

Development and validation of a work-related low back pain risk-assessment tool for sugarcane farmers

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Abstract: This cross sectional study developed and validated a LBP risk-factor screening scale for use with sugarcane farmers. The scale was developed from a synthesis of LBP risk factors, pre-tested with 30 sugarcane farmers and administered to five hundred and forty sugarcane farmers to test its psychometric properties. Results indicated construct validity for three factors; physical factors (19 items) with factor loadings of 0.406 to 0.881 and communalities between 0.471 and 0.991; psychological factors (7 items) with factor loadings of 0.635 to 0.821 and communalities between 0.444 and 0.714, and third, working environment factors (2 items), with factor loadings between 0.345 and 0.347 and communalities between 0.946 and 0.953. The content validity index was 0.90 with reliability index of 0.87. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 82.02%, 30.49%, 62.65% and 54.40% respectively. The area under the receiver operating characteristic was 0.56. The scale's high specificity and sensitivity and comprehensive three risk-factor dimensions should make it a very useful screening tool in primary health care for early detection of LBP and for LBP risk-reduction and prevention advice. Future studies could focus on confirming content and predictive validity in other settings to assess generality of its usage.

Key words: Low back pain, Development and validation, Screening tool, Risk assessment tool, Sugarcane farmers

Introduction

Low back pain (LBP), discomfort or pain experienced in the lumbar spine or lower region of the spine, is a major musculoskeletal disorder with estimated global prevalence among working-age people of around 60–70%¹. LBP

is identified as an important occupational health issue in many countries².

Eighty percent of Thai working-age people are estimated to have musculoskeletal disorders³, with the highest Thai LBP prevalence in informal sector workers who work at home. For example, 46% of sugarcane farmers had LBP⁴. The major cause of LBP among Thai sugarcane farmers is physical labor used in preparing and planting land, the cutting, lifting and carrying sugarcane at harvest rather than using machinery.

Sugarcane farmers with severe LBP have restricted

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movement which reduces work efficiency, increases sick days from work⁵⁾ and impacts on farmers' quality of life and individual and national income. Treating LBP is a major economic cost. For example, in the United States of America LBP-related treatment costs exceeded \$100 billion, in 2006⁶⁾. In 2012, it was estimated the Thai government spent 26,681 million baht (USD 796 million) treating shoulder upper back and low back pain⁷⁾.

The prevention of work-related LBP would improve sugarcane farmers' quality of life, increase work efficiency, sugarcane production and individual and country incomes. The development of a valid and reliable screening tool for early back pain risk detection would be an important contribution to developing prevention strategies for this work group. While there are many tools to measure work risk factors for limb and whole body pain e.g., in industrial, office, furniture and garment factory settings, there is limited research on development of a risk screening tool for LBP among sugarcane farmers. Sugarcane farmers often work many consecutive 12 h days (e.g., 6 am to 7 pm) cane cutting, with repetitive forceful bending and twisting motions different from other farm labor. Some cross-sectional Thai studies have investigated LBP prevalence and LBP risk factors among sugarcane farmers⁸⁾. This study was designed to develop and validate a LBP risk-factor screening scale for use with sugarcane farmers.

Materials and Methods

Research design

This research study used a cross sectional methodological design.

Setting for study and participants

A multistage random sampling technique was used. Firstly a simple random sampling was performed to select three provinces in Northeastern Thailand where sugarcane was a major crop, namely Khon Kaen, Nakhon Ratchasima, and Udon Thani. This was followed by simple random samplings of districts and sub districts from those three provinces. Then cluster random sampling was used to select villages, and all samples that passed the inclusion criteria were selected to join the study. The inclusion criteria included participants had to have been engaged in sugarcane production for at least one year and aged between 18–59 years old. Exclusion criteria were participants with diagnosed pre-existing bone or muscle disease such as gout, arthritis, rheumatism, osteoporosis, osteoarthritis, myasthenia gravis, immune deficiency, menopausal

syndrome, or, those who had received surgery for a bone or muscle disorder. With reference to recommendations for approximately 300 to 500 subjects, or large samples, for factor analysis⁹⁾ a total 540 sugarcane farmers were selected as the sample. It falls within the sample range of 500–999 considered appropriate for factor analysis¹⁰⁾.

