hemodialysis patients after 3 months of using some yogic stretching postures as a modified hatha yoga-based exercise program [11]. Our result match those observations, indicating that increased hand grip strength following modified hatha yoga program in injured workers may be explained by neuromuscular adaptations from the isometric contractions maintained during the steady state of yoga postures [30].

Furthermore, HYG also demonstrated a significant increase in vital capacity. This improvement may be attributed to the slow and deep breathing in the *pranayama* causing a decrease in dead space and increase in alveolar ventilation, thus leading to increase maximum ventilation and vital capacity [31]. Several lines of investigations have shown that the *pranayama*, part of hatha yoga, can improve vital capacity in both healthy [12, 14, 30, 32] and unhealthy people [15]. Panwar et al. [14] studied in 75 healthy medical students, between the ages of 18–25 mentioned that practicing *pranayama* 30 min every day for 3 months increased vital capacity significantly. Hovsepian et al. [33] also suggested that practice of *pranayama,* with regard to its effect on pulmonary capacities, may be useful in people with physical activity limitation. In agreement, our finding strongly supports those evidences and highly recommends using this pose as a part of exercising program in the rehabilitation for injured workers.

In the present study, the scores of sensitivity to stress, as assessed by SPST-60 part 1 questionnaire, did not change as a result of hatha yoga training. However, other studies have shown that yoga does result in a statistically significant attenuation of stress in people experiencing a stressful environment [34]. A study by Phoosuwan et al. [35] also reported an increase in quality of life after 12 weeks of yoga training in Thai population. The present findings, which are not wholly in agreement with the literature, may have several explanations. First, the differences in stress levels of our participants at baseline might have not high enough to detect the stress changes. Second, it might be due to the known disadvantages of using a self-reporting questionnaire in the present study [36]. Last, 8 weeks of yoga training might be insufficient to measure its effect of stress. This result therefore needs to be interpreted with caution. The present findings do suggest that rehabilitation programs for injured workers should pay more attention to the stress reduction program [3]. However further study is required to clarify this matter.

In summary, this study provides data to support the therapeutic effects of yoga on physical fitness variables. Hatha yoga can be a safe adjunct or alternative exercise to routine physical therapy treatment [18] in injured workers. Moreover, our study proposes that the specific yoga's poses including static stretching (the *asanas*), isometric contraction (the *asanas*), the slow and deep breathing (the *pranayama*) and deep relaxation (the *meditation*) are highly recommenced as a crucial part of the exercise program to expedite the recovery and the return of normal life in injured workers.

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Conflict of interest None.

Informed consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

References

1. The Thai's Social Security Office. Annual Report 2009. Social Security Office, Thailand. 2009. http://www.sso.go.th/wpr/eng/annual-report.html. Accessed 20 Feb 2015.
2. Scott-Marshall HK, Tompa E, Wang Y, Liao Q. Long-term mortality risk in individuals with permanent work-related impairment. Can J Public Health. 2014;105(5):e330–5.
3. Nicholas MK. Work Hardening/Conditioning, Functional Restoration and Pain Management Programs for Injured Workers With No 'Red Flag' Conditions. June, 2002.
4. Pichora D, Grant H. Upper extremity injured workers stratified by current work status: an examination of health characteristics, work limitations and work instability. Int J Occup Environ Med. 2010;1(3):124–31.
5. Fenner P. Returning to work after an injury. Aust Fam Physician. 2013;42(4):182–5.
6. Javnbakht M, Kenari RH, Ghasemi M. Effects of yoga on depression and anxiety of women. Complement Ther Clin Pract. 2009;15(2):102–4. doi:10.1016/j.ctcp.2009.01.003.
7. Tracy BL, Hart CE. Bikram yoga training and physical fitness in healthy young adults. J Strength Cond Res. 2013;27(3):822–30. doi:10.1519/JSC.0b013e31825c340f.
8. Galantino ML, Bzdewka TM, Eissler-Russo JL, Holbrook ML, Mogck EP, Geigle P, et al. The impact of modified Hatha yoga on chronic low back pain: a pilot study. Altern Ther Health Med. 2004;10(2):56–9.
9. Telles S, Dash M, Naveen KV. Effect of yoga on musculoskeletal discomfort and motor functions in professional computer users. Work. 2009;33(3):297–306. doi:10.3233/WOR-2009-0877.
10. Garfinkel MS, Singhal A, Katz WA, Allan DA, Reshetar R, Schumacher HR Jr. Yoga-based intervention for carpal tunnel syndrome: a randomized trial. JAMA. 1998;280(18):1601–3.
11. Yurtkuran M, Alp A, Dilek K. A modified yoga-based exercise program in hemodialysis patients: a randomized controlled study. Complement Ther Med. 2007;15(3):164–71. doi:10.1016/j.ctim.2006.06.008.
12. Madanmohan, Thombre DP, Balakumar B, Nambinarayanan TK, Thakur S, Krishnamurthy N, et al. Effect of yoga training on