Development scale

There were two phases in the development of the work-related LBP risk assessment tool¹¹⁾ as follows;

Phase 1: Development of questionnaire

Step 1: Synthesis of LBP risk factors from ergonomic principles underlying work-related LBP^{12–14)} was carried out by (1) reviewing relevant literature using keywords including: LBP, working postures, repetitive work, forceful exertions, financial stress, sugarcane farmers, and keywords from the database of health science electronic databases, and (2) in-depth interviews with 10 purposively-sampled sugarcane farmers. The results from content analysis revealed two dimensions of risk factors; 1) Individual factors: gender, age, weight, high body mass index, smoking, exercise and illness 2) occupational factors, including 2.1) physical factors included repetitive activity, static work posture, awkward postures, and forceful exertions 2.2) psychological factors included working long time, working against time, job demand, job dissatisfaction, job strain and depression, and 2.3) working environment factors such as heat, sunlight.

Step 2: Generate items for the assessment tool development to be used to identify the LBP risks. An item pool was generated from the findings from step 1, which yielded 32 items with yes/no format. It had three domains: 1) a physical domain consisting of repetitive gestures (4 items), long duration posture (3 items), unsuitable posture (6 items), work exertion (8 items), and 2) a psychological domain (9 items) and 3) a work environment domain (2 items).

Step 3: Content validity was performed by six experts: three physical therapists, an occupational health physician, an orthopedic physician and a rehabilitation physician. Their tasks were to determine question consistency for the research and examine the format, clarity, appropriateness, and coverage of content created using the content validity index (CVI). It was found that from all 32 questions, the experts agreed that there were 30 content-related questions.

This questionnaire consisted of four parts. The first part covered general demographic and socioeconomic characteristics, the second focused on ergonomic factors

including working in awkward or stationary positions, lifting heavy or awkward items, repetitive motion, using excessive force, and being exposed to excessive vibration and extreme temperatures. The third part covered psychological factors including work durations, job demands, job satisfaction, strain, and depression. The last part is work environment factor such as heat.

Step 4: A pretest of the preliminary instrument was performed using 30 sugarcane farmers in Sahatsakhan District, Kalasin Province. Kuder Richardson (KR20) was used to determine the internal consistency of the scale to indicate how well the items fit together conceptually. Its internal consistency was found to be within the acceptable value of ≥ 0.70 ¹¹.

Phase 2: Evaluation of psychometric properties

A field-test was conducted to determine the construct validity and predictive validity of the instrument. Five hundred and forty sugarcane farmers tested the instrument's psychometric properties, before it used with the large sample of sugarcane farmers. Exploratory factor analysis (EFA) was performed to evaluate the construct validity. Sensitivity, specificity, positive predictive value, and negative predictive value was calculated to evaluate the predictive validity.

The Standardized Nordic Questionnaire¹⁵ was used to measure the respondents' subjective perceptions of LBP over the last 7 d and/or the last 12 months. The Standardized Nordic Questionnaire is widely used and generally considered to have high reliability, for example achieving a reliability of 0.90¹⁶. In Thailand, the reliability of this instrument has been found to be 0.80.¹⁷ A possible limitation of Standardized Nordic Questionnaire scores is respondents' differential pain tolerance thresholds resulting in low self-reporting of LBP even where participants' range of motion could be considered abnormal. Therefore, two expert physiotherapists performed objective musculoskeletal examinations to assess achievable range of motion (extent to which a joint or group of muscles can be flexed or extended) to confirm the subjective LBP measures from the Standardized Nordic Questionnaire. A LBP code of normal=0 or abnormal=1 was derived from both assessments. An abnormal code on both measures was required to define LBP. The criteria for LBP occurrence in last 12 months was used because sugarcane farming work demands and LBP risk vary across the planting and harvesting seasons.

Data collection

After developing a list of sugarcane farmers, the

researcher worked collaboratively with village health volunteers to make appointments with sugarcane farmers in the village and obtain written consent from the farmers for the participation. LBP perception was collected by using Standardized Nordic Questionnaire and two expert physiotherapists were assigned to assess achievable range of motion. Risk-factor data were collected using the developed questionnaire.

Data analysis

All questionnaire data was entered into Excel spreadsheet format and analyzed using STATA (v 10.0). Descriptive statistics (means or proportions) were used to characterize the demographic data and LBP. The psychometric evaluation of tool used Kuder Richardson (KR20) for reliability and the content validity index (CVI). Likewise, construct validity was tested using exploratory factor analysis (EFA), principal component method with Promax rotation was used to explore the structure of the items and examine its construct validity, since it allows correlation of the factors¹⁸. Predictive validity was measured using sensitivity, specificity, positive predictive value, and negative predictive value. The receiver operating characteristics (ROC) curve was generated to display the trade-off between sensitivity and specificity for a range of test scores. True-positive rate (sensitivity) was plotted on the vertical axis against the false-positive rate (specificity) on the horizontal axis over a range of potential cut off scores. Similarly the area under the curve (AUC) was calculated.

AUC were produced to evaluate the discriminatory ability of the risk score. The risk score was calculated by dividing the coefficients by the absolute value of the smallest coefficient in the final model and rounding up to the nearest integer¹⁹. The area under the ROC would be 0.5. A score performing significantly better than chance was an AUC > 0.5 with the lower limit of the 95% confidence interval Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for several cut-off scores were calculated and the cut-off score with maximum sum of sensitivity and specificity was taken as an optimum²⁰.

Ethical review

The proposal for this research was reviewed and approved by the Human Ethics Research Committee of Khon Kaen University (HE 552186).

Table 1. Participant demographics (n=540)

Characteristics	Number	Percent
Gender		
Male	229	42.4
Female	311	57.6
Age (yr)		
20–29	17	3.1
30–39	103	19.1
40–49	273	50.6
50–59	147	27.2
Mean (SD)=44.75 (7.67)		
Median (Min, Max)= 45 (20,59)		
Marital status		
Single	22	4.1
Married	513	95.0
Widow/divorced/separate	5	0.9
Duration of sugarcane work (yr)		
1–10	261	48.3
11–20	135	25.0
21–30	118	21.9
>30	26	4.8
Mean (SD)=15.41 (10.50)		
Median (Min, Max)=12 (1, 50)		
Working hours a day (h/d)		
≤4	30	5.6
5–6	54	10.0
7–8	361	66.8
>8	95	17.6
Mean (SD)=7.84 (1.64)		
Median (Min, Max)=8 (2, 13)		

Results

Participant demographics

The participants were 540 sugarcane farmers and 57.6% were females. Fifty point six percent were age between 40–49 yr (mean=age 44.75, SD=7.67) and 95% were married. Forty eight point three percent had duration of sugar work from 1 to 10 h (mean=15.41, SD=10.50) and 66.8% had work hours per day between 7–8 h (mean 7.84, SD=1.64). Further details were presented in Table 1.

The prevalence of LBP

The majority of respondents reported LBP in the past 7 d and in the last 12 months; 51.67% (95%CI=47.36 to 55.95) and 58.70% (95% CI=55.42 to 62.89), respectively, and the results are presented in Fig. 1.

Factors associated with LBP among sugarcane farmers

Multiple logistic regression analysis indicated statisti-

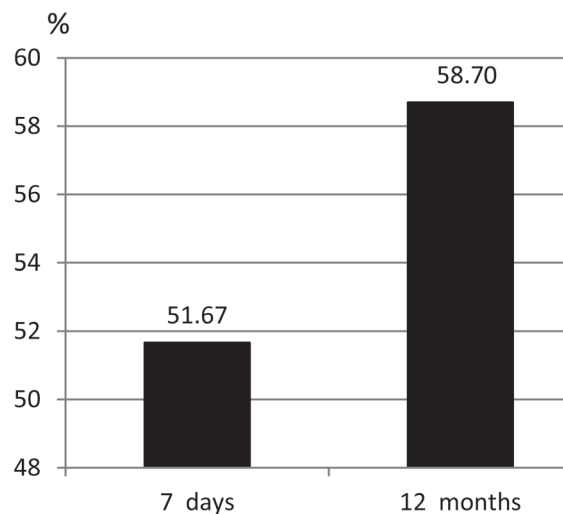


Fig. 1. The prevalence of LBP in the past 7 d, in the last 12 months.

cally significant associations between suffering LBP in last 12 months and several factors (p -value<0.05), and the results are given in Table 2.

Validity and reliability of a work-related low back pain risk assessment tool

The content validity index (CVI) and Kuder-Richardson reliability coefficients were 0.90 and 0.87 respectively. Regarding construct validity, the scale had three dimensions; physical, psychological and work environment. The physical dimension had the largest number of high factor loadings (19 items, factor loading between 0.406 and 0.881), less on psychological dimension (7 items, factor loading between 0.635 and 0.821), and lowest on work environment (2 items, factor loading from 0.345 to 0.347). Fuller details were shown in Table 3.