reaction time, respiratory endurance and muscle strength. Indian J Physiol Pharmacol. 1992;36(4):229–33.
13. Bhonde MS, Bagade AH, Dhanavijay AD. Effect of suryanamaskar on handgrip strength in healthy volunteers in the age group of 20–40 years. Int J Recent Trends Sci Technol. 2014;12(2):236–8.
14. Panwar S, Chourishi A, Makwana J. Effect of pranayama (yoga) on pulmonary function test of young healthy students. Int J Pharma Bio Sci. 2012;3(4):12–6.
15. Raub JA. Psychophysiologic effects of Hatha Yoga on musculoskeletal and cardiopulmonary function: a literature review. J Altern Complement Med. 2002;8(6):797–812. doi:10.1089/10755530260511810.
16. Sareen S, Kumari V, Gajebasia KS, Gajebasia NK. Yoga: a tool for improving the quality of life in chronic pancreatitis. World J Gastroenterol. 2007;13(3):391–7.
17. Evans S, Sternlieb B, Zeltzer L, Tsao J. Iyengar yoga and the use of props for pediatric chronic pain: a case study. Altern Ther Health Med. 2013;19(5):66–70.
18. Middleton K, Acevedo A, Dietz L, Brandon Z, Andrade R, Wallen G. Yoga and physical rehabilitation medicine: a research partnership in integrative care. J Yoga Phys Ther. 2013. doi:10.4172/2157-7595.1000149.
19. Greendale GA, McDivit A, Carpenter A, Seeger L, Huang MH. Yoga for women with hyperkyphosis: results of a pilot study. Am J Public Health. 2002;92(10):1611–4.
20. World Health Organization. International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)-2015-WHO Version for;2015. 2015. http://apps.who.int/classifications/icd10/browse/2015/en. Accessed 20 Feb 2015.
21. American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2000.
22. Mahatnirunkul S, Pumpaisanchai W, Tarpunya P. The construction of Suan Prung stress test for Thai population. Bull Suan Prung. 1997;13(3):1–11.
23. Kongsomboon K. Psychological problems and overweight in medical students compared to students from Faculty of Humanities, Srinakharinwirot University, Thailand. J Med Assoc Thail. 2010;93(Suppl 2):S106–13.
24. Chalernvanichakorn T, Sithisarankul P, Hiransuthikul N. Shift work and type 2 diabetic patients' health. J Med Assoc Thai. 2008;91(7):1093–6.
25. Field T. Yoga clinical research review. Complement Ther Clin Pract. 2011;17(1):1–8. doi:10.1016/j.ctcp.2010.09.007.
26. Tran MD, Holly RG, Lashbrook J, Amsterdam EA. Effects of Hatha Yoga practice on the health-related aspects of physical fitness. Prev Cardiol. 2001;4(4):165–70.
27. Convertino VA. Exercise responses after inactivity. In: Sandler H, Vernikos J, editors. Inactivity: physiological effects. Orlando: Academic; 1986. p. 149–91.
28. Blumenthal JA, Emery CF, Madden DJ, George LK, Coleman RE, Riddle MW, et al. Cardiovascular and behavioral effects of aerobic exercise training in healthy older men and women. J Gerontol. 1989;44(5):M147–57.
29. Dash M, Telles S. Improvement in hand grip strength in normal volunteers and rheumatoid arthritis patients following yoga training. Indian J Physiol Pharmacol. 2001;45(3):355–60.
30. Madanmohan, Mahadevan SK, Balakrishnan S, Gopalakrishnan M, Prakash ES. Effect of six weeks yoga training on weight loss following step test, respiratory pressures, handgrip strength and handgrip endurance in young healthy subjects. Indian J Physiol Pharmacol. 2008;52(2):164–70.
31. Jerath R, Edry JW, Barnes VA, Jerath V. Physiology of long pranayamic breathing: neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system. Med Hypotheses. 2006;67(3):566–71. doi:10.1016/j.mehy.2006.02.042.
32. Birkel DA, Edgren L. Hatha yoga: improved vital capacity of college students. Altern Ther Health Med. 2000;6(6):55–63.
33. Hovsepian V, Marandi SM, Kelishadi R, Zahed A. A comparison between yoga and aerobic training effects on pulmonary function tests and physical fitness parameters. Pak J Med Sci. 2013;29(1 Suppl):317–20.
34. Malathi A, Damodaran A. Stress due to exams in medical students—role of yoga. Indian J Physiol Pharmacol. 1999;43(2):218–24.
35. Phoosuwan M, Kritpet T, Yuktanandana P. The effects of weight bearing yoga training on the bone resorption markers of the postmenopausal women. J Med Assoc Thai=Chotmaihet thangphaet. 2009;92(Suppl 5):S102–8.
36. Everson-Rose SA, Clark CJ. Assessment of Psychosocial Factors in Population Studies. In: Steptoe A, editor. Handbook of behavior medicine methods and applications. New York: Springer; 2010. p. 291.