Predictive validity

Table 4 predictive values for sensitivity, specificity, positive predictive value (PPV+), negative predictive value (NPV-) of the worked-related LBP risk assessment tool were 82.02%, 30.49%, 62.65%, and 54.40% respectively (more details in Table 4) and area under ROC curves equaled 0.56. A cutoff point of equal or more than 10, indicated 2 times (95%CI: 1.33–3.00) the risk of LBP.

Discussion

This study developed and validated work-related low back pain risk-assessment tool for Thai informal sector

Table 2. Factors association with LBP of sugarcane farmers (n=540)

Factors	Number		Prevalence of the LBP; n (%)	Crude OR (95%CI)	Adjusted OR (95%CI)
	No	Yes			
Standing longer than four hours without changing posture per d.	No	54	23 (42.59)	1	1
	Yes	486	294 (60.49)	2.06 (1.16–3.64)	1.15 (1.05–2.56)
Bending their bodies continuously more than 2 h per d.	No	95	46 (48.42)	1	1
	Yes	445	271 (60.90)	1.65 (1.06–2.59)	1.29 (1.17–3.10)
Twisting their bodies continuously more than 2 h per d.	No	75	33 (44.00)	1	1
	Yes	465	284 (61.08)	1.99 (1.22–3.26)	1.50 (1.18–2.62)
Lifting heavy material weighing more than 34 kg more than one time per d.	No	49	20 (40.82)	1	1
	Yes	491	297 (60.49)	2.21 (1.22–4.03)	1.60 (1.07–3.60)
Stooping their bodies more than 2 h continuously per d.	No	105	52 (49.52)	1	1
	Yes	435	265 (60.92)	1.58 (1.03–2.43)	1.35 (1.18–2.12)
Long working hours	No	201	99 (49.25)	1	1
	Yes	339	218 (64.31)	1.85 (1.30–2.65)	1.82 (1.27–2.62)

Table 3. Factor loading and item statements of a work-related low back pain risk assessment tool for sugarcane farmers (n= 540)

Dimensions and item statements	Factor loading			Communalities (h ²)
	1	2	3	
Dimensions 1: Physical factors (19 items with Eigenvalue=1.69, % of Variance=3.51, Communalities (h ²)=0.471–0.991				
-Lifting heavy material weighing more than 25 kg, more than ten times per d.	0.881			0.811
-Lifting heavy material weighing more than 5 kg, two times per min, more than two time per d.	0.870			0.807
-Repetitively lifting shoulder and hands continuously more than 2 h per d.	0.853			0.908
-Sitting in squat position for more than 2 h per d.	0.853			0.766
-Standing without changing posture longer than four h per d.	0.840			0.909
-Working in kneeling position continuously >2 h per d.	0.833			0.898
-Lifting and twisting wrist repetitively more than 2 h per d.	0.802			0.689
-Lifting heavy material weighing more than 34 kg, more than one time per d.	0.788			0.661
-Throwing objects over shoulder continuously.	0.611			0.495
-Lifting heavy material weighing more than 11 kg more than twenty five times per d.	0.573			0.986
-Driving a tractor with vibration for more than 2 h per d.	0.572			0.991
-Driving a sugar cane truck with vibration for more than 2 h a d.	0.570			0.988
-Extending arms and hands for more than 2 h per d.	0.566			0.629
-Throwing and twisting motion more than 2 h per d.	0.545			0.471
-Lifting with hands over shoulder for more than 2 h per d.	0.525			0.655
-Grasping or pressing hands for more than 2 h per d.	0.508			0.928
-Stooping for more than two hours continuously per d.	0.491			0.926
-Bending head down more than 2 h per d.	0.466			0.597
-Lifting head up for more than 2 h per d.	0.406			0.587
Dimensions 2: Psychological factors (7 items with Eigen value=1.69, % of Variance=3.51, Communalities (h ²)=0.444–0.714)				
-Anxiety about poor productivity.		0.821		0.714
-Long working hours.		0.803		0.663
-Stress about low price of sugarcane.		0.802		0.693
-Working harder to increase yield .		0.783		0.641
-Feeling desperate about low income and debt from sugarcane farming.		0.746		0.592
-Stress from working more than 8 h/d.		0.705		0.512
-Insufficient sleep.		0.635		0.444
Dimensions 3: Working environment factors (2 items with Eigen value=1.69, % of Variance=3.51, Communalities (h ²)=0.946–0.953				
-Working in excessive heat continuously for more than 2 h without a break.			0.347	0.946
-Very hot weather or excessive sweating.			0.345	0.953

sugarcane farmers. The tool's content was systematically developed from prior research literature and also incorporated specific work contexts and data from sugarcane farmers who had LBP experience^{21, 22}. The study used mixed methods to provide rigorous evaluation of the tool's development²³.

This work-related LBP risk assessment tool was found to have higher content validity (0.90) than other standards²⁴ with good congruence between the data collection instrument and dimension content factors. The tool may have such a high standard because its content was robustly validated by a variety of relevant experts from this field: three physical therapists, an occupational health physician, an orthopedic physician and a rehabilitation physician. As a result, the tool included the theory based and workers generated risk factors and can be helpful determining whether the measure is well constructed and suitable for psychometric testing²⁵. Kuder-Richardson test was used to test reliability and test and total-item correlation revealed good homogeneity. Kuder-Richardson scores ranged between 0.85 to 0.88 and the total internal consistency 0.87 again at highstandard²³.

Explanatory factor analysis also yielded support for construct validity of the tool and was able to classify the variables into three main dimensions, namely, physical factors, psychological factors and working environment factors¹²⁻¹⁴. Each item was required to have factor loading above the recommended criteria of 0.30^{18, 26, 27}.

The predictive validity of this work-related low back pain risk assessment tool for sugarcane farmers had high sensitivity (88.3%) due to high prevalence of LBP which was gold standard similar to a study of Janwantanakul *et al*⁷. The risk score assessment at cut point (≥ 10 scores) was able to screen LBP among sugarcane farmers because at this cut point, thus a good first choice for a test cut off value is that value which corresponds to a point on the ROC curve nearest to the upper left corner of the ROC graph. The ROC area for this line is 0.61. It was more than 0.5²⁰. As a result, the work-related LBP risk assessment tool had appropriate sensitivity, specificity, PPV+, PPV- and accuracy and at cut point of ≥ 10 , it was able to identify the risk of LBP 2.00 times (95% CI: 1.33-3.00).

Conclusion and Implication

This study presents the development and validation of a LBP risk-assessment instrument for Thai sugarcane workers, a very high LBP at-risk group. Its high specificity and sensitivity and comprehensive three risk-factor dimensions

Table 4. Cut off point, sensitivity, specificity, positive predictive value (PPV+), and negative predictive value (PPV-) of a work-related low back pain risk assessment tool for sugarcane farmers

Cut off point	Sensitivity	Specificity	PPV+	PPV-
≥ 2	99.05	0.45	58.58	25.00
≥ 3	99.05	0.90	58.69	40.00
≥ 4	99.05	2.24	59.02	62.50
≥ 5	98.74	5.83	59.85	76.47
≥ 6	98.43	6.31	60.08	73.68
≥ 7	97.16	10.31	60.63	71.88
≥ 8	96.53	14.35	61.57	74.42
≥ 9	91.80	17.94	61.39	60.61
≥ 10	82.02	30.49	62.65	54.40
≥ 11	79.18	35.43	63.54	54.48
≥ 12	63.41	56.95	67.68	52.26
≥ 13	47.39	60.99	55.61	52.92
≥ 14	46.69	69.96	68.84	48.00

Remark: Prevalence of LBP in the last 12 months was applied as gold standard (58.70).

should make it a very useful tool for primary health care personnel for early screening and treatment of LBP and for providing risk-reduction and LBP prevention advice. Future studies could focus on further confirming content and predictive validity in other settings to assess generality of its usage.

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References

- 1) O'Sullivan P (2005) Diagnosis and classification of chronic low back pain disorders: maladaptive movement and motor control impairments as underlying mechanism. *Man Ther* **10**, 242-55.
- 2) Weiner SS, Nordin M (2010) Prevention and management of chronic back pain. *Best Pract Res Clin Rheumatol* **24**, 267-79.
- 3) Social Security Office Thailand. Annual report 2013. <http://www.sso.go.th/wpr/uploads/uploadImages/file/AnnualReportBook2556.pdf>. Accessed June 21, 2015.
- 4) Nilvarangkul K, Adler Collins JK, Thawenongiew K,

- Clangglang R (2009) Community participation in health service system for informal sector workers in primary care units: a case study of sugarcane farmers. Bangkok, Thailand: Thai Health Promotion Foundation.
- 5) Nyman T, Grooten WJ, Wiktorin C, Liwing J, Norrman L, Norrman L (2007) Sickness absence and concurrent low back and neck-shoulder pain: results from the MUSIC-Norråljä study. *Eur Spine J* **16**, 631–8.
 - 6) Crow WT, Willis DR (2009) Estimating cost of care for patients with acute low back pain: a retrospective review of patient records. *J Am Osteopath Assoc* **109**, 229–33.
 - 7) Janwantanakul P, Pensri P, Moolkay P, Jiamjarasrangsi W (2011) Development of a risk score for low back pain in office workers—a cross-sectional study. *BMC Musculoskelet Disord* **12**, 23.
 - 8) Sriwong N, Inmuong U (2013) Health impacts from sugarcane growing on sugarcane farmers in Nongkungeao Sub-district, Sriboonrung District, Nongbualamphu Province. *KKU J Public Health Res* **6**, 14–22.
 - 9) Gonzalez R, Griffin D (2001) Testing parameters in structural equation modeling: every “one” matters. *Psychol Methods* **6**, 258–69.
 - 10) Comrey AL, Lee HB (1992) A first course in factor analysis. Academic Press. University of California, San Diego.
 - 11) DeVellis RF (2012) Scale Development: Theory and applications, 3rd ed., Thousand Oaks, California.
 - 12) National Institute for Occupational Safe and Health [NIOSH] (1997) Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. <http://www.cdc.gov/niosh/docs/97-141/97-141pd.html>. Accessed May 2, 2015.
 - 13) Occupational Safety and Health Administration [OSHA] (2003) Sewing and related procedures ergonomics. http://www.osha.gov/SLTC/etools/sewing/pdf/sewinggandrelateprocedurestask_pdf. Accessed June 12, 2015.
 - 14) Das B, Ghosh T, Gangopadhyay S (2012) Assessment of ergonomic and occupational health-related problems among female prawn seed collectors of Sunderbans, West Bengal, India. *Int J Occup Saf Ergon* **18**, 531–40.
 - 15) Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, Jørgensen K (1987) Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon* **18**, 233–7.
 - 16) Dawson AP, Steele EJ, Hodges PW, Stewart S (2009) Development and test-retest reliability of an extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E): a screening instrument for musculoskeletal pain. *J Pain* **10**, 517–26.
 - 17) Sungkhabut W, Chaiklieng S (2011) Musculoskeletal disorders among informal sector workers. *Srinagarind Med J* **26**, 225–32.
 - 18) Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL (2006) *Multivariate data Analysis*, 6th ed., New Jersey, Prentice-Hall.
 - 19) Sullivan LM, Massaro JM, D’Agostino RB Sr (2004) Presentation of multivariate data for clinical use: the Framingham Study risk score functions. *Stat Med* **23**, 1631–60.
 - 20) Eberhart LH, Geldner G, Kranke P, Morin AM, Schäuffelen A, Treiber H, Wulf H (2004) The development and validation of a risk score to predict the probability of postoperative vomiting in pediatric patients. *Anesth Analg* **99**, 1630–7.
 - 21) Leboeuf-Yde C (2000) Body weight and low back pain. A systematic literature review of 56 journal articles reporting on 65 epidemiologic studies. *Spine* **25**, 226–37.
 - 22) Leino-Arjas P, Hänninen K, Puska P (1998) Socioeconomic variation in back and joint pain in Finland. *Eur J Epidemiol* **14**, 79–87.
 - 23) Johnson RB, Onwuegbuzie AJ (2004) Mixed methods research: a research paradigm whose time has come. *Educ Res* **33**, 14–26.
 - 24) Aday LA (1996) *Designing and conducting health surveys*, 2nd ed., Jossey-Bass, San Francisco.
 - 25) Davis L (1992) Instrument review: getting the most from your panel of expert. *Appl Nurs Res* **5**, 194–7.
 - 26) Kim JO, Mueller CW (1978) *Factor analysis: statistical methods and practical issues*. Sage Publication, Beverley Hills.
 - 27) Dillon WR, Goldstein M (1984) *Multivariate analysis: Methods and applications*. John Wiley & Sons, New York.